US Army Corps of Engineers
Philadelphia District

New Jersey Department of
Environmental Protection

New Jersey Beneficial Use of Dredged Material for the Delaware River

Feasibility Report and Integrated Environmental Assessment
Technical Appendices

Volume II

February 2020

Volume II

Appendix A – Economic Analysis

Appendix B – Real Estate Plan

Beneficial Use of Dredged Material for the Delaware River

New Jersey

Coastal Storm Risk Management Project

Integrated Feasibility Study and Environmental Assessment

Appendix A

Economics

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Executive Summary

The economic modeling analysis for the New Jersey Beneficial Use of Dredged Material for the Delaware River Study consists of six sites along the Delaware Bay coastline. This includes, from North to South, Gandys Beach, Fortescue, Reeds Beach, Pierces Point, Del Haven, and Villas. In total, these six sites include over 38,000 feet of shoreline along the Delaware Bay within Cumberland and Cape May counties.

This study is undertaken to assess the feasibility of providing Federal Coastal Storm Risk Management measures to each of the six target sites or some combination thereof. Coastal damage for each of the alternatives at each site is evaluated using the certified USACE model Beach-fx version 1.1. This model employs an event-based Monte Carlo life cycle simulation software to estimate erosion, wave, and inundation damages in the With- and Without-Project conditions. Final benefits and costs are stated in the current FY2020 price level and are discounted using the FY2020 Project Evaluation and Formulation Rate (Discount Rate) of 2.75%.

Following preliminary screenings and a detailed study evaluation, the Project Delivery Team (PDT) has determined a Recommended Plan for reducing coastal storm damage and maximizing net benefits. The Recommended Plan includes constructing and maintaining optimized dune and berm configurations for Gandys Beach, Fortescue, and the southern portion of Villas (Villas South). Benefits are captured by reducing wave attack damages, erosion damages, and land loss damages. Due to back bay flooding at these locations, inundation reduction benefits are minimal.

The evaluation covers a 50-year period of analysis with a base year of 2022. Plan formulation is based on the Intermediate Relative Sea Level Change (RSLC) curve as calculated by the USACE Sea Level Change Curve Calculator, but will include model results for both the Low (Historic) and High RSLC Curves. Periodic Nourishment is based on a six year cycle.

The table below shows the Average Annual Benefits (AAB), Average Annual Costs (AAC), Average Annual Net Benefits (AANB), and Benefit-Cost Ratio (BCR):

Table 1: Recommended Plan Benefit-Cost Ratio

ITEM	DUNE HEIGHT	BERM WIDTH	TOTAL AAB
Fortescue	6.5ft	75ft	$3,015,000
Gandys Beach	6.5ft	75ft	$2,549,000
Villas (South)	12.0ft	50ft	$2,692,000
SUBTOTAL	**-**	**-**	**$8,256,000**
AAC	-	-	$5,913,000
AANB	**-**	**-**	**$2,344,000**
BCR	**-**	**-**	**1.4**

With reduced erosion, inundation, and wave damages to coastal infrastructure, the present value Average Annual Net Benefits for the Recommended Plan is $2,344,000 with a Benefit-Cost Ratio of 1.4.

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INTRODUCTION

This appendix presents the economics methodology, assumptions, and resulting analysis for managing coastal storm risk along the Delaware Bay coastline. The report will detail each step of the Beach-fx modeling process and describe the relevant inputs and results for each study site. The assessment is conducted at a Feasibility level and covers six New Jersey potential project sites:

Figure 1: Dredge Material Utilization – New Jersey - Study Area

BEACH-FX ANALYSIS SOFTWARE DESCRIPTION

Beach-fx modeling software was developed by researchers at the Engineering Research and Development Center (ERDC) Coastal and Hydraulics Laboratory and the U.S. Army Engineer Institute for Water Resources (IWR) as a tool for accurately evaluating the physical performance and economic benefits and costs of shore protection projects. The software employs an event-based Monte Carlo life cycle simulation to measure the impact of future hurricane and storm damages over the project life while accounting for risk and uncertainty in the analysis. The software evaluates shoreline change and economic consequences associated with three damage drivers: inundation, erosion, and wave attack.

This study utilized an individual Beach-fx model for each of the six potential project locations. All economic inputs were developed by the project development team economist and all morphology inputs, including profile determination and SBEACH modeling, were developed by engineering (see Engineering Appendix).

Model Elements

Beach-fx is divided into three levels of socioeconomic inputs: Reaches, Lots, and Damage Elements. Reaches are contiguous stretches of the shoreline that share a common morphological makeup with a particular beach Profile. They are the broadest category and are used to organize damage results, periodic nourishment volumes, and other model outputs. Lots are organizational containers within the model to more efficiently evaluate Damage Elements. The effects of morphology changes are transferred to individual Damage Elements via Lots. Damage Elements themselves are the most specific item within the Beach-fx structure inventory and represent any structure where damages can be incurred. This includes residential houses, commercial buildings, public structures, and other elements. Damage Elements include the following variables to evaluate inundation, erosion, and wave attack damages:

- Representative geographical reference (New Jersey State Plane Projected Coordinate System)
- Usage or Type (e.g., Residential Single-Family, Residential Multi-Family, Commercial)
- Alongshore length and cross shore width
- Number of floors
- Foundation type
- First Floor Elevation (Ground Elevation plus Foundation Height)
- Depreciated Replacement Value of Structure
- Depreciated Replacement Value of Contents
- Number of Rebuilds (Maximum number of repairs over project life)
- Rebuild Time (Length of time to complete each structure repair)

This appendix will cover each site individually and explain the methodology and assumptions behind each of the inputs used in their respective Beach-fx models. All aerial imagery was supplied by Esri, DigitalGlobe, NOAA Digital Coast, and the New Jersey Office of Information Technology.

SITE OVERVIEW

Gandys Beach (Downe Township, Cumberland County, NJ)

Gandys Beach is a small beach community that includes 69 unique Damage Elements, fourteen Lots, and three Reaches:

Figure 2: Gandys Beach Inventory

Fortescue (Downe Township, Cumberland County, NJ)

Fortescue is another beach community on the outskirts of Downe Township, NJ. In total, the study area includes 234 unique Damage Elements, 45 Lots, and five Reaches:

Figure 3: Fortescue Inventory

Reeds Beach (Middle Township, Cape May County, NJ)

Reeds Beach is a shorefront community in Middle Township. The study area contains 86 Damage Elements, five Lots, and five Reaches.

Figure 4: Reeds Beach Inventory

Pierces Point (Middle Township, Cape May County, NJ)

Pierces Point is another beach community on the shoreline of Middle Township. The study area includes 70 Damage Elements, six Lots, and five Reaches.

Figure 5: Pierces Point Inventory

Del Haven (Middle Township, Cape May County, NJ)

Del Haven is a larger community on the shoreline of Middle Township. The majority of its structures are not directly on the coastline. It includes 51 Damage Elements, six Lots, and six Reaches.

Figure 6: Del Haven Beach Inventory

Villas North (Lower Township, Cape May County, NJ)

Villas is a large beach community on the shoreline of Lower Township with a considerable number of structures built close to the coastline. For use within Beach-fx, Villas was divided into two distinct models due to differences in existing conditions: Villas North and Villas South. The Villas North study area includes 496 Damage Elements, 32 Lots, and five Reaches.

Figure 7: Villas North Inventory

Villas South (Lower Township, Cape May County, NJ)

Villas South is the lower half of Villas, NJ. This area experiences considerably greater coastal erosion than the Villas North coastline. The study area includes 468 Damage Elements, 29 Lots, and seven Reaches.

Figure 8: Villas South Inventory

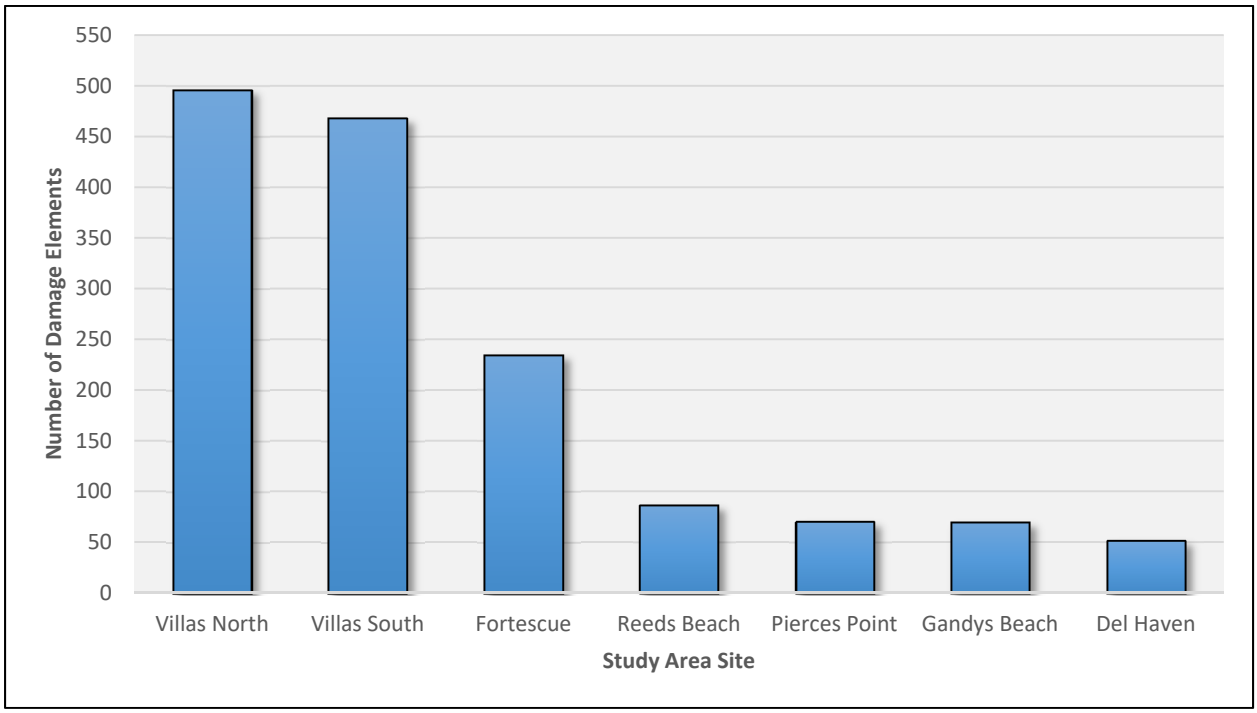
Total Study Area Inventory

Table 2 :Complete New Jersey Dredge Material Utilization Study Inventory

Site	Reaches	Lots	Damage Elements
Gandys Beach	3	14	69
Fortescue	5	45	234
Reeds Beach	5	5	86
Pierces Point	5	6	70
Del Haven	6	6	51
Villas (North)	5	32	496
Villas (South)	7	29	468
Total	**36**	**137**	**1,474**

The Total Study Inventory stands at 1,474 structures spread over 36 study reaches along approximately 38,000 feet of New Jersey shoreline.

Figure 9 : Complete New Jersey Beneficial Use of Dredge Material Study Inventory



EXISTING CONDITIONS

Cumberland County, NJ, has an estimated permanent population of 157,035 (2015 U.S. Census Bureau American Community Survey) with populations centered in the City of Bridgeton, the City of Vineland, and the City of Millville. The county has grown its population by 7.24% over the past 15 years. In total, Cumberland County has an estimated 56,216 housing units with a median value of $162,400. Median household income is $49,984 with a per capita income of $22,417. 17.9% of persons in Cumberland County fall below the poverty line. Demographically, the county is predominantly Caucasian (48.5%) and Hispanic (28.6%) with African-Americans (18.6%), Asians (1.3%), and Others (3.0%) comprising the remainder of the county population. By value of sales, Cumberland County's largest business sectors are Retail Trade and Transportation and Warehousing.

Cape May County, NJ, has an estimated permanent population of 95,805 (2015 U.S. Census Bureau American Community Survey) with populations centered in Lower Township, Middle Township, and Ocean City. The county has experienced a decrease in population of 6.37% over the past 15 years. In total, Cape May County has an estimated 98,747 housing units with a median value of $299,700. Median household income is $57,637 with a per capita income of $33,028. 10.4% of persons in Cape May County fall below the poverty line. Demographically, the county is predominantly Caucasian (85.9%) with Hispanics (7.0%), African-Americans (4.6%), Asians (1.1%), and Others (1.4%) comprising the remainder of the county population. By value of sales, Cape May County's largest business sectors are Retail Trade and Accommodation and Food Services.

Data Collection and Beach-fx Methodology

The structure inventory for each of the study sites was created using materials supplied by the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Geographic Information Network (NJGIN), National Oceanic and Atmospheric Administration (NOAA) Digital Coast, and DigitalGlobe. Software used to construct the inventory includes ArcGIS 10.5.1, Marshall & Swift Residential Estimator 7, Marshall & Swift Commercial / Agricultural Estimator, Google Earth Pro, and Palisades DecisionTools Suite.

As stated earlier in the Appendix, Beach-fx requires a comprehensive structure inventory comprised of Reaches, Lots, and Damage Elements for each project site. Forming each of the model inputs was an iterative process and is accompanied by a series of model assumptions.

Structure Inventory Creation

NJDEP supplied building footprint Esri shapefiles for each of the structures within the study area. The building footprint shapefiles contain information on street address, building type code, building dimensions and square footage, and parcel identification numbers. The attributes of the building footprint are transferred to a single internal centroid and provided a Northing and Easting coordinate point using New Jersey State Plane Projected Coordinate System (U.S. Feet).

The New Jersey Geographic Information Network (NJGIN) supplied the Cumberland County and Cape May County parcel map overlays. This parcel map overlay includes parcel identification numbers, county tax assessment values (stated as improvement values), and other county tax list attributes. Using a spatial join to associate the building centroids with their tax parcels, attributes for Owner Name, Improvement Value, and Street Address were added to the inventory.

Foundation height elevation and foundation type data were collected using Google Earth street view for the entire population of structures with the exception of Villas, NJ. For Villas, due to the large number of structures in the project area, a stratified random sample was applied to collect foundation height and foundation type estimates. In total, 415 of the 964 structures in the Villas study area were sampled: 226 single-family residential one story (SFR1) structures, 185 single-family residential multi story (SFRM) structures, and 4 commercial or hotel structures (COMM). The results of the sampling effort are shown below:

Table 3: Villas, NJ Stratified Random Sample Results

DE Type	Pop.	Sample	Percent Sampled	Average	StDev	Z Value (α = 0.025)	Margin of Error
SFR1	639	226	35.4%	2.54	1.92	1.96	0.25
SFRM	318	185	58.2%	4.22	2.93	1.96	0.42
COMM	7	4	57.1%	3.38	3.25	1.96	3.19

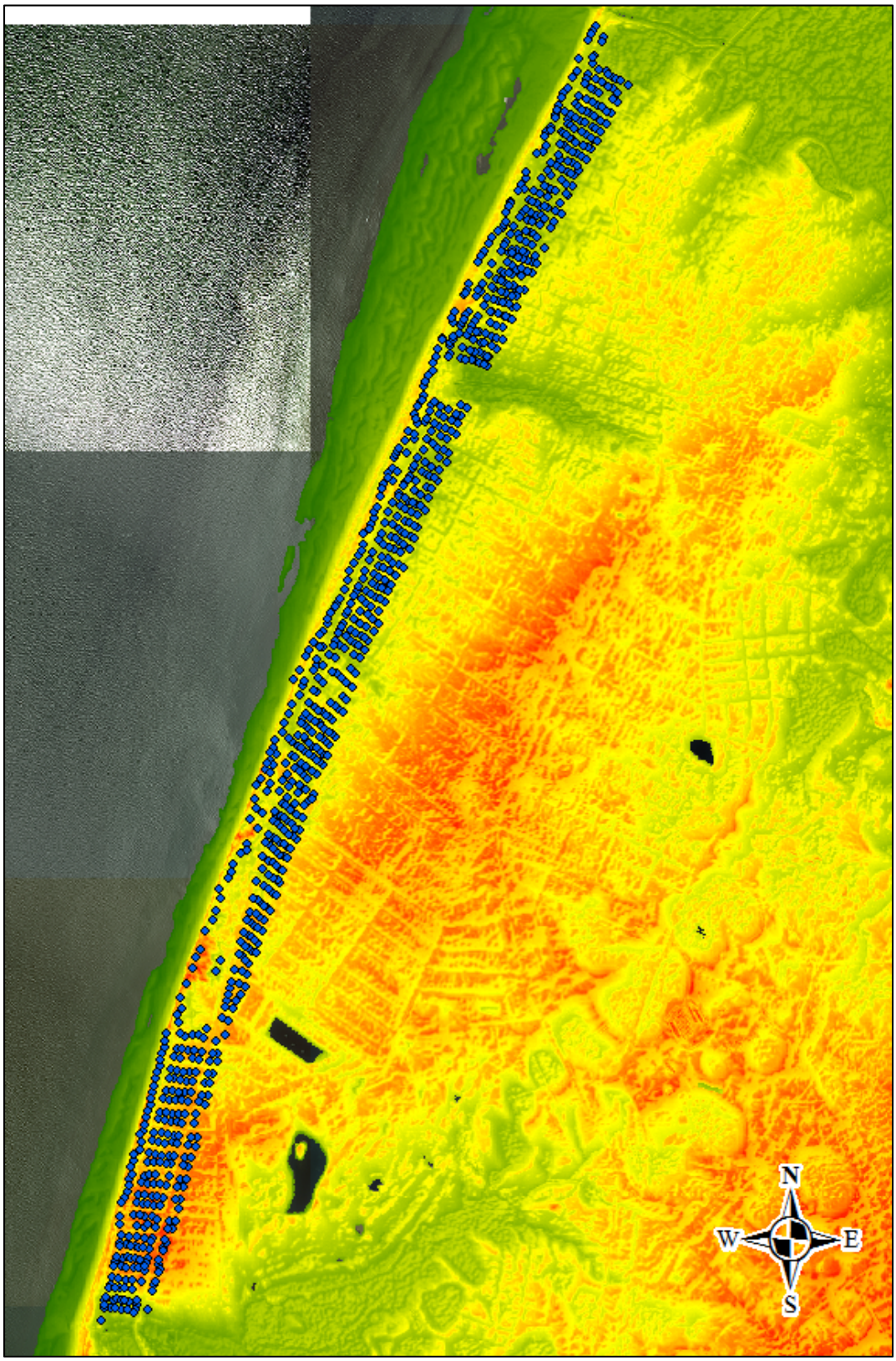
The margin of error accounts for the sampling uncertainty of the assigned foundation height. As detailed in EM 1110-2-1619 *Risk Assessment for Flood Risk Management Studies*, sampling uncertainty is "when a value of a parameter is estimated through random sampling, sampling error is a by-product of applying sample statistics (e.g., the sample mean) to unobserved values." The calculated margin of error for a 95% level of confidence is unique to each structure occupancy type and used to inform the minimum and maximum value in the first-floor elevation triangle probability distribution.

Per structure type, the average foundation height was added to the measured ground elevation as calculated using NOAA Digital Coast LiDAR-derived Bare Earth Digital Elevation Model (DEM) to formulate the total first-floor elevation. Ground elevation was measured for the entire population of structures throughout all study areas. Figure 10 shows the Digital Elevation Model for Villas, NJ with damage elements represented by point markers.

For foundation type, the overwhelming majority (95%+) of residential and commercial structures within the sampled Villas study area have a pile foundation.

All Damage Elements are assigned a foundation type (slab or pile) and usage type (single-family residential one story (SFR1), single-family residential multi story (SFRM), or commercial or hotel (COMM).

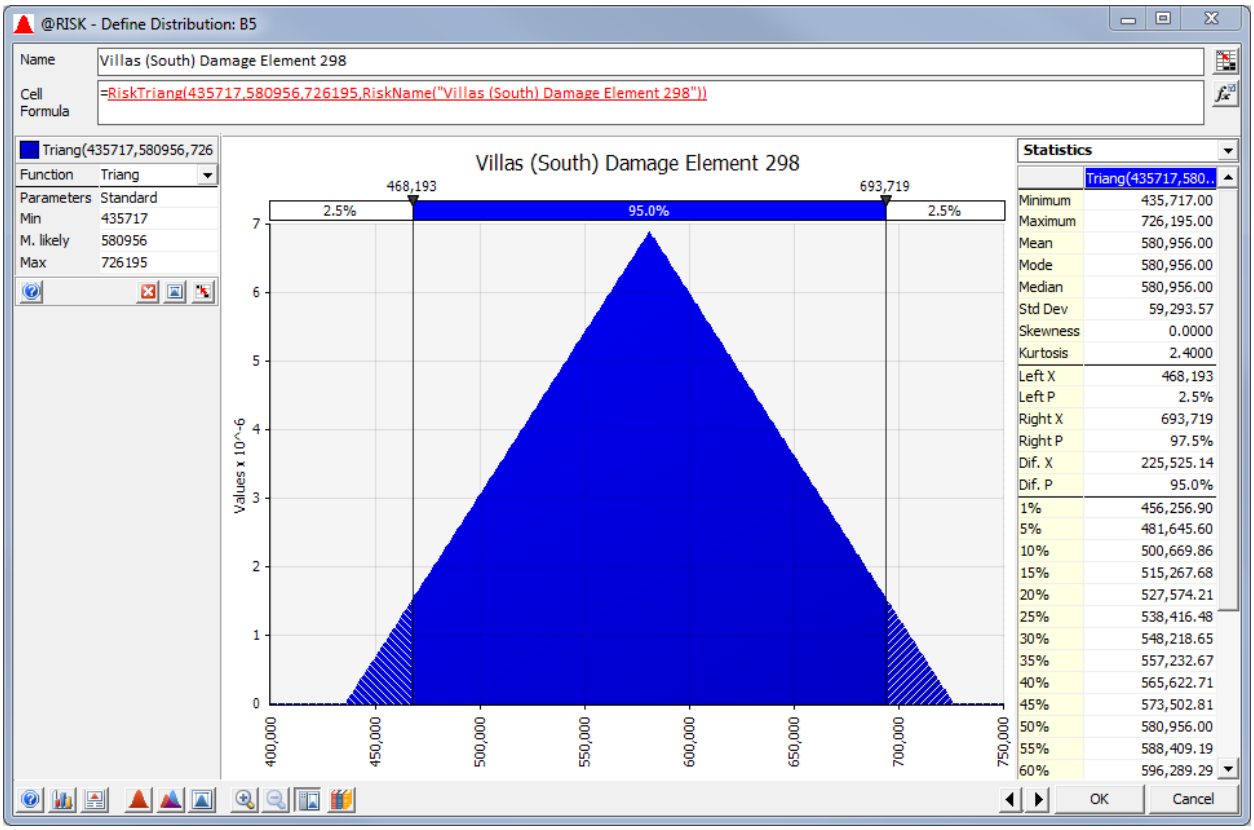
Figure 10: Villas, NJ Digital Elevation Model



Tax Assessment Improvement Values were used as the basis for Depreciated Replacement Value in compliance with EM 1110-2-1619 *Risk-Based Analysis for Flood Damage Reduction Studies*. The tax assessment values, identified per structure by the GIS parcel overlay, were weighted using Marshall & Swift Residential Estimator 7 and Marshall & Swift Commercial / Agricultural Estimator. For each site, a 10% stratified random sample of the inventory was evaluated using the estimator tools. The resulting Depreciated Replacement Values calculated by the Marshall & Swift estimator software were then compared to the stated tax assessment value to formulate a weighting factor. The average weight factor was then applied across the entire population. This process was applied for each site independently. Each structure value was then converted to a triangle distribution using Palisades @Risk software and added to the inventory.

Figures 11 and 12 show an example triangle distribution for a residential building in the Villas South structure inventory and the Marshall & Swift Standard Report for the same structure.

Figure 11: @Risk Structure Inventory Triangle Distribution Example



Formulation and evaluation of alternatives was completed using the then current FY2017 Price Level and FY2017 Federal Discount Rate of 2.875%. Model results for the Recommended Plan were then updated to the FY2018 Price Level and FY2018 Federal Discount Rate of 2.75% and then finally updated to the current FY2020 Price Level and FY2020 Federal Discount Rate of 2.75% (section titled: *FY2020 Price Level and Discount Rate Adjustment*; page 86).

Figure 12: Marshall & Swift Residential Estimator 7 Report–Villas South Damage Element 298

Standard Report

Estimate ID:	Villas_South_DE_298
Property Owner:	[redacted]
Address:	[redacted]
City:	Villas
State/Province:	New Jersey
ZIP/Postal Code:	08251
Surveyed By:	Preston Oakley
Survey Date:	5/15/2017

Single-family Residence			
Effective Age:	10	Floor Area:	6,000 Square Feet
Cost as of:	March, 2017	Quality:	3.5 Average/Good
Style:	Two Story	Condition:	3.5 Average/Good
Exterior Wall:	Frame, Siding, Vinyl 100%		
Plumbing Fixtures:	11		

	Units	Cost	Total
Base Cost	6,000	65.77	394,620
Plumbing Fixtures	11	2,368.45	26,053
Plastic Tile	6,000	3.95	23,700
Raised Subfloor	6,000	13.80	82,800
Floor Cover Allowance	6,000	7.54	45,240
Forced Air Furnace	6,000	5.29	31,740
Plumbing Rough-ins	1	834.15	834
Appliance Allowance	1	6,164.00	6,164
Basic Structure Total Cost	6,000	101.86	611,151
Built-in Garage	700	32.19	22,533
Subtotal Garage			22,533
Wood Deck	179	26.43	4,731
Subtotal Extras			4,731
Replacement Cost New	6,000	106.40	638,415
Physical + Functional Depreciation 9.0%			57,459
Total Depreciated Cost			580,956
Total			$580,956

Cost data by Marshall & Swift/Boeckh, LLC and its licensors.

Inventory Structure and Content Value

The economic value of the existing study structure inventory represents the depreciated replacement costs of damageable structures and their associated contents. The total study inventory of all 1,474 damage elements has an estimated value of $438,417,004. Content values were established as a percentage of structure values based on the type of structure in accordance with EM 1110-2-1619 *Risk-Based Analysis for Flood Damage Reduction Studies*.

Table 4: Distribution of Structures and Structure Value by Site

Site	No. of Damage Elements	Structure Value	Content Value	Total Value	Percent of Total (Count)	Percent of Total (Value)
Gandys Beach	69	$11,459,700	$4,973,500	$16,433,200	4.7%	3.7%
Fortescue	234	$30,460,700	$12,784,539	$43,245,239	15.9%	9.9%
Reeds Beach	86	$11,216,534	$4,671,694	$15,888,228	5.8%	3.6%
Pierces Point	70	$12,469,796	$5,159,044	$17,628,840	4.7%	4.0%
Del Haven	51	$11,026,461	$4,578,596	$15,605,057	3.5%	3.6%
Villas North	496	$90,479,755	$38,325,062	$128,804,817	33.6%	29.4%
Villas South	468	$141,800,912	$59,010,711	$200,811,624	31.8%	45.8%
Total	**1474**	**$308,913,858**	**$129,503,146**	**$438,417,004**	**100.0%**	**100.0%**

Table 5: Distribution of Structure Type by Site

Site	No. of DEs	SFR1	SFRM	COMM	Res	Non-Res
Gandys Beach	69	57	12	0	100.0%	0.0%
Fortescue	234	143	56	35	85.0%	15.0%
Reeds Beach	86	46	40	0	100.0%	0.0%
Pierces Point	70	30	38	2	97.1%	2.9%
Del Haven	51	23	28	0	100.0%	0.0%
Villas North	496	387	104	5	99.0%	1.0%
Villas South	468	252	214	2	99.6%	0.4%
Total	**1474**	**938**	**492**	**44**	**97.0%**	**3.0%**

Table 6: Distribution of Structure and Structure Value per Reach by Site

Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Gandys Beach R-1	16	$2,568,000	$1,114,800	$3,682,800	23.2%	22.4%
Gandys Beach R-2	44	$7,643,400	$3,317,000	$10,960,400	63.8%	66.7%
Gandys Beach R-3	9	$1,248,300	$541,700	$1,790,000	13.0%	10.9%
Total	**69**	**$11,459,700**	**$4,973,500**	**$16,433,200**	**100.0%**	**100.0%**

Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Fortescue R-1	22	$4,966,000	$2,081,471	$7,047,471	9.4%	16.3%
Fortescue R-2	53	$6,404,200	$2,720,754	$9,124,954	22.6%	21.1%
Fortescue R-3	82	$7,485,600	$3,112,514	$10,598,114	35.0%	24.5%
Fortescue R-4	56	$8,537,500	$3,586,421	$12,123,921	23.9%	28.0%
Fortescue R-5	21	$3,067,400	$1,283,380	$4,350,780	9.0%	10.1%
Total	**234**	**$30,460,700**	**$12,784,539**	**$43,245,239**	**100.0%**	**100.0%**

Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Reeds Beach R-1	9	$1,320,457	$568,469	$1,888,926	10.5%	11.9%
Reeds Beach R-2	18	$2,445,848	$1,020,153	$3,466,001	20.9%	21.8%
Reeds Beach R-3	14	$1,203,106	$513,135	$1,716,241	16.3%	10.8%
Reeds Beach R-4	24	$3,120,349	$1,278,026	$4,398,375	27.9%	27.7%
Reeds Beach R-5	21	$3,126,774	$1,291,911	$4,418,685	24.4%	27.8%
Total	**86**	**$11,216,534**	**$4,671,694**	**$15,888,228**	**100.0%**	**100.0%**

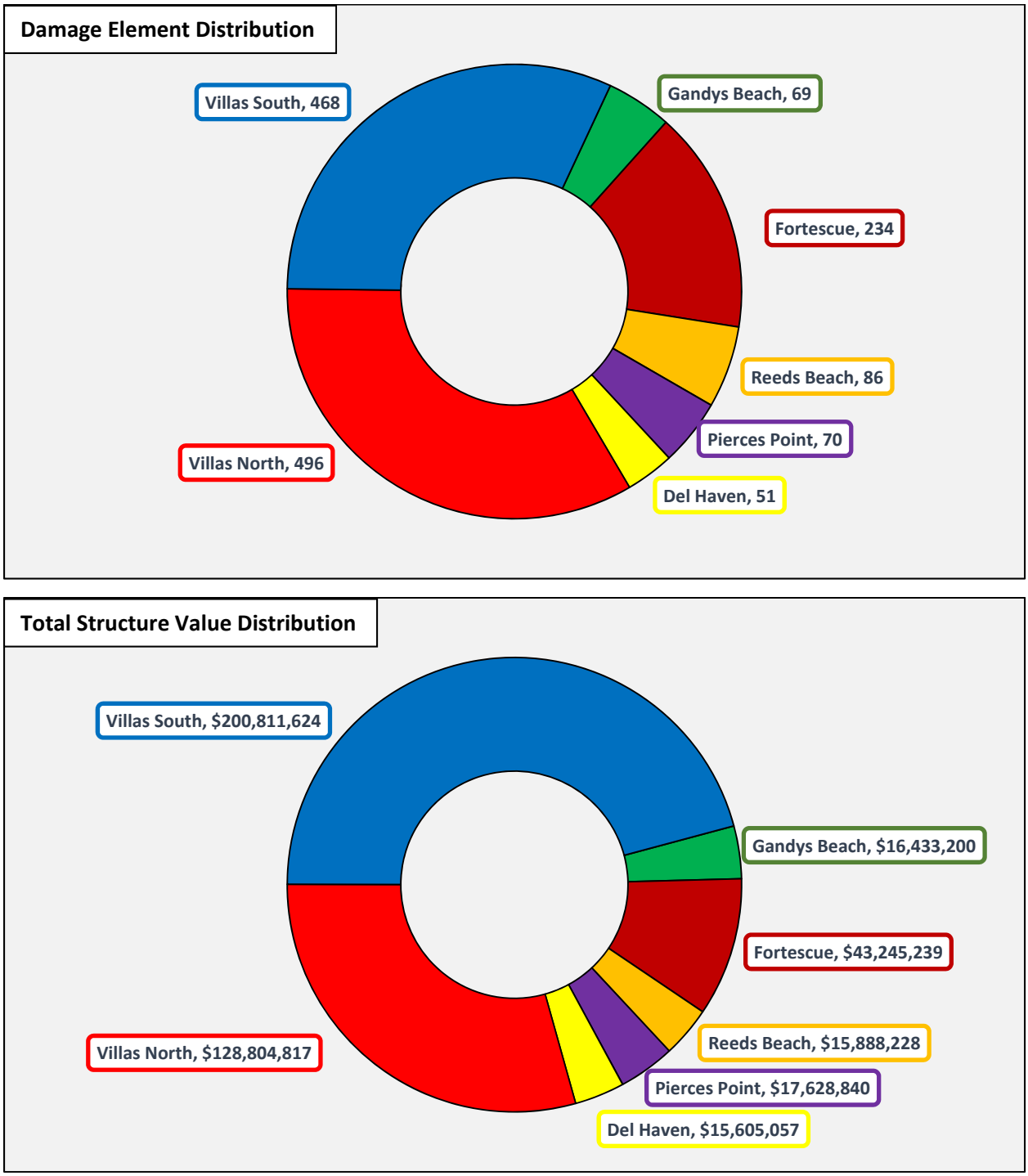
Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Pierces Point R-1	32	$5,213,204	$2,155,374	$7,368,578	45.7%	41.8%
Pierces Point R-2	18	$3,057,538	$1,255,235	$4,312,773	25.7%	24.5%
Pierces Point R-3	3	$760,440	$320,028	$1,080,468	4.3%	6.1%
Pierces Point R-4	15	$2,455,004	$1,032,996	$3,488,000	21.4%	19.8%
Pierces Point R-5	2	$983,610	$395,411	$1,379,021	2.9%	7.8%
Total	**70**	**$12,469,796**	**$5,159,044**	**$17,628,840**	**100.0%**	**100.0%**

Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Del Haven R-1	2	$589,084	$237,990	$827,074	3.9%	5.3%
Del Haven R-2	9	$2,074,345	$856,584	$2,930,929	17.6%	18.8%
Del Haven R-3	0	$0	$0	$0	0.0%	0.0%
Del Haven R-4	29	$6,490,400	$2,700,292	$9,190,692	56.9%	58.9%
Del Haven R-5	11	$1,872,632	$783,730	$2,656,362	21.6%	17.0%
Del Haven R-6	0	$0	$0	$0	0.0%	0.0%
Total	**51**	**$11,026,461**	**$4,578,596**	**$15,605,057**	**100.0%**	**100.0%**

Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Villas North R-1	32	$6,323,077	$2,673,406	$8,996,482	6.5%	7.0%
Villas North R-2	88	$14,990,525	$6,395,096	$21,385,621	17.7%	16.6%
Villas North R-3	81	$14,007,436	$5,914,128	$19,921,564	16.3%	15.5%
Villas North R-4	92	$16,451,760	$6,919,684	$23,371,444	18.5%	18.1%
Villas North R-5	203	$38,706,956	$16,422,750	$55,129,706	40.9%	42.8%
Total	**496**	**$90,479,755**	**$38,325,062**	**$128,804,817**	**100.0%**	**100.0%**

Reach	No. of DEs	Structure Value	Content Value	Total Value	% of DEs	% Total Value
Villas South R-1	81	$19,330,515	$8,203,733	$27,534,248	17.3%	13.7%
Villas South R-2	43	$11,308,167	$4,751,741	$16,059,908	9.2%	8.0%
Villas South R-3	85	$25,342,978	$10,612,555	$35,955,533	18.2%	17.9%
Villas South R-4	32	$11,795,525	$4,887,911	$16,683,436	6.8%	8.3%
Villas South R-5	58	$20,180,047	$8,292,534	$28,472,581	12.4%	14.2%
Villas South R-6	150	$47,874,662	$19,782,227	$67,656,889	32.1%	33.7%
Villas South R-7	19	$5,969,019	$2,480,009	$8,449,028	4.1%	4.2%
Total	**468**	**$141,800,912**	**$59,010,711**	**$200,811,624**	**100.0%**	**100.0%**

Figure 13: Damage Element and Total Structure Value Distribution by Site



As Figure 13 shows, Villas North and Villas South comprise the majority of structures from the entire study domain (65%). These two sites also comprise an even greater share of the total structure value across the study domain (75%).

PRELIMINARY BEACH-FX ANALYSIS

Future Without Project Condition (FWOP)

As stated earlier, Beach-fx is an event-based Monte Carlo life cycle simulation that uses historic storms to calculate damages over the course of a project period of analysis. The model links the predictive capability of coastal evolution modeling with project area infrastructure information, structure and content damage functions, and economic valuations to estimate the costs and total damages under various shore protection alternatives while accounting for risk and uncertainty. The model output can then be used to determine the net benefits of each project alternative. Storm damage is defined as the ongoing monetary loss to contents and structures incurred as a direct result of wave attack, erosion, and inundation caused by a storm of a given magnitude and probability. The model also computes permanent shoreline reductions. These damages and associated costs are calculated over the project period of analysis based on storm probabilities, tidal cycle, tidal phase, beach morphology, and many other factors. Data on historic storms, beach survey profiles, and beach reactions to specific storm events can be found in the Engineering Appendix.

For the Future Without Project (FWOP) Condition and Future With Project (FWP) Condition, the structure inventory and values are the same as the existing condition barring any structures that are deemed condemned by Beach-fx over the period of analysis. This conservative approach neglects any increase in potentially damageable assets accrued from future development even though Cumberland County and Cape May County have seen population density and structure assessment values increase in recent years. Use of the existing inventory is preferable due to uncertainty and limitations in projecting future development.

The FWOP damages are used as the base condition and potential project alternatives are measured against this base to evaluate effectiveness and CSRM damages reduced. Once damages reduced (benefits) are calculated for alternative plans they will be compared to the plan alternative cost to calculate the Benefit-to-Cost Ratio (BCR) and Average Annual Net Benefits (AANB). The BCR is calculated by dividing the Average Annual Benefits (AAB) by the Average Annual Costs (AAC) and the AANB calculated by subtracting the AAC from the AAB. The ratio must be greater than 1.0 to be deemed justified and implementable. The Recommended Plan is the plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective.

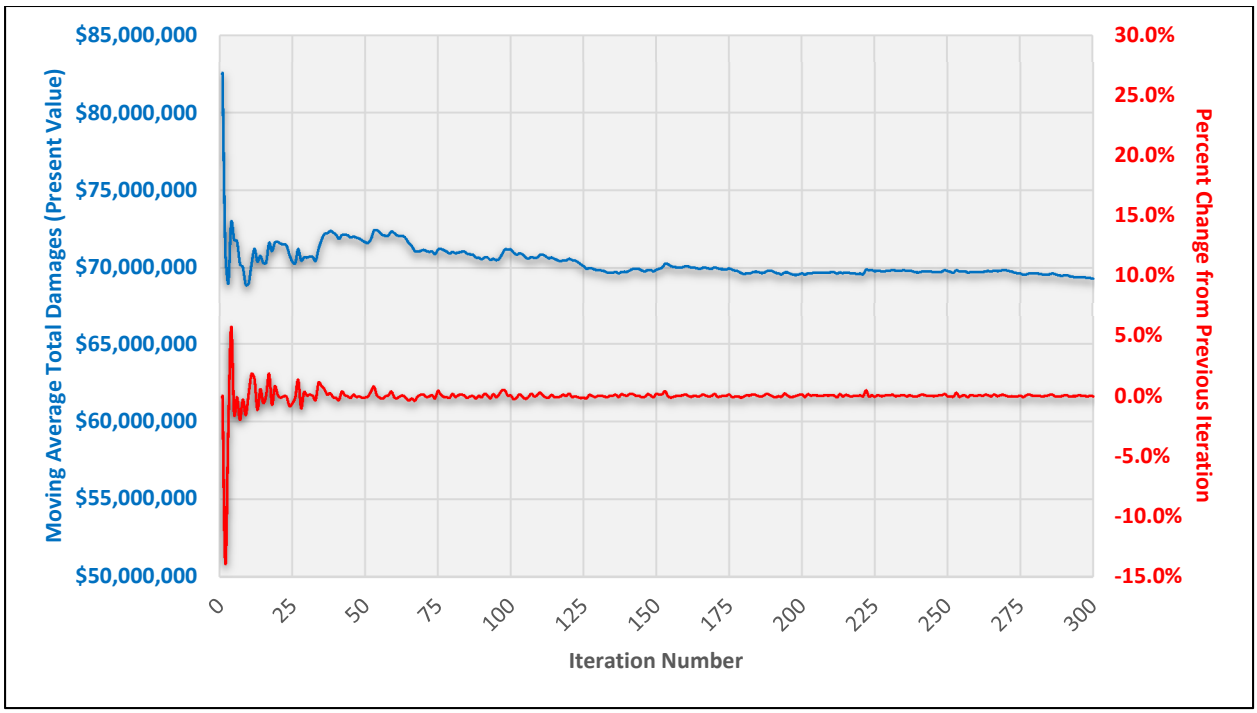
Future Without Project Condition Model Assumptions

In addition to the series of inputs relating to the Coastal Morphology and Structure Inventory, Beach-fx also requires a number of assumptions to compute the FWOP damages. These assumptions were reached after careful discussion within the PDT and after consulting outside experts. All data definitions are taken from the Beach-fx User's Manual: Version 1.0.

Start Year – 2017
Base Year – 2022
Period of Analysis – 50 years
FY2017 Federal Discount Rate – 2.875%
Damage Element Condemnation Ratio – 50% – maximum damage a Damage Element can receive from a single storm event before becoming condemned and removed from the inventory. Once a Damage Element is removed from the inventory, it can no longer receive further damages during that life cycle.
Number of Rebuilds – 50 – maximum number of repairs a Damage Element can undergo during the project life cycle. For clarification, the term "rebuild" does not refer to a total re-construction event

(100% of structure value), but rather any repair event. A repair is to fix any previously sustained damage, even exceptionally low damages, from a Damage Element. The number of rebuilds is limited to prevent overstating CSRM damages. If a structure is condemned, they are no longer "rebuilt" in that life cycle.
Time to Rebuild – 182 days, 365 days, 547 days – this is a triangle distribution denoting time necessary to complete a structure rebuild.
Control Line Offset – negative 1000 feet – this variable controls the threshold distance measured from the centroid of the Lot to the seaward toe of the dune at which Lots in the Reach will be marked condemned and Damage Elements in the Lot will be prohibited from being rebuilt. Due to high erosion rates at the project sites, if the Control Line Offset was set to 0, Lots were condemned in the model at a much earlier time and rate than expected when comparing to historic data. Adjustment of the offset prevents Lots from being condemned earlier than expected due to erosion, but allows for individual Damage Elements to still be condemned and removed from the inventory if their damages reached 50% or greater from a single storm event or they exceeded their Number of Rebuilds over the project life cycle.
Applied Erosion Rates – Profile specific – feet per year of erosion or accretion to calibrate the expected historic erosion rate. Erosion rates supplied by Engineering.
Berm Width Recovery Factor – 95% - percent of storm-induced berm width change that is restored due to post-storm recovery processes
Storm Recovery Period – 21 days – number of days before post-storm recovery processes are applied
Lot Armor – None – refers to seawalls, bulkheads, etc.
Back Bay Flooding – On – Inundation flooding from low lying surrounding areas
Iterations – 300 iterations – sufficient for model results to reach equilibrium (see Figure 14 below)

Figure 14: Gandys Beach Without Project Model Equilibrium



As Figure 14 shows, variance for Without Project Average Total Damages for the Gandys Beach example approaches zero percent by iteration 85. This allows greater confidence in the resulting Average Present Value Total Damages model results. Results were similar for the five other study sites.

Damage Functions

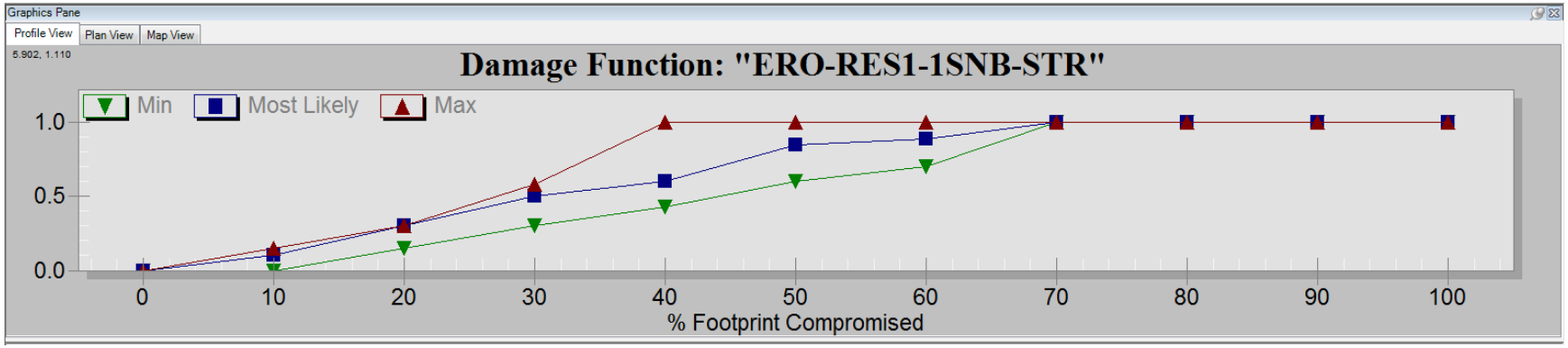
Damage functions are user-defined curves that are applied within the model to determine the extent of storm-induced damages attributable to any specific combination of damage element type and foundation type. Each structure references six damage functions, which calculate erosion, inundation, and wave attack damage for both the structure and its contents. For example, there is a specific set of six damage functions for single-family residential one story Damage Elements with slab foundations and a separate, unique set of damage functions for single-family residential one story Damage Elements with pile foundations. This analysis used a total of 48 damage functions to calculate storm-induced damages.

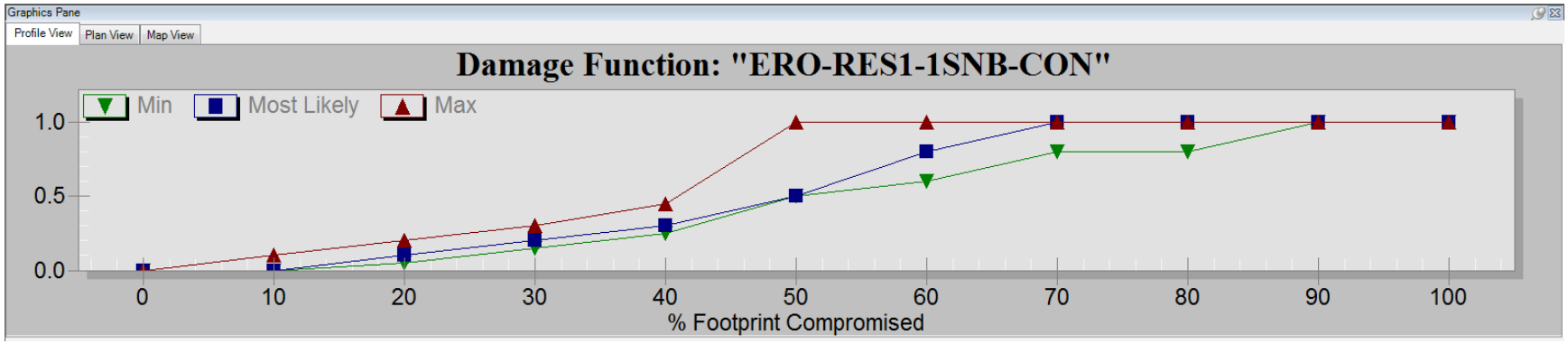
Damage is determined as a percentage of overall depreciated structure or content value using a triangle distribution of values. For erosion functions, damage is dependent upon the extent to which a structure's footprint has been compromised. For inundation and wave attack functions, damage is determined by the storm surge heights in excess of first-floor elevation.

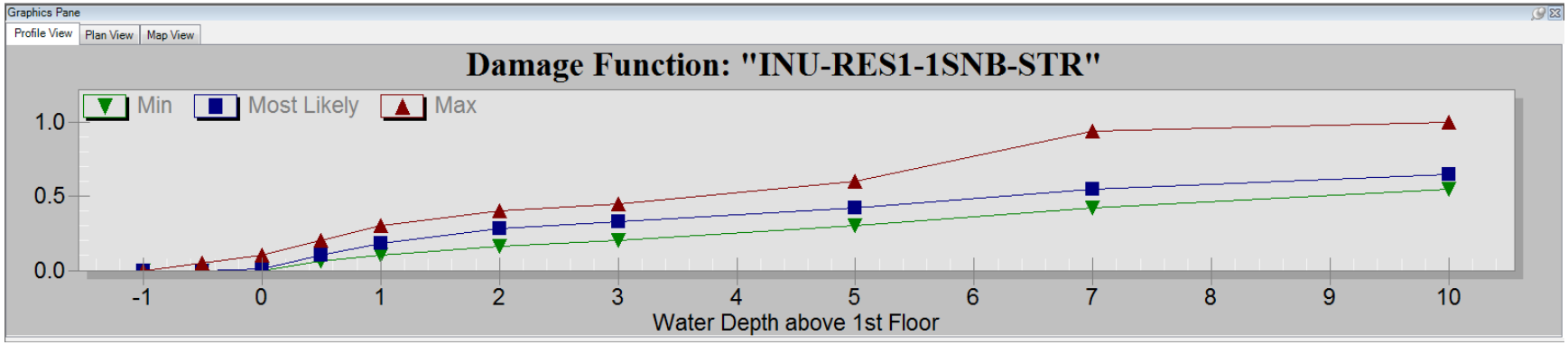
Damage functions were developed using the North Atlantic Coast Comprehensive Study (NACCS) Resilient Adaption to Increasing Risk: Physical Depth Damage Function Summary Report.

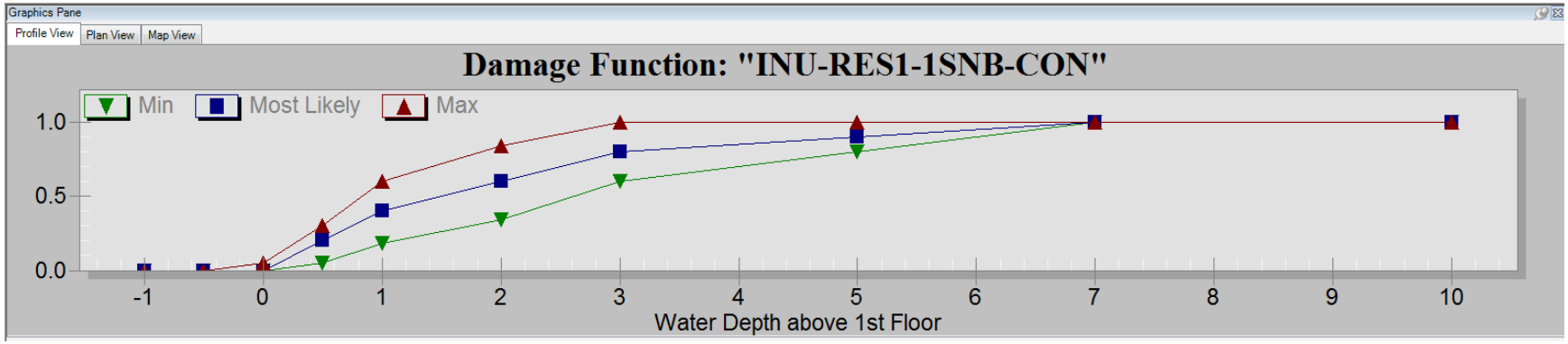
As an example, the set of six damage functions for a single-family residential one story structure on piles (no basement) is shown in Figure 15. The damage function name describes the specific damage driver, category type, occupancy type, and damage item for which it is intended. For example, the first function (ERO-RES1-1SNB-STR) is used for Erosion – Residential – 1 Story No Basement – Structure.

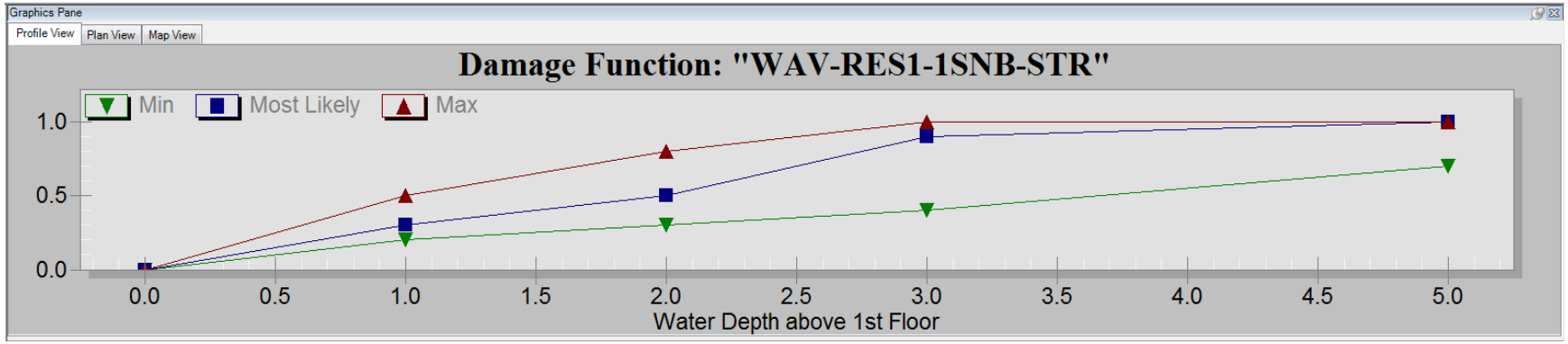
Figure 15: Erosion, Inundation, and Wave Attack Damage Functions for Structure and Content








Graphics Pane
Profile View
Plan View
Map View
Damage Function: "INU-RES1-1SNB-CON"
Min
Most Likely
Max
1.0
0.5
0.0
-1
0
1
2
3
4
5
6
7
8
9
10
Water Depth above 1st Floor


Graphics Pane
Profile View
Plan View
Map View
Damage Function: "WAV-RES1-1SNB-STR"
Min
Most Likely
Max
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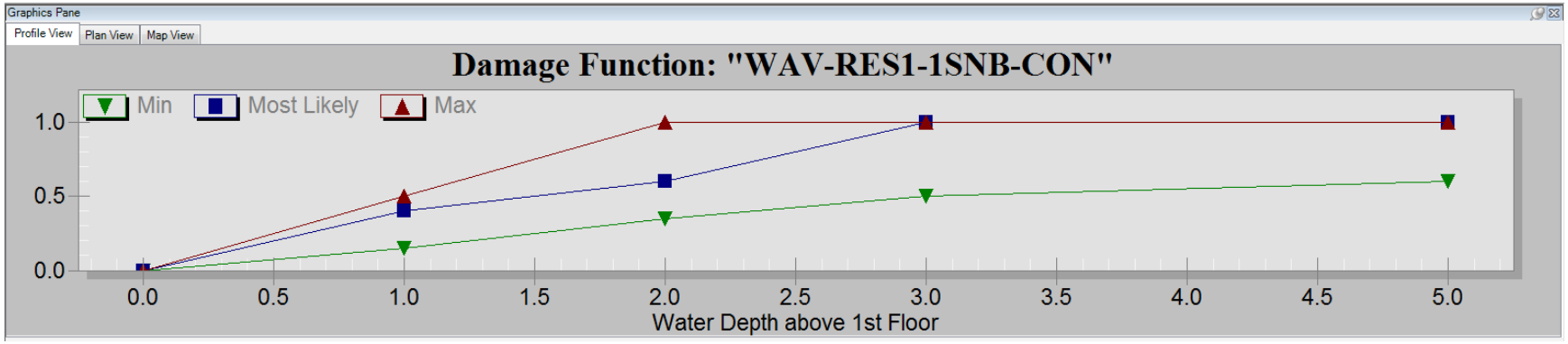
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Water Depth above 1st Floor


Graphics Pane
Profile View
Plan View
Map View
Damage Function: "WAV-RES1-1SNB-CON"
Min
Most Likely
Max
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Water Depth above 1st Floor

Future Without Project Condition Damages

The FWOP net present value damages are a combination of the CSRM damages experienced at each individual project site. Damages are measured by both structure and content and averaged over 300 iterations. Values are in present value using the then current FY2017 Federal Discount Rate for the Structure, Content, and Total Damage columns. Present value damages are then converted to Average Annual Damages (AAD). All results are shown at the Intermediate Relative Sea Level Change (RSLC) rate.

The model was designed to address all storm impacts from the Current Year to Base Year through to the end of project life in 2072. Damages incurred before the Base Year in 2022 are identical in the With and Without Project conditions and are not counted towards CSRM benefits calculations.

Table 7: Future Without Project Condition Damages by Site

Site	Structure Damage	Content Damage	Total Damage	AAD	% Total
Gandys Beach	$46,131,536	$20,172,003	$66,303,539	$2,516,092	20.17%
Fortescue	$79,693,844	$39,354,815	$119,048,659	$4,517,669	36.21%
Reeds Beach	$23,473,888	$10,059,969	$33,533,857	$1,272,546	10.20%
Pierces Point	$17,347,995	$7,367,046	$24,715,041	$937,889	7.52%
Del Haven	$13,816,658	$6,471,968	$20,288,625	$769,914	6.17%
Villas (North)	$6,379,033	$3,272,824	$9,651,857	$366,269	2.94%
Villas (South)	$39,404,142	$15,851,381	$55,255,523	$2,096,841	16.81%
Total	**$226,247,095**	**$102,550,006**	**$328,797,101**	**$12,477,221**	**100.00%**

Table 8: Future Without Project Condition Damages per Reach by Site

Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Gandys Beach R-1	$1,541,001	$747,131	$2,288,132	$86,830	3.45%
Gandys Beach R-2	$39,852,261	$17,332,482	$57,184,743	$2,170,052	86.25%
Gandys Beach R-3	$4,738,274	$2,092,391	$6,830,665	$259,211	10.30%
Total	**$46,131,536**	**$20,172,004**	**$66,303,539**	**$2,516,092**	**100.00%**

Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Fortescue R-1	$5,536,533	$3,269,075	$8,805,608	$334,156	7.40%
Fortescue R-2	$11,009,964	$5,690,914	$16,700,878	$633,766	14.03%
Fortescue R-3	$19,043,080	$9,193,030	$28,236,110	$1,071,506	23.72%
Fortescue R-4	$36,232,357	$17,258,830	$53,491,187	$2,029,888	44.93%
Fortescue R-5	$7,871,909	$3,942,967	$11,814,876	$448,352	9.92%
Total	**$79,693,843**	**$39,354,815**	**$119,048,658**	**$4,517,669**	**100.00%**

Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Reeds Beach R-1	$1,576,899	$1,042,470	$2,619,369	$99,400	7.81%
Reeds Beach R-2	$2,894,475	$1,231,816	$4,126,290	$156,585	12.30%
Reeds Beach R-3	$3,737,765	$1,608,375	$5,346,141	$202,876	15.94%
Reeds Beach R-4	$8,994,188	$3,597,769	$12,591,958	$477,841	37.55%
Reeds Beach R-5	$6,270,560	$2,579,539	$8,850,099	$335,844	26.39%
Total	**$23,473,888**	**$10,059,969**	**$33,533,857**	**$1,272,546**	**100.00%**

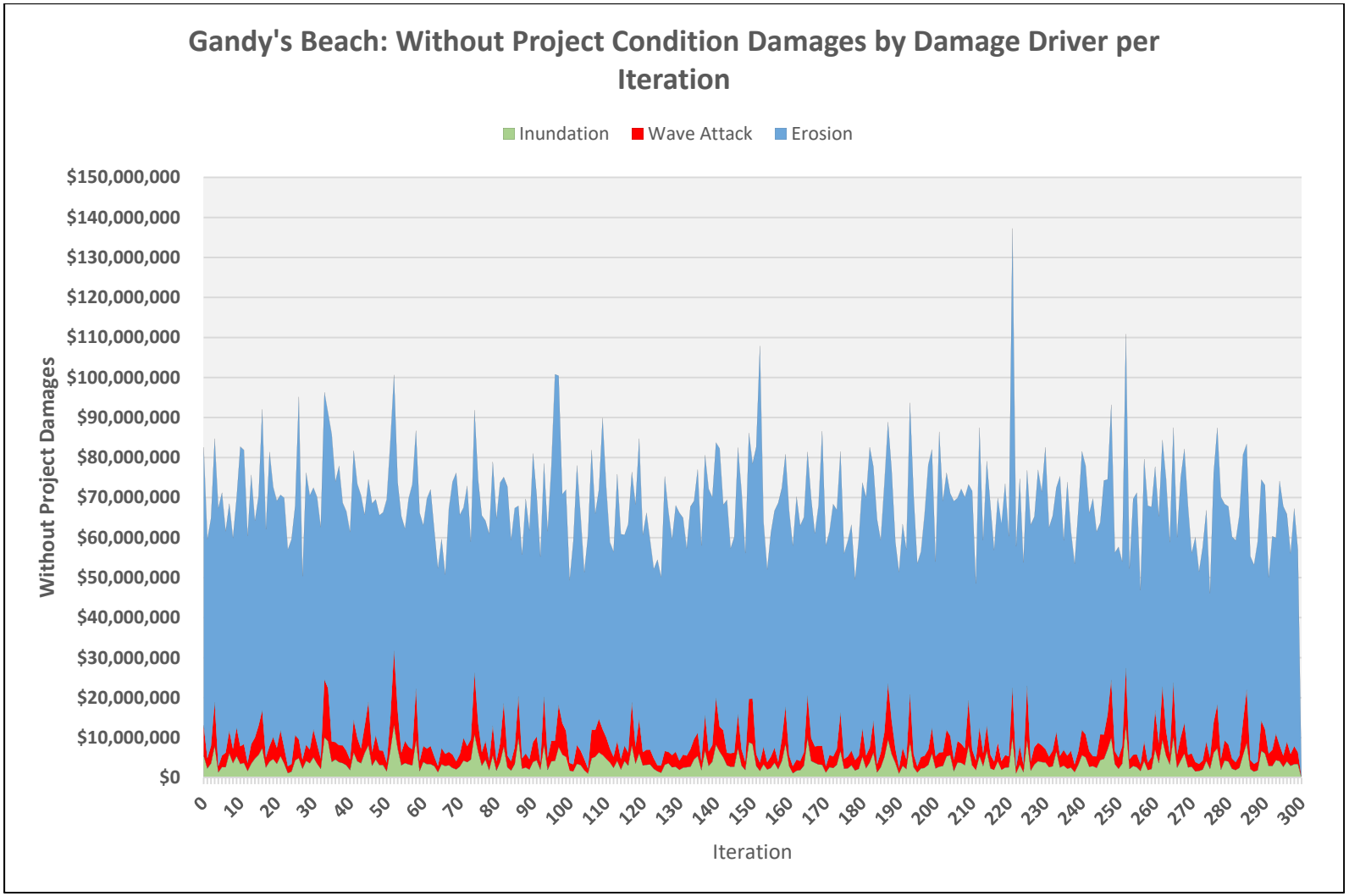
Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Pierces Point R-1	$7,628,390	$3,147,055	$10,775,445	$408,908	43.60%
Pierces Point R-2	$2,233,633	$888,827	$3,122,460	$118,491	12.63%
Pierces Point R-3	$65,125	$26,036	$91,160	$3,459	0.37%
Pierces Point R-4	$2,333,178	$1,005,624	$3,338,802	$126,701	13.51%
Pierces Point R-5	$5,087,670	$2,299,504	$7,387,174	$280,329	29.89%
Total	**$17,347,995**	**$7,367,046**	**$24,715,041**	**$937,889**	**100.00%**

Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Del Haven R-1	$292,345	$112,057	$404,402	$15,346	1.99%
Del Haven R-2	$1,127,887	$438,311	$1,566,199	$59,434	7.72%
Del Haven R-3	$0	$0	$0	$0	0.00%
Del Haven R-4	$8,379,367	$4,118,969	$12,498,336	$474,288	61.60%
Del Haven R-5	$4,017,058	$1,802,631	$5,819,689	$220,846	28.68%
Del Haven R-6	$0	$0	$0	$0	0.00%
Total	**$13,816,658**	**$6,471,968**	**$20,288,625**	**$769,914**	**100.00%**

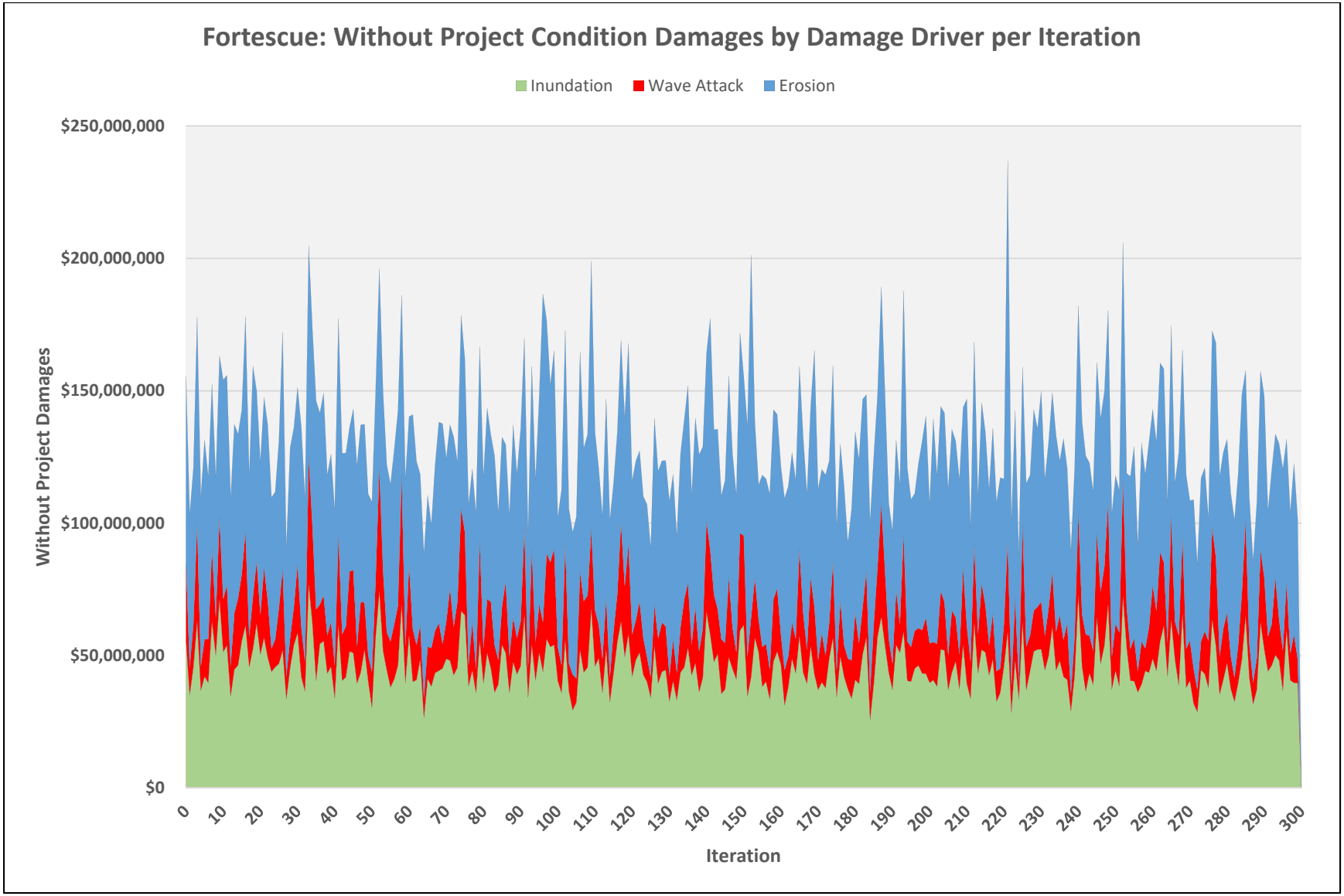
Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Villas (North) R-1	$2,807,782	$1,418,626	$4,226,408	$160,384	43.79%
Villas (North) R-2	$1,344,245	$671,988	$2,016,232	$76,512	20.89%
Villas (North) R-3	$1,001,760	$500,246	$1,502,005	$56,998	15.56%
Villas (North) R-4	$672,526	$386,204	$1,058,730	$40,177	10.97%
Villas (North) R-5	$552,721	$295,761	$848,482	$32,198	8.79%
Total	**$6,379,033**	**$3,272,824**	**$9,651,857**	**$366,269**	**100.00%**

Reach	Structure Damage	Content Damage	Total Damage	AAD	% Total
Villas (South) R-1	$4,654,892	$1,964,847	$6,619,739	$251,206	11.98%
Villas (South) R-2	$4,431,058	$1,811,308	$6,242,366	$236,886	11.30%
Villas (South) R-3	$7,389,239	$2,948,845	$10,338,084	$392,311	18.71%
Villas (South) R-4	$5,574,110	$2,195,518	$7,769,628	$294,843	14.06%
Villas (South) R-5	$12,547,896	$4,977,587	$17,525,483	$665,059	31.72%
Villas (South) R-6	$4,454,878	$1,792,708	$6,247,585	$237,084	11.31%
Villas (South) R-7	$352,069	$160,567	$512,637	$19,454	0.93%
Total	**$39,404,142**	**$15,851,381**	**$55,255,523**	**$2,096,841**	**100.00%**

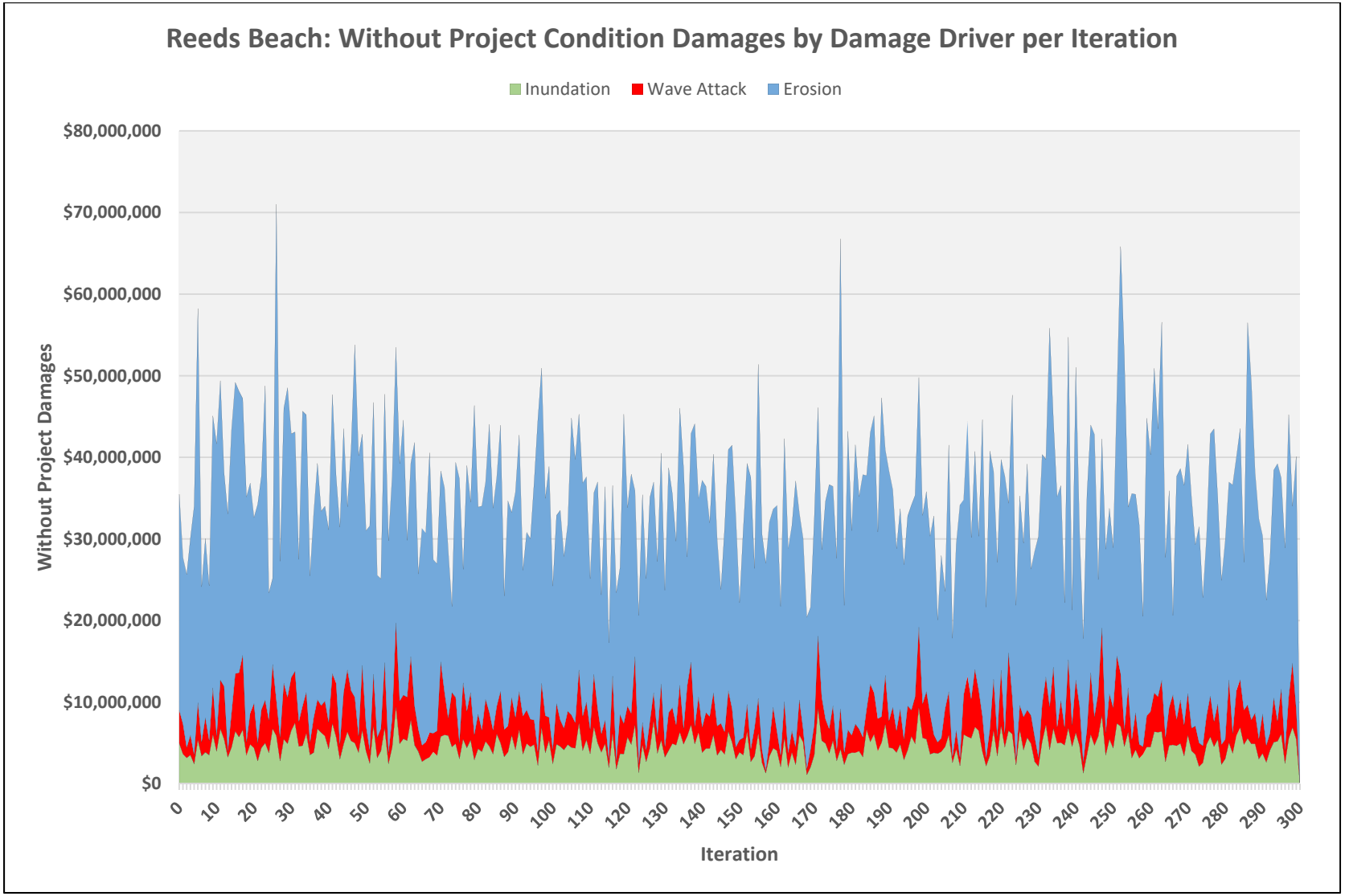
Figure 16: Future Without Project Condition Damages by Damage Driver



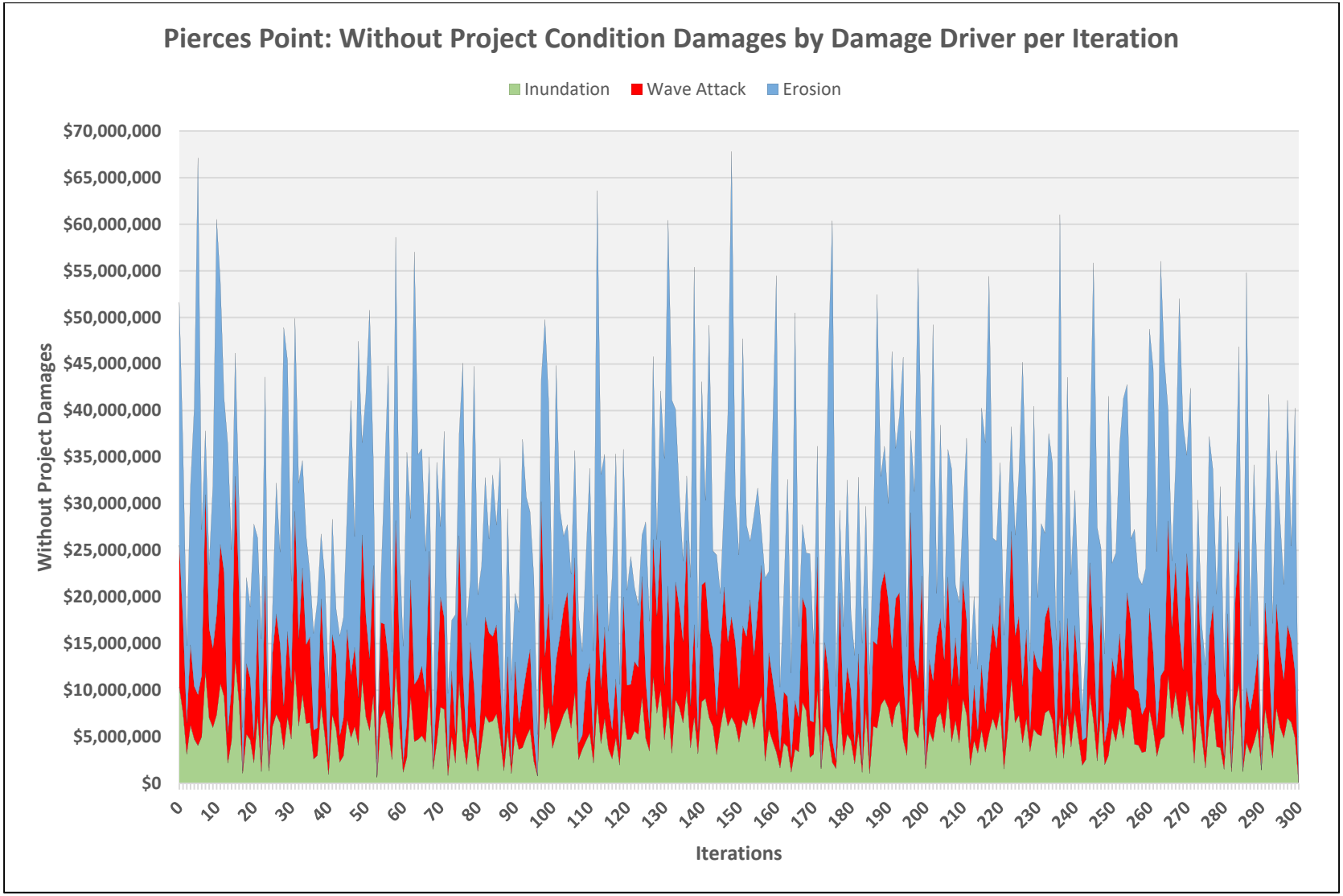
The vast majority of damages at Gandys Beach (87.3%) are due to erosion-related impacts. Inundation and Wave Attack damages are relatively minor as most structures in the study area are already elevated. Meanwhile, in the modeling, a future continuation of the high historic erosion rate (-2.5ft/yr) causes considerable damage.



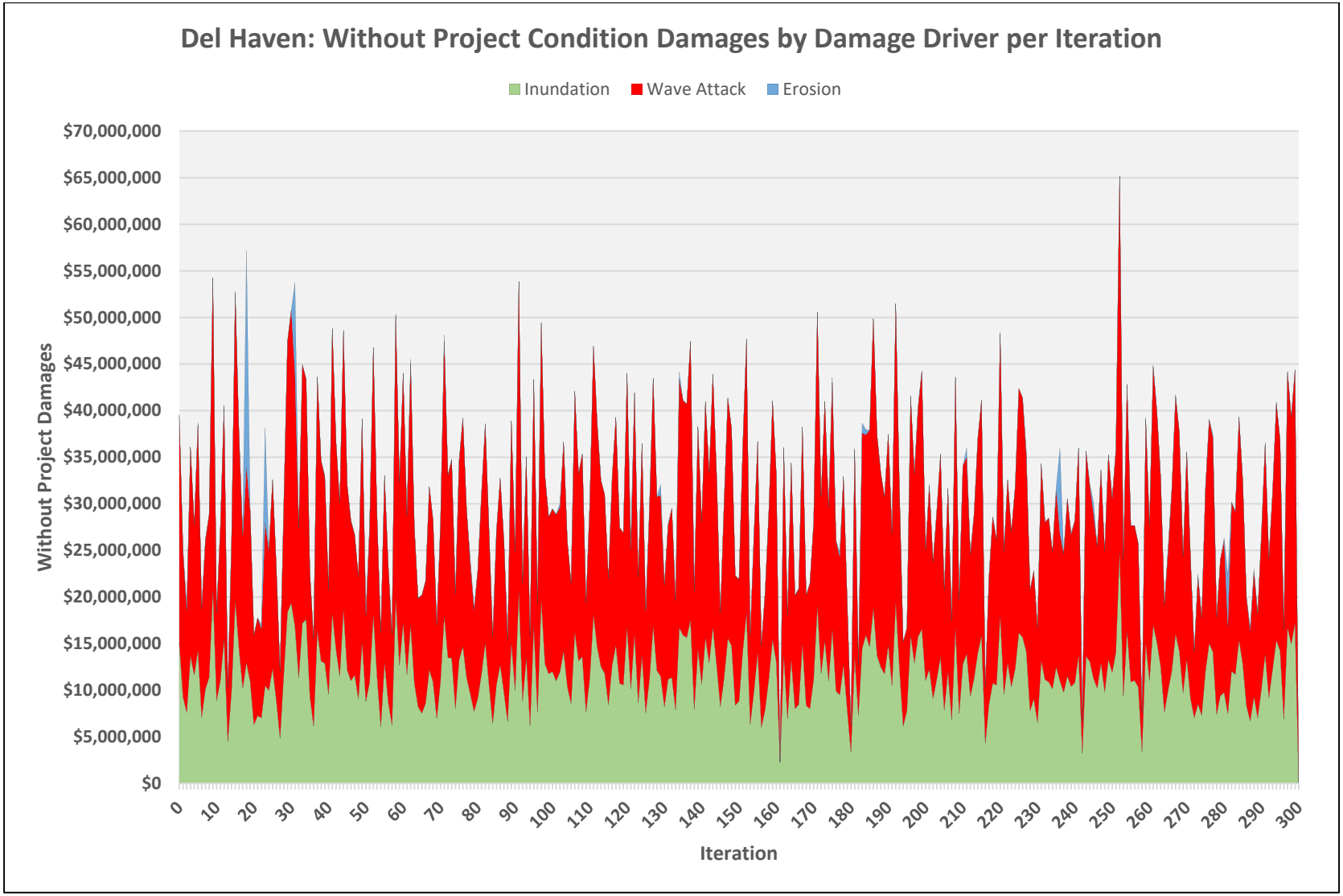
Fortescue also has significant erosion-related impacts (49.9%), but a lower ratio of elevated homes in the study area, especially moving inland away from the shore, increases the relative inundation (35.2%) and wave attack damages (14.8%).



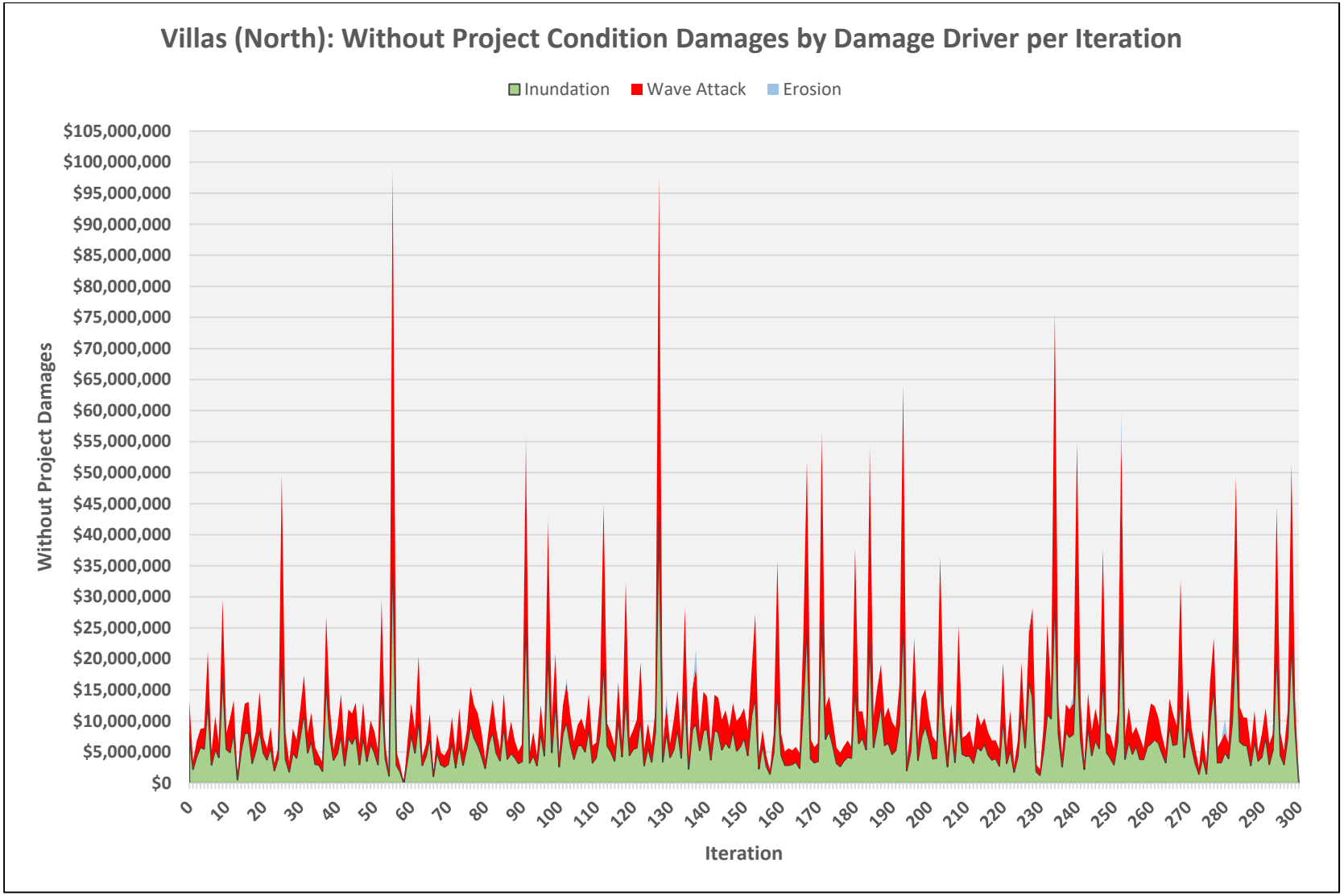
Reeds Beach has a similar structure inventory to Gandys Beach in terms of number of damage elements, total structure value, and ratio of elevated structures. However, the historic erosion rate for Reeds Beach is considerably less severe at -1.0 ft/yr. This explains the similarity in relative impact of damage drivers (erosion comprises 75.6% of damages), but the drastically reduced overall damage totals.



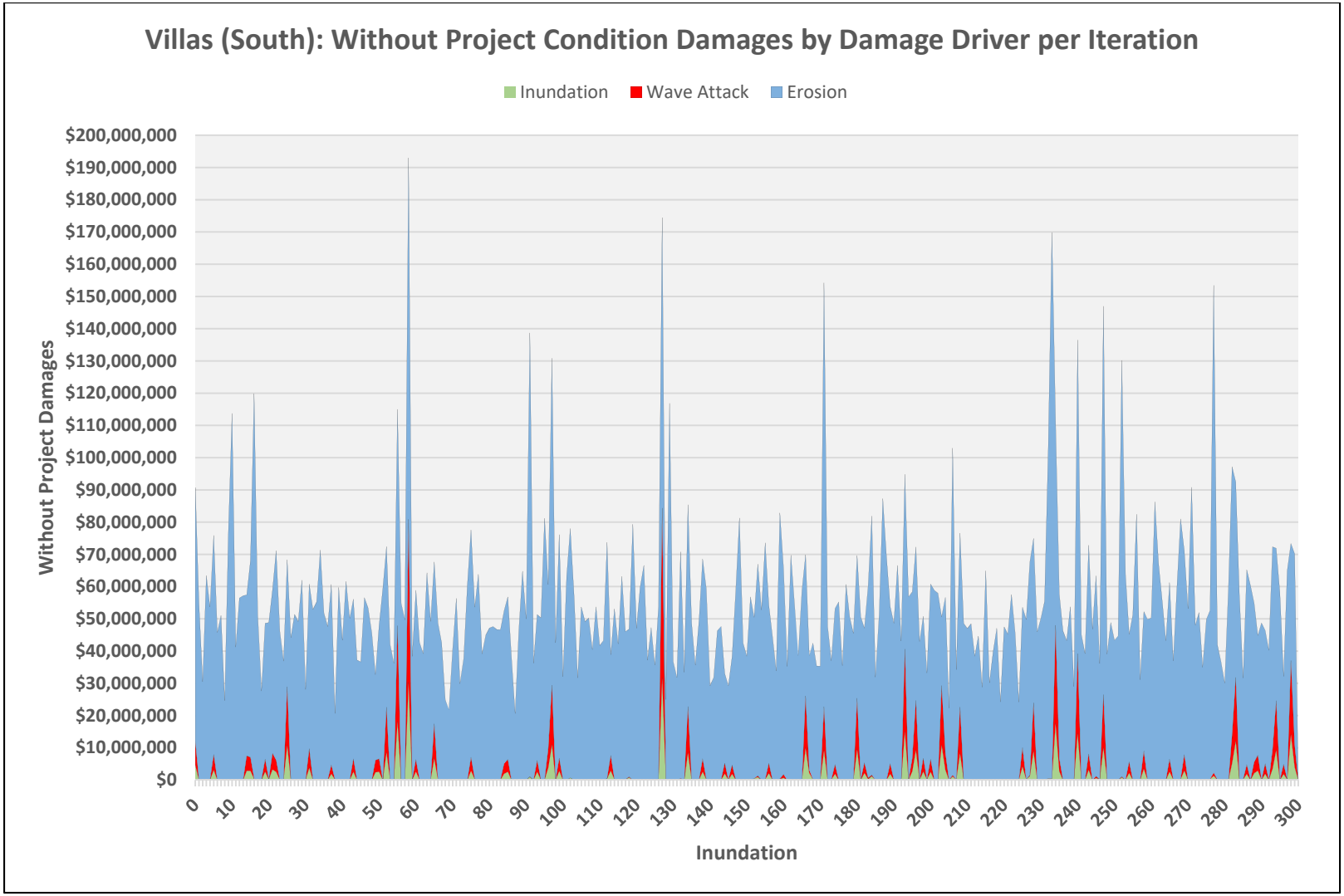
Pierces Point has similar existing conditions to Reeds Beach in terms of structure value and historic erosion rate (-1.0ft/yr), but the variability between iterations is much greater. This suggests that Pierces Point and Reeds Beach react similarly in iterations with more low frequency (high damage) events, but Pierces Point incurs significantly less damage in iterations with more high frequency (low damage) events.



Del Haven has similar inventory characteristics to both Pierces Point and Reeds Beach, but experiences a -0.0ft/yr historic erosion rate. As the figure shows, erosion damages are minimal (0.9%). Inundation (38.6%) and Wave Attack (60.5%) are more impactful, though overall damage totals are lower than either Pierces Point or Reeds Beach.



Villas (North) has a sizeable structure inventory valued at approximately $129,000,000; however, the +0.5 ft/yr accretion rate and the high ratio of elevated homes keeps Without Project damages relatively low. Only in iterations with several high damage storm events does the study area experience significant inundation and wave damages. Erosion damage, even in high damage iterations, remains low (0.5% of total damages).



Villas (South) has a similar structure inventory to Villas (North) in terms of number of structures, structure type, and structure value. However, a key difference is that the southern portion of Villas experiences a -1.5 ft/yr erosion rate (compared to +0.5 ft/yr for the northern half of Villas). So while the two areas respond similarly in terms of minimal wave and inundation damages, erosion damages add significantly to the total Without Project damages calculation for Villas (South).

Future With Project Condition (FWP)

This section of the Appendix describes the evaluation of the selected CSRM alternative for the six New Jersey sites. A description of the alternative, the methodology for developing cost estimates, and the alternative's performance in terms of damages reduced (benefits) are included in this section.

Dune and Berm Construction and Periodic Nourishment

The tentative alternatives optimization effort for the With Project Condition analysis consists of initial construction for a range of Dune Heights with Dune Widths set at 25 feet and Berm Widths at 75 feet. This measure includes placement of beach compatible material dredged from the Delaware River channel for both the initial construction and nourishments. Periodic nourishment is on an eight year cycle, timed with maintenance dredging from the Delaware River Main Channel Deepening Project. Nourishment of the beach is undertaken periodically to maintain the erosion control features within design dimensions. In addition to assumptions stated for the FWOP Beach-fx scenario, the FWP scenario requires assumptions for the modeled alternative. All assumptions (except number of iterations) stated in the FWOP section are included and identical to the assumptions stated for the FWP scenario.

Start Date – January 1, 2022 – Initial Construction completed and Period Nourishment cycle begins
Time Increment – 8 years – Periodic Nourishment cycle
Production Rate – 5,500 cubic yards per day
Reach Planform Rate – dependent on Dune/Berm configuration. Added to historic (background) erosion. This is the added erosion rate due to construction of a wider berm.
Borrow to Placement Ratio – 100% – All lost beach material is replaced by an equal volume of material during beach nourishment
Mobilization Threshold – 10,000 cubic yards
Iterations – 100 – sufficient for model equilibrium and more efficient screening process
Nourishment Trigger – 95% – fractional amount of template (dune height, dune width, berm width) that denotes requirement for renourishment.

Beach-fx uses a Periodic-Tested nourishment implementation. This type of nourishment implementation assumes testing volumetric nourishment needs on a regular cycle; in this preliminary analysis an eight year cycle has been applied. If, at the time of testing, the volumetric nourishment needs for all of the Reaches at a given site are less than the mobilization threshold, the nourishment mobilization is not implemented during that cycle and not reattempted until the next cycle. If a given site does have a nourishment need greater than the mobilization threshold, but none of the nourishment triggers have been reached for either Dune Height, Dune Width, or Berm Width for any of the Reaches at a given site, then nourishment implementation is again skipped for that cycle.

If any Reach, however, has crossed the nourishment trigger threshold for any portion of the design template, then all Reaches within the site are nourished back to full design template specifications. Essentially, this means that there is a maximum of six periodic nourishment implementations over the period of analysis for each site, but sites will not necessarily receive all six nourishments if their beach profiles do not cross selected mobilization and nourishment triggers at the start of a periodic nourishment cycle.

Table 9: Future With Project Condition Alternatives per Site

Site	Historic Erosion Rate	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Dune Height (NAVD88)	RPR* (ft/yr)	Dune Height (NAVD88)	RPR* (ft/yr)	Dune Height (NAVD88)	RPR* (ft/yr)	Dune Height (NAVD88)	RPR* (ft/yr)
Gandys Beach	-2.5 ft/yr	6.5 ft	-4.4	8.0 ft	-6.2	10.0 ft	-7.0	12.0 ft	-7.9
Fortescue	-2.5 ft/yr	6.5 ft	-2.8	8.0 ft	-3.9	10.0 ft	-4.5	12.0 ft	-5.0
Reeds Beach	-1.0 ft/yr	5.5 ft	-1.2	8.0 ft	-2.3	10.0 ft	-2.8	12.0 ft	-3.3
Pierces Point	-1.0 ft/yr	6.0 ft	-5.9	8.0 ft	-9.5	10.0 ft	-11.9	12.0 ft	-14.2
Del Haven	-0.0 ft/yr	8.0 ft	-1.7	10.0 ft	-2.4	12.0 ft	-3.0	14.0 ft	-3.7
Villas North	+0.5 ft/yr	8.0 ft	-1.0	10.0 ft	-2.0	12.0 ft	-2.4	14.0 ft	-2.9
Villas South	-1.5f t/yr	12.0 ft	-1.7	14.0 ft	-2.2	16.0 ft	-2.7	-	-

**Reach Planform Rate*

Each alternative was modeled independently for each site. This allows for a modular screening process where different combinations of sites and intra-site alternatives could be analyzed to identify the preliminary optimized plan.

Alternative 1 for each site, the lowest dune height, is equal to the upland elevation at that particular location. Additionally, all alternatives for Gandys Beach and Fortescue require the construction of a terminal groin. The Villas (North) alternatives require the construction of eleven outfalls and the Villas (South) alternatives require the construction of a separate set of eleven outfalls. For the preliminary cost estimates shown in Tables 10 through 15, these extra costs are represented in the *Equipment* and *Additional* columns.

Project Cost Methodology

All preliminary cost estimates detailed in this section were used for initial screening and optimization of alternatives, but were ultimately revised during final Beach-fx and cost analysis. While Beach-fx derived cost estimates are sufficient to allow comparisons between alternatives, all final costs must be developed using Corps-certified cost estimating software. Certified project cost estimates are shown at the FY2018 Price Level and the current FY2020 Price Level in Table 34 on page 91 of this Appendix.

The preliminary cost estimating methodology used during initial screening and optimization is shown below to explain the preliminary economic assessment and to explain the process by which three sites were screened from further consideration. All cost figures presented can be disregarded with respect to the final certified project cost methodology and estimates.

For preliminary cost estimates, Beach-fx only uses two inputs: Mobilization Cost and Unit Placement Cost. Mobilization Cost includes Mob/Demob/Prep Work costs, Planning Engineering and Design (PED) costs, Construction Management (S&I) costs, groin equipment and materials cost (if applicable), and outfalls equipment and materials costs (if applicable). These are fixed costs that are identical for every mobilization that is run. Unit Placement Cost constitutes the variable cost. This is the cost per cubic yard of beach material placement. Necessary placement volumes will vary each periodic nourishment cycle.

A key assumption in this study is the application of Federal Standard dredging and disposal costs. As explained in greater detail in the Main Report, the Federal Standard is the practice of dredged material disposal at the least cost, environmentally acceptable disposal location. For this study area, the current least cost, environmentally acceptable disposal location is an overboard disposal site designated as Buoy 10. This site is a deep trench in the lower portion of the Delaware Bay located approximately six miles northwest of Cape May Point. Buoy 10 is currently used as a disposal location for maintenance dredging material as part of the Delaware River Main Channel Deepening Project. Proposed alternatives would divert this dredged material from disposal at the fixed capacity Buoy 10 site and instead use that dredged material as beachfill at the project locations. For this reason, the Federal Standard cost of disposal at Buoy 10 is accepted as a Without Project Cost. Therefore, the cost of the alternative is only the incremental cost above the Federal Standard.

Another important assumption used during the cost estimation process is the expectation that the Buoy 10 disposal site, using current capacity constraints and current disposal volume rates, will exceed its limits in year 2030 (or 8 years into the 50 year project life cycle). Starting in year 2030, disposal material from maintenance dredging would need to be shipped to an alternate disposal site, the most likely being Artificial Island. Figure 17 shows the approximate locations of disposal sites Buoy 10 and Artificial Island. The latter disposal site has a capacity of 15.8 million cubic yards to a dike height of 50 feet and is located approximately 40 miles further up the channel. This change in disposal location is important as the Federal Standard Without Project Cost changes significantly between the two sites. Transportation and disposal of dredge material at Artificial Island is more expensive than similar work at Buoy 10.

In effect, the Federal Standard Without Project Cost for Initial Construction and Periodic Nourishment in year 2030 will be different than the Federal Standard Without Project Cost in the remaining five periodic nourishment cycles. This necessitates an update of the Mobilization and Unit Placement Cost inputs for the Beach-fx model to reflect the change in incremental project cost. The Mobilization Cost and Unit Placement Cost are weighted to reflect this change in Project Year 8.

The Federal Standard cost for Buoy 10 disposal area is $17.88 per cubic yard of material and with a $2,382,497 cost for Mob/Demob, PE&D, and S&I. Federal Standard cost for Artificial Island is $42.30 per cubic yard of material with a $5,887,374 cost for Mob/Demob, PE&D, and S&I.

Figure 17: Buoy 10 and Artificial Island Disposal Site Locations

Table 10: Initial Construction Cost Beach-fx Inputs without Federal Standard

Site	Unit Price Input	Mobilization Cost Input						
		Mob/Demob	Real Estate	PE&D	S&I	Equipment	Additional*	Total
Gandys Beach	$50.57	$4,417,467	$1,513,581	$1,026,051	$696,436	$69,922	$699,212	$8,422,668
Fortescue	$56.12	$4,417,467	$1,873,403	$1,223,378	$696,436	$69,922	$699,212	$8,979,817
Reeds Beach	$77.39	$4,417,467	$2,778,621	$670,878	$818,688	$0	$0	$8,685,655
Pierces Point	$73.92	$4,417,467	$1,202,062	$473,564	$453,947	$0	$0	$6,547,040
Del Haven	$48.14	$5,207,209	$2,094,203	$591,955	$702,452	$0	$0	$8,595,819
Villas	$47.37	$5,207,209	$4,599,851	$1,696,942	$1,850,784	$1,511,622	$15,116,223	$29,982,631

*Construction or extension of outlets

Table 11: Initial Construction Cost Beach-fx Inputs with Buoy 10 Federal Standard

Site	Unit Price Input	Mobilization Cost Input						
		Mob/Demob	Real Estate	PE&D	S&I	Equipment	Additional*	Total
Gandys Beach	$32.70	$4,020,384	$1,513,581	$1,026,051	$696,436	$69,922	$699,212	$8,025,586
Fortescue	$38.25	$4,020,384	$1,873,403	$1,223,378	$696,436	$69,922	$699,212	$8,582,734
Reeds Beach	$59.51	$4,020,384	$2,778,621	$670,878	$818,688	$0	$0	$8,288,572
Pierces Point	$56.04	$4,020,384	$1,202,062	$473,564	$453,947	$0	$0	$6,149,957
Del Haven	$30.26	$4,810,126	$2,094,203	$591,955	$702,452	$0	$0	$8,198,736
Villas	$29.50	$4,810,126	$4,599,851	$1,696,942	$1,850,784	$1,511,622	$15,116,223	$29,585,548

Table 12: Initial Construction Cost Beach-fx Inputs with Artificial Island Federal Standard

Site	Unit Price Input	Mobilization Cost Input						
		Mob/Demob	Real Estate	PE&D	S&I	Equipment	Additional*	Total
Gandys Beach	$8.27	$3,436,238	$1,513,581	$1,026,051	$696,436	$69,922	$699,212	$7,441,440
Fortescue	$13.82	$3,436,238	$1,873,403	$1,223,378	$696,436	$69,922	$699,212	$7,998,588
Reeds Beach	$35.09	$3,436,238	$2,778,621	$670,878	$818,688	$0	$0	$7,704,426
Pierces Point	$31.62	$3,436,238	$1,202,062	$473,564	$453,947	$0	$0	$5,565,811
Del Haven	$5.84	$4,225,980	$2,094,203	$591,955	$702,452	$0	$0	$7,614,590
Villas	$5.07	$4,225,980	$4,599,851	$1,696,942	$1,850,784	$1,511,622	$15,116,223	$29,001,402

Table 13: Periodic Nourishment Cost Beach-fx Inputs without Federal Standard

Site	Unit Price Input	Mobilization Cost Input						
		Mob/Demob	Real Estate	PE&D	S&I	Equipment	Additional	Total
Gandys Beach	$57.32	$4,131,478	$0	$552,487	$377,793	$0	$0	$5,061,758
Fortescue	$64.60	$4,131,478	$0	$749,814	$377,793	$0	$0	$5,259,085
Reeds Beach	$87.63	$4,131,478	$0	$670,878	$377,793	$0	$0	$5,180,149
Pierces Point	$81.06	$4,131,478	$0	$473,564	$387,816	$0	$0	$4,992,858
Del Haven	$80.93	$4,131,478	$0	$591,955	$377,793	$0	$0	$5,101,226
Villas	$72.14	$4,131,478	$0	$1,223,378	$401,843	$0	$0	$5,756,699

Table 14: Periodic Nourishment Cost Beach-fx Inputs with Buoy 10 Federal Standard

Site	Unit Price Input	Mobilization Cost Input						
		Mob/Demob	Real Estate	PE&D	S&I	Equipment	Additional	Total
Gandys Beach	$39.44	$3,734,395	$0	$552,487	$377,793	$0	$0	$4,664,675
Fortescue	$46.72	$3,734,395	$0	$749,814	$377,793	$0	$0	$4,862,002
Reeds Beach	$69.76	$3,734,395	$0	$670,878	$377,793	$0	$0	$4,783,066
Pierces Point	$63.18	$3,734,395	$0	$473,564	$387,816	$0	$0	$4,595,775
Del Haven	$63.05	$3,734,395	$0	$591,955	$377,793	$0	$0	$4,704,143
Villas	$54.26	$3,734,395	$0	$1,223,378	$401,843	$0	$0	$5,359,616

Table 15: Periodic Nourishment Cost Beach-fx Inputs with Artificial Island Federal Standard

Site	Unit Price Input	Mobilization Cost Input						
		Mob/Demob	Real Estate	PE&D	S&I	Equipment	Additional	Total
Gandys Beach	$15.02	$3,150,249	$0	$552,487	$377,793	$0	$0	$4,080,529
Fortescue	$22.30	$3,150,249	$0	$749,814	$377,793	$0	$0	$4,277,856
Reeds Beach	$45.33	$3,150,249	$0	$670,878	$377,793	$0	$0	$4,198,920
Pierces Point	$38.75	$3,150,249	$0	$473,564	$387,816	$0	$0	$4,011,629
Del Haven	$38.62	$3,150,249	$0	$591,955	$377,793	$0	$0	$4,119,997
Villas	$29.84	$3,150,249	$0	$1,223,378	$401,843	$0	$0	$4,775,470

Table 16: Weighted Cost Beach-fx Inputs with Applied Federal Standard

Site	Cost Type	Buoy 10 Federal Standard		Artificial Island Federal Standard				
		Year 0 (IC)	Year 8	Year 16	Year 24	Year 32	Year 40	Year 48
Gandys Beach	Unit Price	$32.70	$39.44	$15.02	$15.02	$15.02	$15.02	$15.02
	Mobilization	$8,025,586	$4,664,675	$4,080,529	$4,080,529	$4,080,529	$4,080,529	$4,080,529
Fortescue	Unit Price	$38.25	$46.72	$22.30	$22.30	$22.30	$22.30	$22.30
	Mobilization	$8,582,734	$4,862,002	$4,277,856	$4,277,856	$4,277,856	$4,277,856	$4,277,856
Reeds Beach	Unit Price	$59.51	$69.76	$45.33	$45.33	$45.33	$45.33	$45.33
	Mobilization	$8,288,572	$4,783,066	$4,198,920	$4,198,920	$4,198,920	$4,198,920	$4,198,920
Pierces Point	Unit Price	$56.04	$63.18	$38.75	$38.75	$38.75	$38.75	$38.75
	Mobilization	$6,149,957	$4,595,775	$4,011,629	$4,011,629	$4,011,629	$4,011,629	$4,011,629
Del Haven	Unit Price	$30.26	$63.05	$38.62	$38.62	$38.62	$38.62	$38.62
	Mobilization	$8,198,736	$4,704,143	$4,119,997	$4,119,997	$4,119,997	$4,119,997	$4,119,997
Villas	Unit Price	$29.50	$54.26	$29.84	$29.84	$29.84	$29.84	$29.84
	Mobilization	$29,585,548	$5,359,616	$4,775,470	$4,775,470	$4,775,470	$4,775,470	$4,775,470

Table 16 shows the resulting Federal Standard cost applications with the assumption that the Buoy 10 disposal site will reach capacity following year 2030 (project year 8). As Beach-fx only accepts one unit price value and one mobilization price per scenario, the above costs are appropriately weighted and then added to Beach-fx to approximate cost for the alternatives listed in Table 9.

Table 17: Final Beach-fx Cost Variables

Item	Gandys Beach	Fortescue	Reeds Beach	Pierces Point	Del Haven	Villas
Unit Price	$21.03	$28.06	$50.85	$44.71	$40.92	$33.28
Mobilization	$4,155,386	$4,324,524	$4,256,864	$4,096,329	$4,302,036	$4,863,870

*Additional Initial Construction cost added in Year 0 to Beach-fx calculated costs

As stated earlier, the resultant cost estimates were only used to aid decision making in the preliminary screening effort and final cost estimates for the proposed alterative were ultimately calculated using the appropriate certified cost estimator model and procedures. Those final cost estimates are presented in the Executive Summary and in the section titled *FY2020 Price Level and Discount Rate Adjustment* (page 86).

Coastal Storm Risk Management (CSRM) Benefits

Damages Reduced constitute the Coastal Storm Risk Management Benefits of the study. Benefits are computed using the formula *Without Project Damages – With Project Damages = CSRM Benefits.* Residual risk refers to storm damages a study area can be anticipated to experience post project implementation. This is computed using *Without Project Damages – CSRM Benefits = Residual Risk*. Additional benefits, such as Benefits During Construction (BDC), Local Costs Foregone, and Recreation Benefits may also be present, but were not quantified for this study phase.

Present Worth values were annualized using the FY2017 Federal Discount Rate of 2.875% over a 50-year project life cycle.

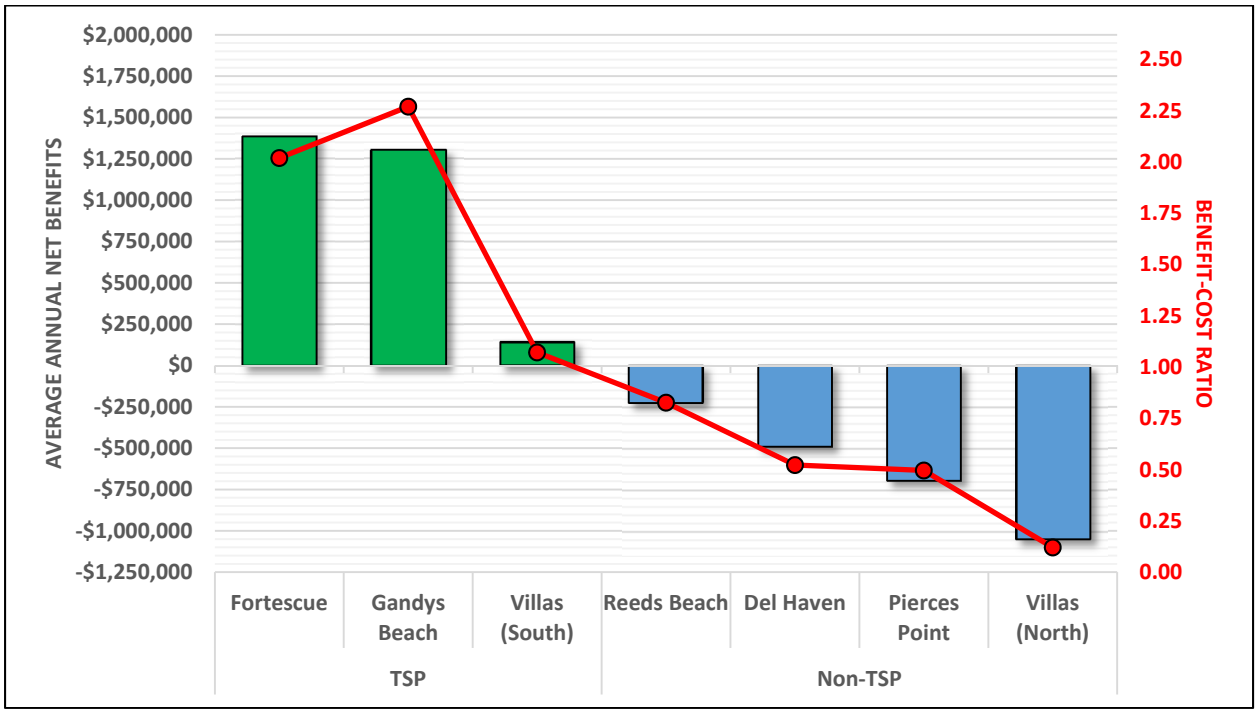
Table 18: Coastal Storm Risk Management Benefits by Site (for Best Alternative)

Site	Dune Height Alternative	Without Project Condition		With Project Condition		Damages Reduced		
		Total Damage	AAD	Total Damage	AAD	Total Damage	AAD	Residual
Gandys Beach	6.5 ft	$66,303,539	$2,516,092	$5,080,528	$192,796	$61,223,011	$2,323,296	7.7%
Fortescue	6.5 ft	$119,048,659	$4,517,669	$46,923,905	$1,780,672	$72,124,753	$2,736,996	39.4%
Reeds Beach	5.5 ft	$33,533,857	$1,272,546	$5,481,732	$208,021	$28,052,125	$1,064,524	16.4%
Pierces Point	6.0 ft	$24,715,041	$937,889	$6,719,798	$255,003	$17,995,244	$682,885	27.2%
Del Haven	8.0 ft	$20,288,625	$769,914	$6,205,887	$235,502	$14,082,738	$534,413	30.6%
Villas (North)	12.0 ft	$9,651,857	$366,269	$5,868,713	$222,706	$3,783,144	$143,563	60.8%
Villas (South)	12.0 ft	$55,255,523	$2,096,841	$1,003,115	$38,066	$54,252,408	$2,058,775	1.8%
Total	-	**$328,797,101**	**$12,477,221**	**$77,283,678**	**$2,932,768**	**$251,513,423**	**$9,544,453**	**23.5%**

Table 19: Average Annual Net Benefits and Benefit-Cost Ratio for All Sites

Site	Initial Construction	Periodic Nourishment	Total Project Cost	Average Annual Cost	Average Annual Benefits	Average Annual Net Benefits	Benefit-Cost Ratio
Gandys Beach	$12,766,361	$14,199,797	$26,966,158	$1,023,314	$2,323,296	$1,299,982	2.27
Fortescue	$15,964,212	$19,743,722	$35,707,934	$1,355,048	$2,736,996	$1,381,949	2.02
Reeds Beach	$24,000,268	$9,918,247	$33,918,514	$1,287,143	$1,064,524	-$222,618	0.83
Pierces Point	$9,792,752	$26,471,219	$36,263,971	$1,376,148	$682,885	-$693,263	0.50
Del Haven	$16,884,504	$10,054,137	$26,938,641	$1,022,270	$534,413	-$487,857	0.52
Villas (North)	$23,785,872	$7,527,988	$31,313,860	$1,188,301	$143,563	-$1,044,738	0.12
Villas (South)	$19,663,266	$30,953,006	$50,616,272	$1,920,791	$2,058,775	$137,984	1.07
Total	**$122,857,236**	**$118,868,115**	**$241,725,351**	**$9,173,014**	**$9,544,453**	**$371,439**	**1.04**

Figure 18: Average Annual Net Benefits and Benefit-Cost Ratio



Of all six communities analyzed, only Gandys Beach, Fortescue, and Villas (South) had positive Average Annual Net Benefits (AANB) and a Benefit-Cost Ratio (BCR) above 1.0 over the 50-year project period of analysis.

As each site must be independently justified for inclusion in the final Recommended Plan, Reeds Beach, Del Haven, Pierces Point, and Villas (North), with BCRs below 1.0, were screened from further consideration. As noted earlier, the values above correspond to the alternative in each site that maximizes National Economic Development benefits. For the three sites preliminarily included in the Recommended Plan, the alternatives screening results are shown in greater detail below.

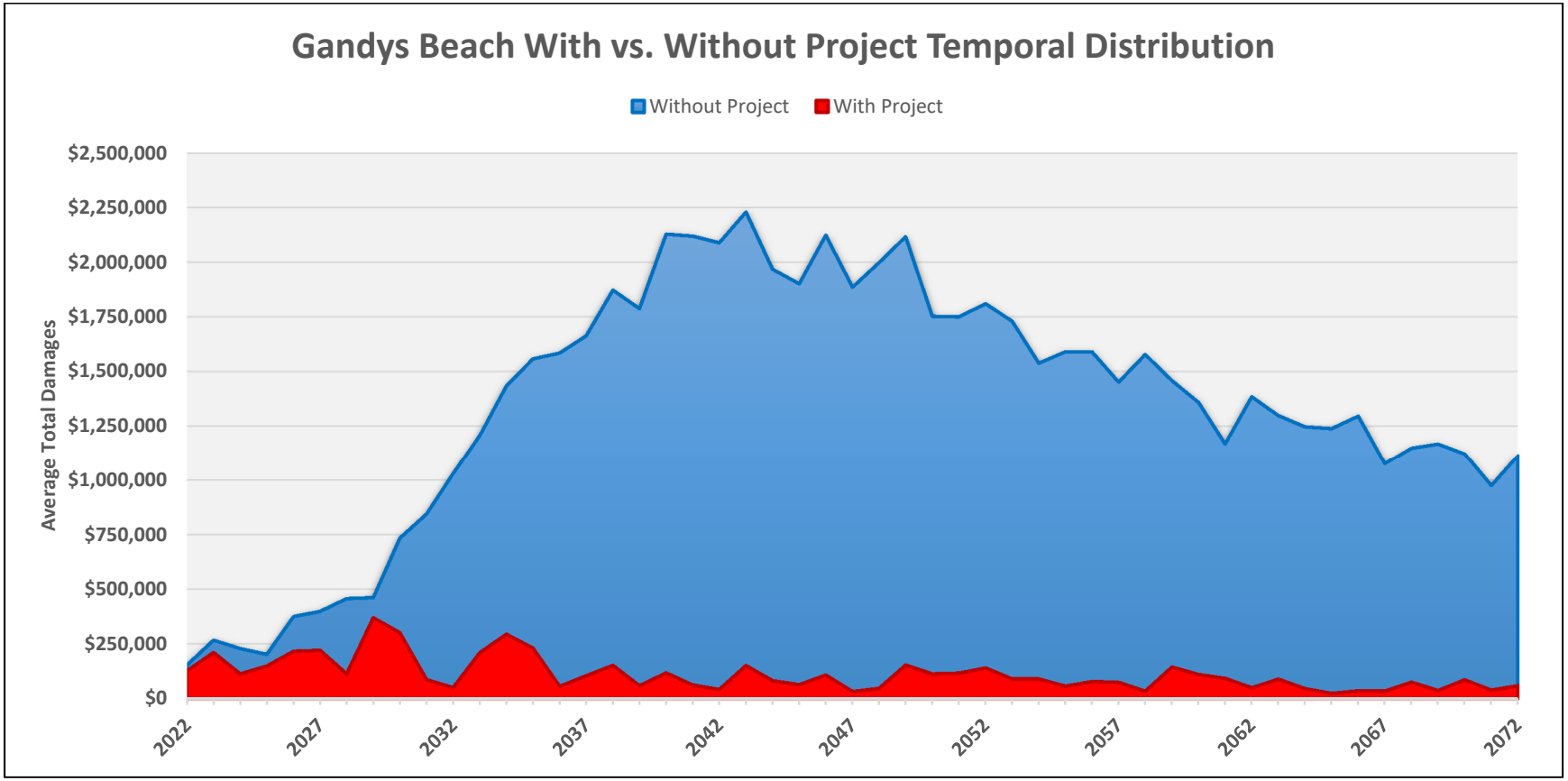
Table 20: Alternatives Screening In-Depth Results for Identified Sites

Alternative		Berm Width Change Rate	Category	Damages		Damages Prevented	Residual Damage	Total Project Cost	Average Net Benefits	AAB	AAC	AANB	BCR
				Without Project	With Project								
Gandys Beach	6.5' Dune	-4.4ft/yr	Structure	$46,131,536	$3,328,827								
			Content	$20,172,003	$1,751,701								
			Total	$66,303,539	$5,080,528	$61,223,011	7.66%	$26,966,158	$34,256,853	$2,323,296	$1,023,314	$1,299,982	2.27
	8' Dune	-6.2ft/yr	Structure	$46,131,536	$2,783,074								
			Content	$20,172,003	$1,515,472								
			Total	$66,303,539	$4,298,546	$62,004,993	6.48%	$28,195,378	$33,809,615	$2,352,971	$1,069,961	$1,283,010	2.20
	10' Dune	-7.0ft/ur	Structure	$46,131,536	$2,322,501								
			Content	$20,172,003	$1,327,163								
			Total	$66,303,539	$3,649,665	$62,653,875	5.50%	$29,829,472	$32,824,402	$2,377,595	$1,131,971	$1,245,623	2.10
	12' Dune	-7.9ft/yr	Structure	$46,131,536	$2,070,944								
			Content	$20,172,003	$1,222,569								
			Total	$66,303,539	$3,293,513	$63,010,026	4.97%	$31,325,361	$31,684,665	$2,391,110	$1,188,738	$1,202,372	2.01

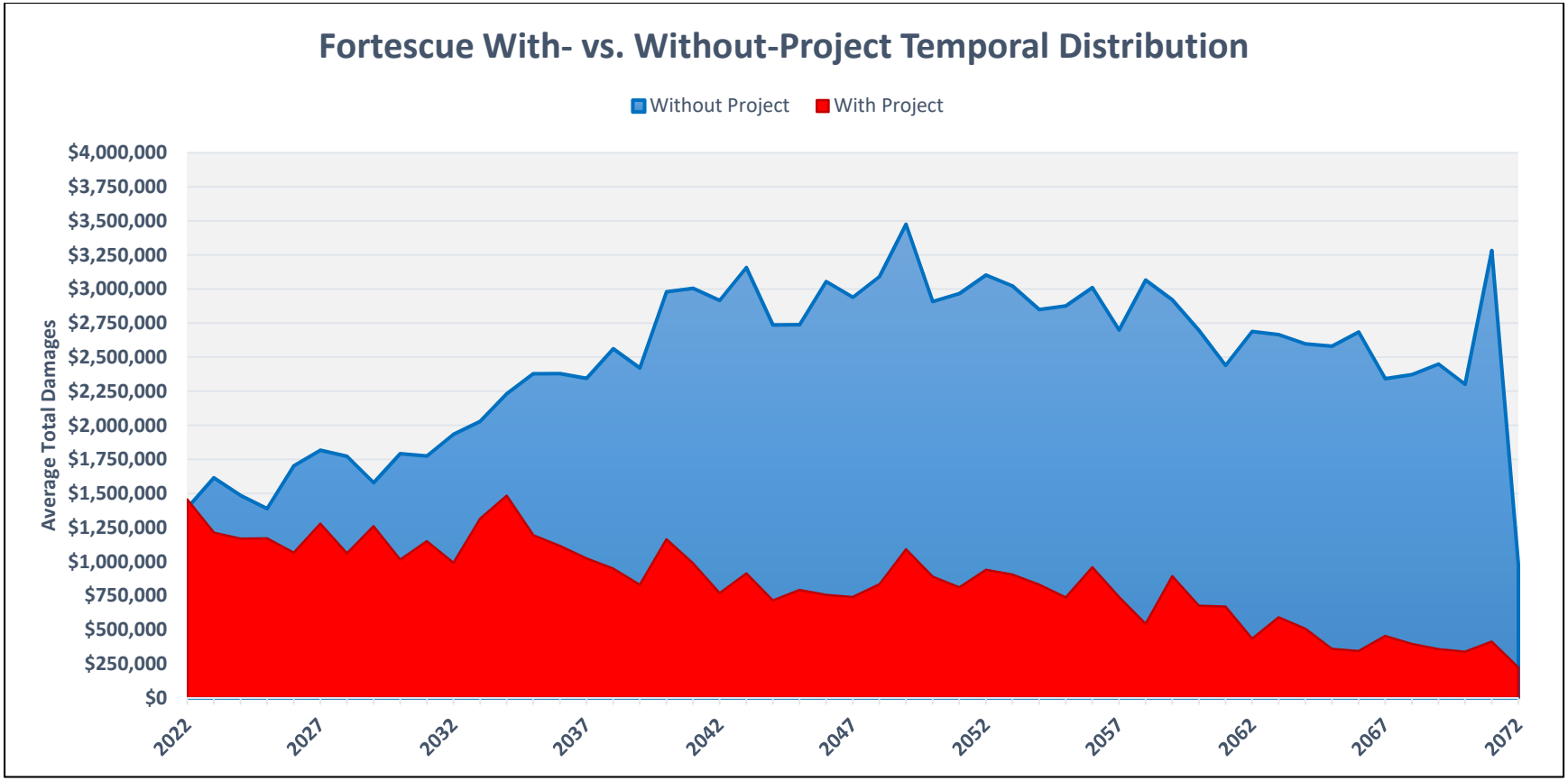
Alternative		Berm Width Change Rate	Category	Damages		Damages Prevented	Residual Damage	Total Project Cost	Average Net Benefits	AAB	AAC	AANB	BCR
				Without Project	With Project								
Fortescue	6.5' Dune	-2.8ft/yr	Structure	$79,693,844	$27,993,598								
			Content	$39,354,815	$18,930,307								
			Total	$119,048,659	$46,923,905	$72,124,753	39.42%	$35,707,934	$36,416,819	$2,736,996	$1,355,048	$1,381,949	2.02
	8' Dune	-3.9ft/yr	Structure	$79,693,844	$28,869,629								
			Content	$39,354,815	$19,218,122								
			Total	$119,048,659	$48,087,751	$70,960,908	40.39%	$39,135,736	-$26,691,056	$2,692,831	$1,485,126	$1,207,704	1.81
	10' Dune	-4.5ft/yr	Structure	$79,693,844	$27,210,074								
			Content	$39,354,815	$18,609,435								
			Total	$119,048,659	$45,819,509	$73,229,149	38.49%	$41,364,658	-$26,691,056	$2,778,906	$1,569,710	$1,209,196	1.77
	12' Dune	-5.0ft/yr	Structure	$79,693,844	$26,691,056								
			Content	$39,354,815	$18,429,610								
			Total	$119,048,659	$45,120,666	$73,927,992	37.90%	$45,140,021	-$26,691,056	$2,805,426	$1,712,977	$1,092,448	1.64

Alternative		Berm Width Change Rate	Category	Damages		Damages Prevented	Residual Damage	Total Project Cost	Average Net Benefits	AAB	AAC	AANB	BCR
				Without Project	With Project								
Villas (South)	12' Dune	-1.2ft/yr	Structure	$39,404,142	$685,083								
			Content	$15,851,381	$318,032								
			Total	$55,255,523	$1,003,115	$54,252,408	1.82%	$50,616,272	$3,636,137	$2,058,775	$1,920,791	$137,984	1.07
	14' Dune	-2.2ft/yr	Structure	$39,404,142	$483,022								
			Content	$15,851,381	$239,969								
			Total	$55,255,523	$722,991	$54,532,533	1.31%	$59,480,800	-$26,691,056	$2,069,405	$2,257,182	-$187,777	0.92
	16' Dune	-2.7ft/yr	Structure	$39,404,142	$176,644								
			Content	$15,851,381	$119,094								
			Total	$55,255,523	$295,738	$54,959,785	0.54%	$64,690,656	-$26,691,056	$2,085,619	$2,454,887	-$369,268	0.85

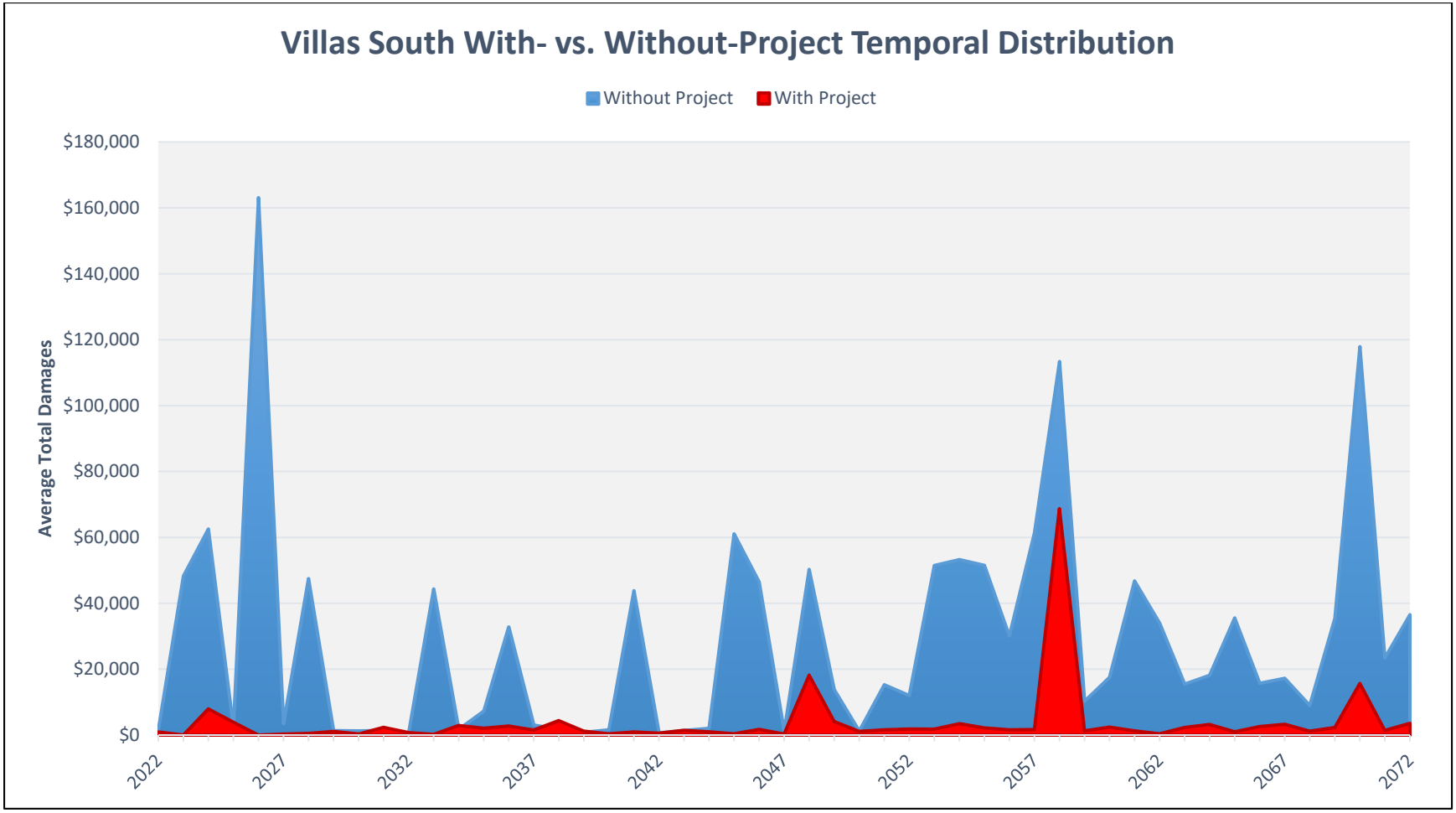
Figure 19: Temporal Distribution of Damages Reduced for Identified Sites



Gandys Beach experiences a significant reduction in future With Project damages with only 7.7% of residual damages; all from inundation-related impacts. The Without Project damages are greatest in Year 2043, but then as structures become condemned in Beach-fx (experience greater than 50% reduction in value before structure repair or exceed maximum number of rebuilds permitted) they are removed from the inventory and no longer contribute to the damage pool. So while inundation, wave attack, and erosion impacts may increase indefinitely over time, the modeled conditions in Gandys Beach appropriately reflect a shifting without project condition inventory as structures are removed from the floodplain.



Fortescue has a much greater percentage of non-elevated, near ground elevation structures within the study area. As the proposed alternative is not anticipated to greatly reduce inundation damages, residual risk (39.4%) is much greater than in Gandys Beach (7.7%). For the Without Project condition, Fortescue reaches maximum damage in Year 2049, but then experiences a gradual decrease in expected Without Project Damages with an exception in Year 2071. Several Beach-fx iterations have major storm events in this year that are modeled to cause significant damage, even to a reduced inventory.



Villas (South) follows a much different pattern than either Gandys Beach or Fortescue. While the inventory size at Villas (South) is larger, the structures are generally farther from the shore and more likely to be elevated. As this is the reason for the reduced Without Project condition damage pool (in comparison to Gandys Beach and Fortescue), it also explains the relative stability of the inventory. Few of the structures are condemned throughout the project life so damages remain fairly even over time and only change based on specific low frequency storm events in certain years. As inundation damages are minor even in the Without Project Condition, residual damages for the site are low (1.8%).

Recommended Plan Results and Risk Analysis

After identification of the three incrementally justified sites, costs were slightly refined for the remaining areas to reflect changes to the Federal Standard application. With fewer study locations remaining after the screening, the Federal Standard cost deductions are slightly higher for each site, reducing the Average Annual Cost and marginally boosting the Average Annual Net Benefits and Benefit-Cost Ratio. Results are shown in Table 21:

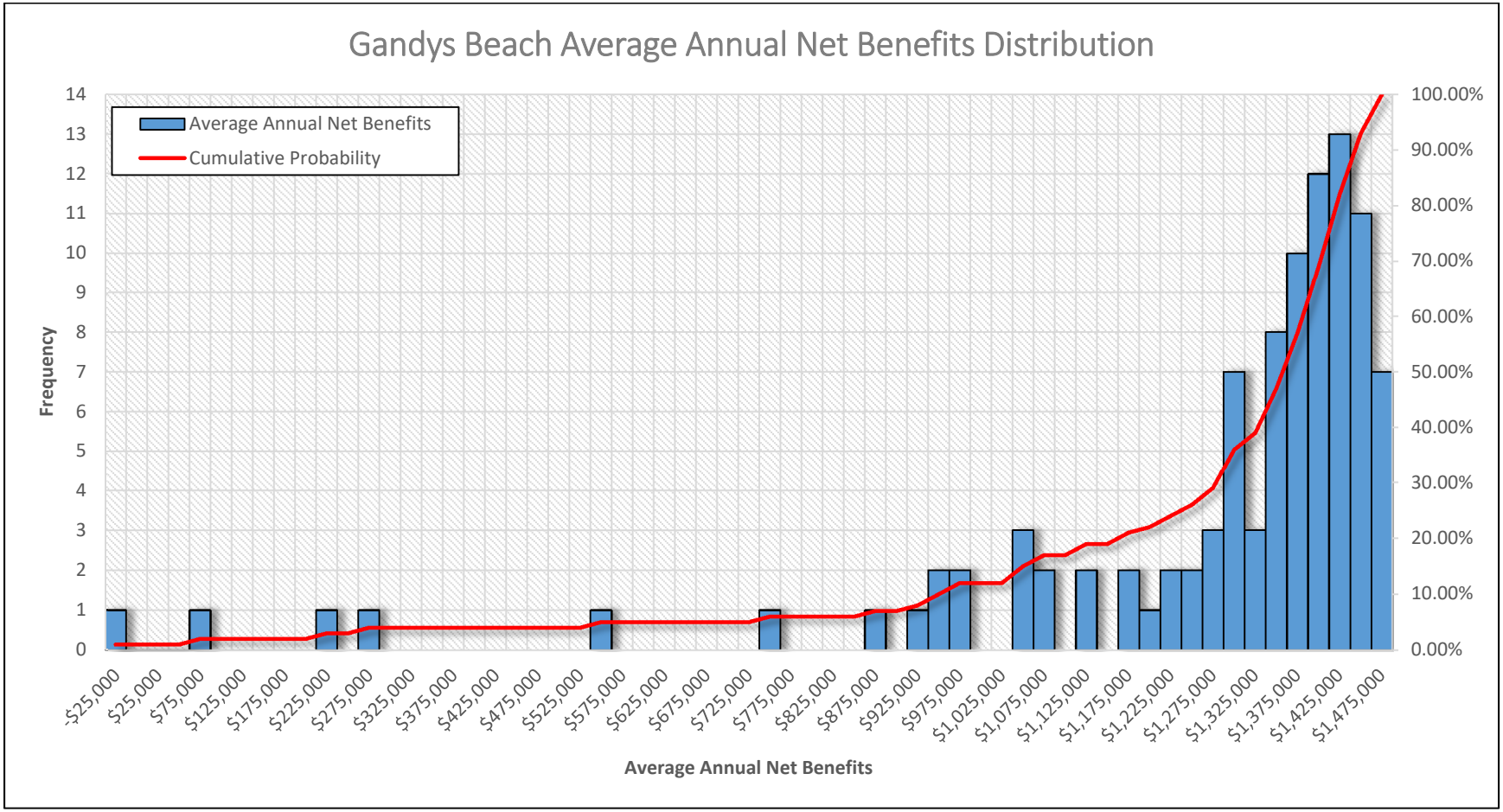
Table 21: Refined (Preliminary) Average Annual Net Benefits and Benefit-Cost Ratio

Site	Initial Construction	Periodic Nourishment	Total Project Cost	Average Annual Cost	Average Annual Benefits	Average Annual Net Benefits	Benefit-Cost Ratio
Gandys Beach	$12,648,657	$13,479,621	$26,128,279	$991,518	$2,323,296	$1,331,778	2.34
Fortescue	$15,846,509	$19,125,084	$34,971,594	$1,327,105	$2,736,996	$1,409,891	2.06
Villas (South)	$21,916,695	$25,718,947	$47,635,642	$1,807,681	$2,058,775	$251,094	1.14
Total	**$50,411,861**	**$58,323,653**	**$108,735,514**	**$4,126,305**	**$7,119,067**	**$2,992,763**	**1.73**

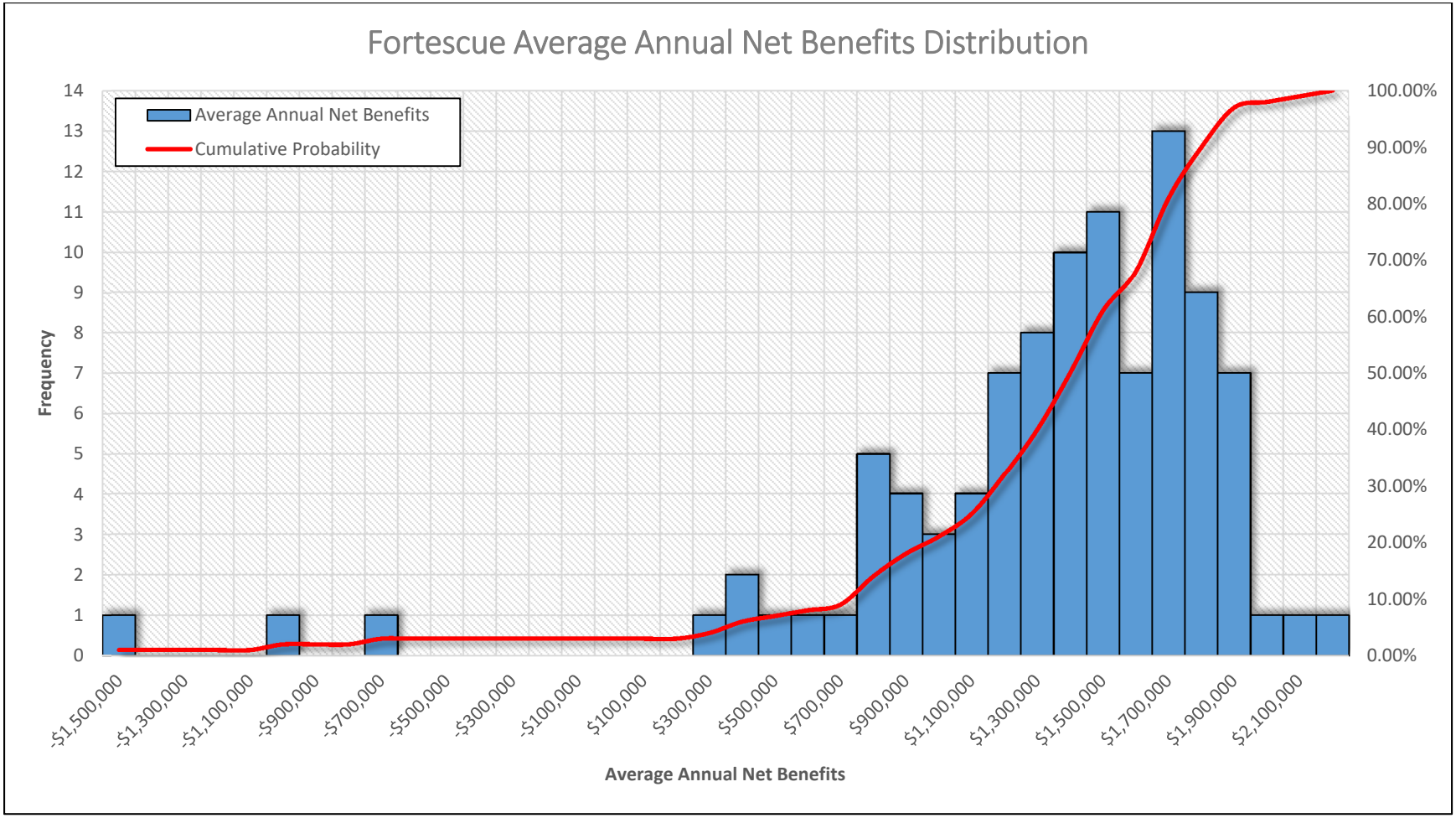
The values in Table 21 provide deterministic results for Average Annual Net Benefits. However, to properly evaluate project risk, the distribution of results for each site is shown in Figure 20.

As noted earlier in the document, the benefits and costs provided in this section were compiled at the then current FY2017 Price Level and FY2017 Federal Discount Rate. The analysis was later updated to FY2018 Price Level and Federal Discount Rate (page 62) and then completed at the current FY2020 Price Level and Federal Discount Rate (page 86).

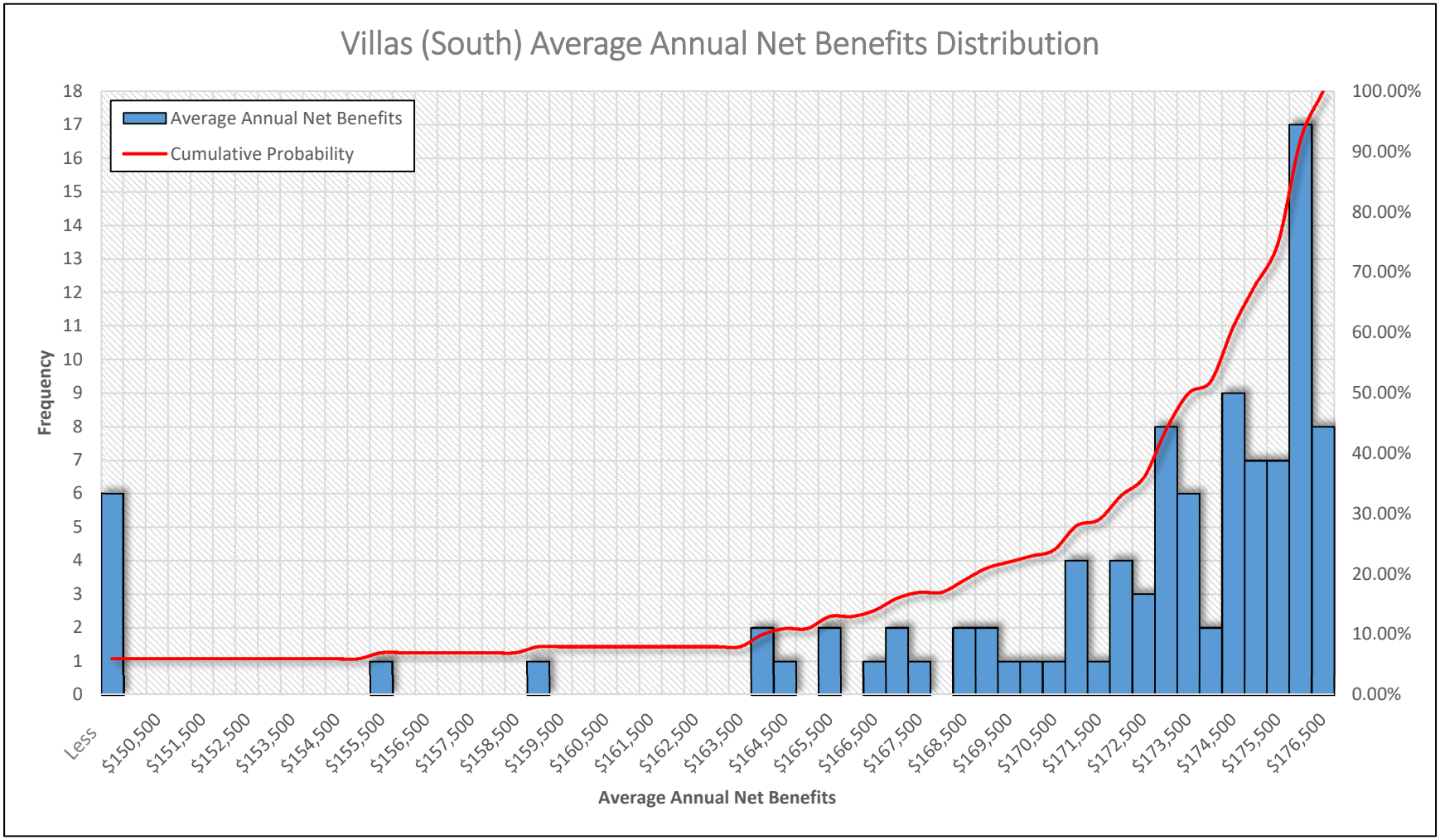
Figure 20: Average Annual Net Benefits Distribution



The mean Average Annual Net Benefits for Gandys Beach across all 100 iterations is $1,331,778 with a median of $1,359,968 and a standard deviation of $287,502. As the figure shows, the distribution of results is skewed left with outliers pulling the average left of the median. The cumulative probability series shows that 90% of results have an AANB of over $875,000 and only 1% of results show an AANB below $0.



The mean Average Annual Net Benefits for Fortescue across all 100 iterations is $1,409,891 with a median of $1,398,562 and a standard deviation of $582,217. Fortescue has a wider distribution of results as evidenced by a greater standard deviation than Gandys Beach or Villas (South). Even so, the cumulative probability series shows that 90% of results have an AANB of over $700,000 with only 3% of results showing an AANB below $0.



The mean Average Annual Net Benefits for Villas (South) across all 100 iterations is $137,984 with a median of $173,589 and a standard deviation of $306,486. Villas (South) is highly clustered around the median with 90% of results showing an AANB greater than $164,000. However, a few significant outliers, including 3% of results below $0, cause a significant pull on the overall average.

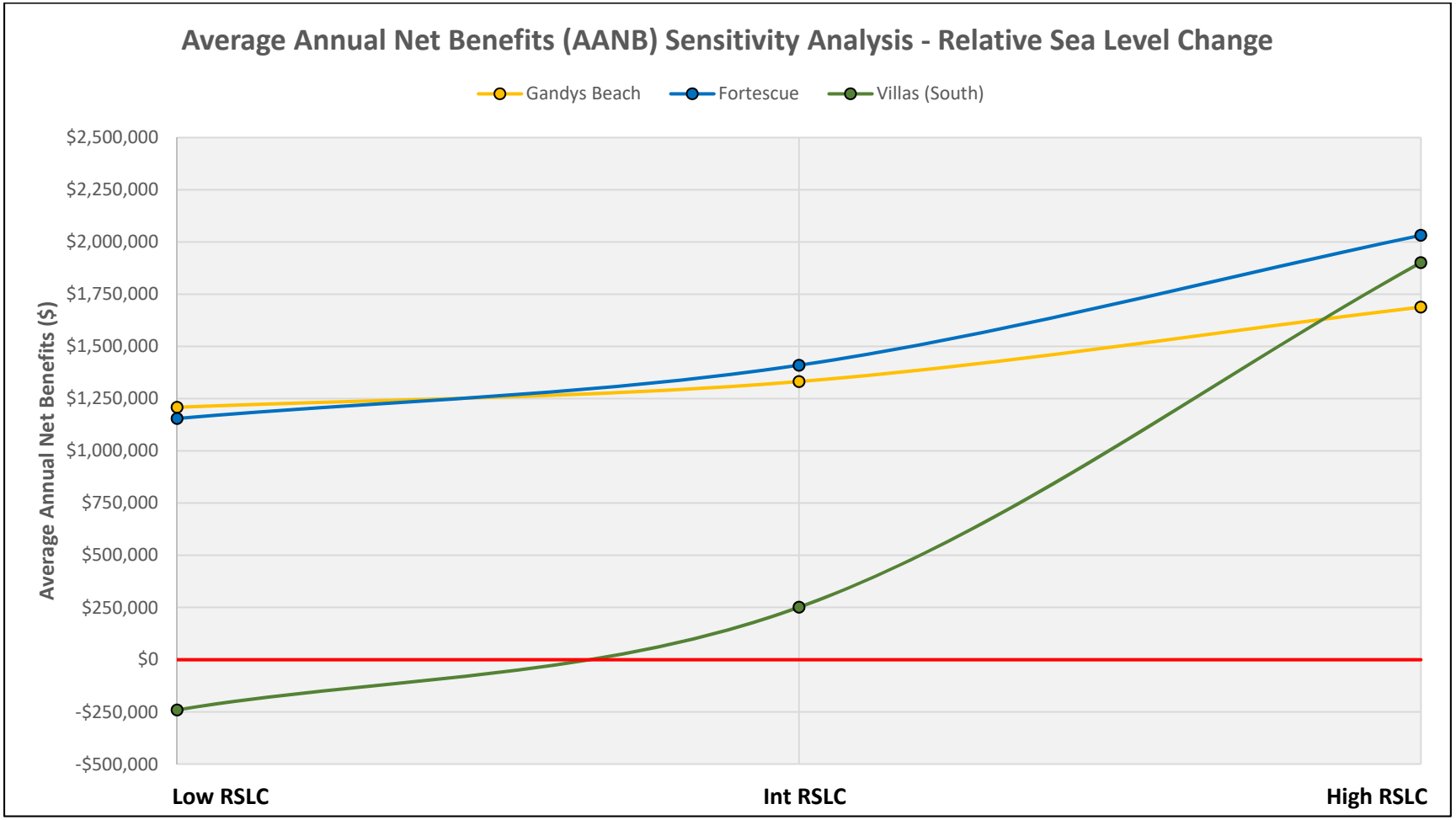
As mentioned earlier, formulation was completed using the Intermediate Relative Sea Level Change (RSLC) curve. A sensitivity analysis was completed to quantify the effect of sea level change on the selected plan. Results for the Low (Historic) and High RSLC curves are shown in Table 22 and Figure 21:

Table 22: Relative Sea Level Change Sensitivity Analysis

Low RSLC	Initial Construction	Periodic Nourishment	Total Project Cost	Average Annual Cost	Average Annual Benefits	Average Annual Net Benefits	Benefit-Cost Ratio
Gandys Beach	$12,648,657	$13,287,364	$25,936,021	$984,222	$2,192,404	$1,208,181	2.23
Fortescue	$15,846,509	$18,662,568	$34,509,077	$1,309,553	$2,464,669	$1,155,116	1.88
Villas (South)	$21,916,695	$24,874,579	$46,791,274	$1,775,639	$1,535,089	-$240,551	0.86
Total	**$50,411,861**	**$56,824,511**	**$107,236,372**	**$4,069,415**	**$6,192,161**	**$2,122,746**	**1.52**

High RSLC	Initial Construction	Periodic Nourishment	Total Project Cost	Average Annual Cost	Average Annual Benefits	Average Annual Net Benefits	Benefit-Cost Ratio
Gandys Beach	$12,648,657	$14,098,837	$26,747,494	$1,015,016	$2,703,445	$1,688,428	2.66
Fortescue	$15,846,509	$20,586,685	$36,433,194	$1,382,570	$3,414,286	$2,031,716	2.47
Villas (South)	$21,916,695	$28,419,497	$50,336,192	$1,910,162	$3,811,359	$1,901,197	2.00
Total	**$50,411,861**	**$63,105,019**	**$113,516,880**	**$4,307,748**	**$9,929,090**	**$5,621,341**	**2.30**

Figure 21: Relative Sea Level Change Sensitivity Analysis



Sea Level change has the greatest impact on Villas (South). As Villas (South) has a significantly larger inventory than either Fortescue or Gandys Beach, a slight change to estimated future Without Project Damages per structure has a much more measurable impact. This is especially evident in the High RSLC scenario where Villas (South) experiences a significantly greater boost to AANB than the other sites as the increased projected damages avoided far outweigh the increased initial construction and periodic nourishment cost requirements. Gandys Beach and Fortescue, with considerably fewer structures, are relatively inelastic to changes in projected RSLC.

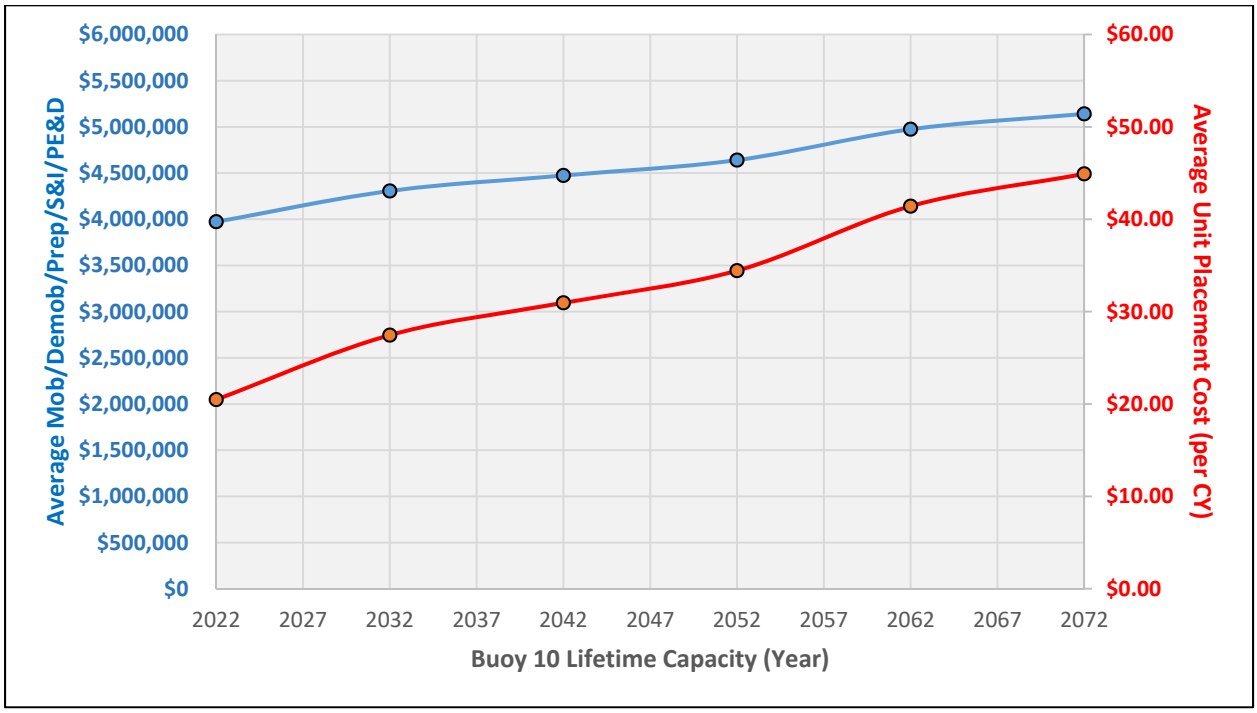
As mentioned in the preliminary Project Cost Methodology section, a major study assumption is based on projected lifetime capacity of the Buoy 10 disposal site as it pertains to the application of the Federal Standard. Current projections (most likely scenario) estimate that Buoy 10 will reach lifetime volume capacity in 2030, or in Project Year 8.

To evaluate the risk in this assumption, unit placement and mobilization costs were calculated from the minimum scenario (Buoy 10 reaches capacity before 2022 and all 50 years of project life cost use Artificial Island Federal Standard) to the maximum scenario (Buoy 10 never reaches capacity and all 50 years of project life use Buoy 10 Federal Standard). Cost estimates are shown in Table 23:

Table 23: Federal Standard Sensitivity Analysis Inputs

Year Buoy 10 Reaches Capacity	Gandys Beach		Fortescue		Villas (South)	
	Mob/Demob	Unit Cost	Mob/Demob	Unit Cost	Mob/Demob	Unit Cost
2072	$5,048,903	$38.48	$5,246,230	$45.51	$5,127,601	$50.72
2062	$4,882,004	$34.99	$5,079,331	$42.02	$4,960,702	$47.23
2052	$4,548,206	$28.01	$4,745,533	$35.04	$4,626,904	$40.26
2042	$4,381,307	$24.52	$4,578,634	$31.55	$4,460,005	$36.77
2032	$4,214,408	$21.03	$4,411,735	$28.06	$4,293,106	$33.28
2022	$3,880,610	$14.05	$4,077,937	$21.08	$3,959,309	$26.30

Figure 22: Federal Standard Sensitivity Analysis Inputs



Unit placement costs are more sensitive to the Federal Standard assumption than mobilization costs. While average mobilization costs only increase by 29.41% from the minimum scenario to the maximum scenario, average unit costs increase by 119.29% over the same time span.

To analyze the sensitivity of the selected plan's Average Annual Net Benefits and Benefit-Cost Ratio to the current Federal Standard assumption, results for each site are calculated for each of the six scenarios.

Table 24: Federal Standard Sensitivity Analysis Results

	Site	Mob/Demob	Unit Placement	Additional IC Cost*	Total Project Cost	AAC	AAB	AANB	BCR
Buoy 10 0 Years	Gandys Beach	$15,211,478	$4,888,227	$2,282,714	$22,382,419	$849,370	$2,323,296	$1,473,926	2.74
	Fortescue	$15,984,974	$11,295,484	$2,642,536	$29,922,994	$1,135,520	$2,736,996	$1,601,476	2.41
	Villas (South)	$15,519,990	$16,989,779	$9,308,356	$41,818,125	$1,586,918	$2,058,775	$471,857	1.30
	Total	**$46,716,442**	**$33,173,490**	**$14,233,606**	**$94,123,538**	**$3,571,808**	**$7,119,067**	**$3,547,259**	**1.99**

*Includes additional costs for groin / outfall construction as included in the selected plan

	Site	Mob/Demob	Unit Placement	Additional IC Cost*	Total Project Cost	AAC	AAB	AANB	BCR
Buoy 10 10 Years**	Gandys Beach	$16,519,922	$7,325,643	$2,282,714	$26,128,279	$991,518	$2,323,296	$1,331,778	2.34
	Fortescue	$17,293,418	$15,035,640	$2,642,536	$34,971,594	$1,327,105	$2,736,996	$1,409,891	2.06
	Villas (South)	$16,828,432	$21,498,854	$9,308,356	$47,635,642	$1,807,681	$2,058,775	$251,094	1.14
	Total	**$50,641,772**	**$43,860,136**	**$14,233,606**	**$108,735,514**	**$4,126,305**	**$7,119,067**	**$2,992,763**	**1.73**

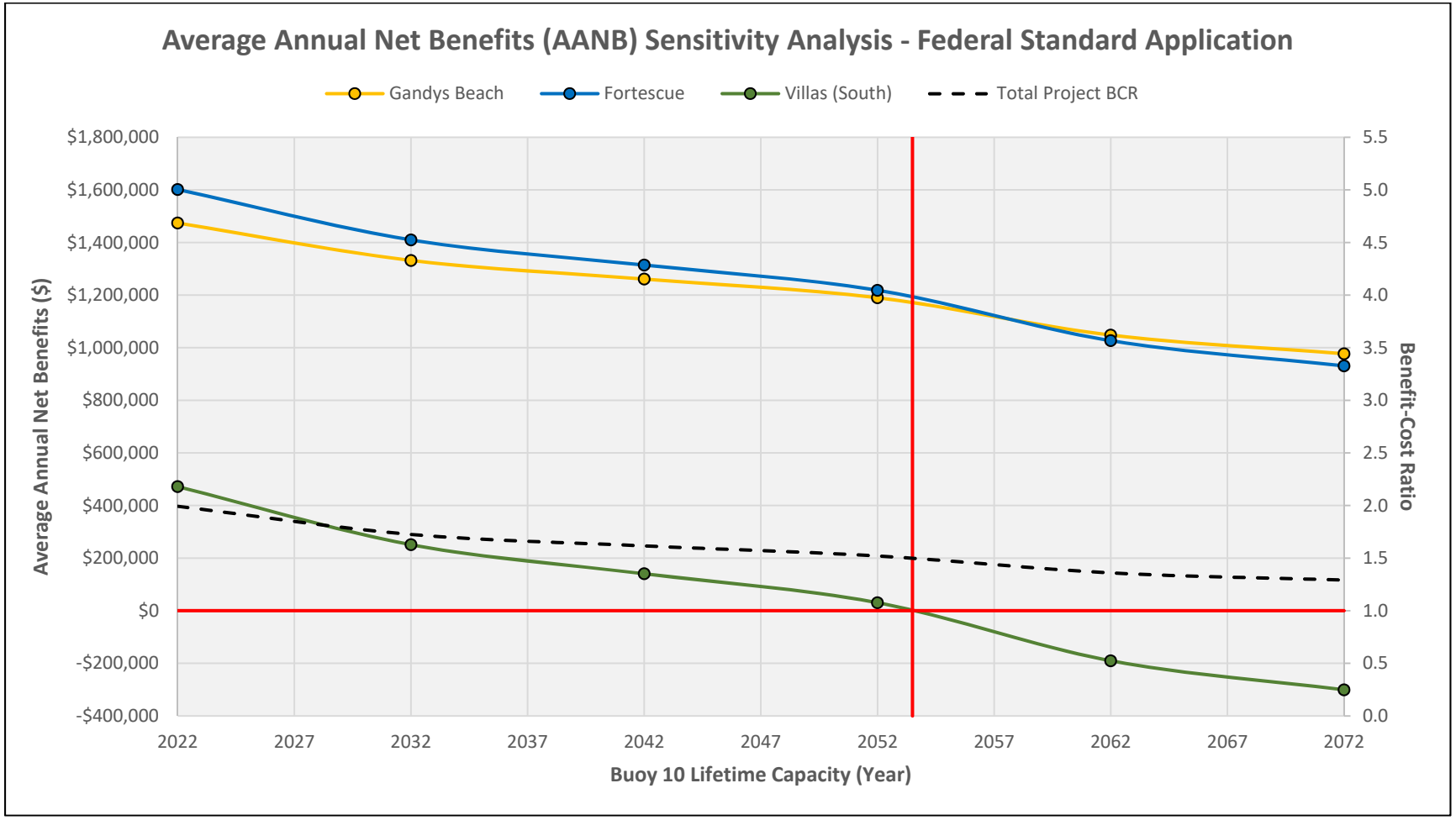
	Site	Mob/Demob	Unit Placement	Additional IC Cost*	Total Project Cost	AAC	AAB	AANB	BCR
Buoy 10 20 Years	Gandys Beach	$17,174,144	$8,541,358	$2,282,714	$27,998,216	$1,062,479	$2,323,296	$1,260,817	2.19
	Fortescue	$17,947,639	$16,905,718	$2,642,536	$37,495,893	$1,422,897	$2,736,996	$1,314,099	1.92
	Villas (South)	$17,482,655	$23,753,391	$9,308,356	$50,544,402	$1,918,063	$2,058,775	$140,712	1.07
	Total	**$52,604,438**	**$49,200,467**	**$14,233,606**	**$116,038,511**	**$4,403,439**	**$7,119,067**	**$2,715,628**	**1.62**

	Site	Mob/Demob	Unit Placement	Additional IC Cost*	Total Project Cost	AAC	AAB	AANB	BCR
Buoy 10 30 Years	Gandys Beach	$17,828,366	$9,757,073	$2,282,714	$29,868,153	$1,133,439	$2,323,296	$1,189,857	2.05
	Fortescue	$18,601,861	$18,775,796	$2,642,536	$40,020,193	$1,518,690	$2,736,996	$1,218,307	1.80
	Villas (South)	$18,136,878	$26,007,928	$9,308,356	$53,453,162	$2,028,445	$2,058,775	$30,330	1.01
	Total	**$54,567,105**	**$54,540,797**	**$14,233,606**	**$123,341,508**	**$4,680,574**	**$7,119,067**	**$2,438,493**	**1.52**

	Site	Mob/Demob	Unit Placement	Additional IC Cost*	Total Project Cost	AAC	AAB	AANB	BCR
Buoy 10 40 Years	Gandys Beach	$19,136,810	$12,188,504	$2,282,714	$33,608,028	$1,275,360	$2,323,296	$1,047,936	1.82
	Fortescue	$19,910,350	$22,515,951	$2,642,536	$45,068,838	$1,710,276	$2,736,996	$1,026,720	1.60
	Villas (South)	$19,445,324	$30,510,542	$9,308,356	$59,264,222	$2,248,964	$2,058,775	-$190,189	0.92
	Total	**$58,492,484**	**$65,214,998**	**$14,233,606**	**$137,941,088**	**$5,234,600**	**$7,119,067**	**$1,884,467**	**1.36**

	Site	Mob/Demob	Unit Placement	Additional IC Cost*	Total Project Cost	AAC	AAB	AANB	BCR
Buoy 10 50 Years	Gandys Beach	$19,791,032	$13,404,219	$2,282,714	$35,477,965	$1,346,321	$2,323,296	$976,975	1.73
	Fortescue	$20,564,527	$24,386,029	$2,642,536	$47,593,093	$1,806,067	$2,736,996	$930,930	1.52
	Villas (South)	$20,099,547	$32,765,080	$9,308,356	$62,172,983	$2,359,346	$2,058,775	-$300,571	0.87
	Total	**$60,455,106**	**$70,555,328**	**$14,233,606**	**$145,244,040**	**$5,511,733**	**$7,119,067**	**$1,607,334**	**1.29**

Figure 23: Federal Standard Sensitivity Analysis Results



As the results in Table 24 and Figure 23 show, the Total Project Average Annual BCR and Net Benefits remain positive even if the study never applies the Artificial Island Federal Standard. However, while Gandys Beach and Fortescue remain justified in all scenarios, Villas (South) is only justified if Buoy 10 reaches capacity at 2054 (Project Year 32) or earlier. As current projections depict Buoy 10 to reach capacity in Year 8, forecasts would need to be underestimating future capacity conditions by 300% in order to jeopardize project justification at Villas (South).

UPDATED BEACH-FX ANALYSIS

Following the identification of the three incrementally justified potential project sites, certain study inputs were updated before finalizing feasibility results. Primarily, this included updating the Federal Discount Rate, creating certified cost estimates, altering the periodic nourishment increment, and adding the Land Loss benefit category. The impact of these updates on the final Average Annual Net Benefits and Benefit-Cost Ratio results are shown in the following sections. Costs provided here supersede those shown in previous sections and are further updated in the section titled *FY2020 Price Level and Discount Rate Adjustment*.

As results from the preliminary Beach-fx investigation indicated that Villas (South) had the lowest Benefit-Cost Ratio of the three incrementally justified sites, additional sensitivity work was completed to confirm that incrementally adding Villas (South) to the Recommended Plan increased total Average Annual Net Benefits.

The outcome of this sensitivity analysis is shown in the Average Annual Net Benefits and Benefit-Cost Ratio section with results shown for both a two-site alternative (Gandys Beach and Fortescue only) as well as the three-site alternative (Gandys Beach, Fortescue, and Villas South).

Future Without Project Condition (FWOP)

The only change between the preliminary Beach-fx results and the Beach-fx results presented below is an update from the FY2017 Price Level and Federal Discount rate of 2.875% to the then current FY2018 Price Level and Federal Discount Rate of 2.75%. This change resulted in a small increase in Average Annual Damages (AAD) across all three sites.

Future Without Project Condition Damages

Table 25: Future Without Project Condition Damages by Site

Site	Structure	Content	Total (PV)	AAD	% Total
Fortescue	$82,248,991	$40,546,907	$122,795,898	$4,548,473	49.3%
Gandys Beach	$47,665,110	$20,841,909	$68,507,019	$2,537,563	27.5%
Villas (South)	$41,162,033	$16,556,909	$57,718,942	$2,137,963	23.2%
TOTAL	**$171,076,134**	**$77,945,725**	**$249,021,860**	**$9,223,999**	**100.0%**
TOTAL (ROUND)	**$171,076,000**	**$77,946,000**	**$249,022,000**	**$9,224,000**	**-**

As shown in the Preliminary Beach-fx results section, Fortescue accounts for a great deal of Without Project Condition Damages, though approximately 35% of these damages are from inundation and not erosion or wave attack. The majority of damages from both Villas (South) and Gandys Beach are erosion related.

Future With Project Condition (FWP)

The Recommended Plan also shifted from an 8-year periodic nourishment cycle to a 6-year periodic nourishment cycle. This change was implemented to reduce the risk of coastal storm damage during the break between nourishment increments. Periodic nourishments are also now set definitively with each alternative having exactly eight nourishments with no possibility for skipping nourishment cycles. This change was implemented to mitigate risk of underrepresenting project costs.

The number of iterations run for the With Project Condition damages was raised from 100 to 300 to increase model accuracy and provide a more robust distribution of future conditions scenarios.

Table 26: Future With Project Condition Alternatives per Site

Site	Dune Height	Dune Width	Berm Width	RPR*
Gandys Beach	6.5 ft	0 ft	75 ft	-4.4 ft/yr
Fortescue	6.5 ft	0 ft	75 ft	-2.8 ft/yr
Villas (South)	12.0 ft	25 ft	50 ft	-1.2 ft/yr

* Reach Planform Rate

Project Cost Methodology

Cost estimation methodology was significantly overhauled following the identification of the three potential project sites to better comply with USACE regulations. During preliminary screening, Beach-fx was used to calculate approximate initial construction and periodic nourishment costs using a limited range of cost inputs. While this method is satisfactory for a preliminary comparison between potential sites, final cost estimates were performed by PDT engineers using Micro-Computer Aided Cost Estimating System (MCACES) Second Generation (MII) to calculate initial and periodic costs with a significantly higher degree of accuracy. The results of this cost estimation are shown in this section with further details provided in the Cost Engineering Appendix. MCACES involves risk analysis via Oracle Crystal Ball and is certified through Agency Technical Review (ATR) and the USACE Cost Engineering Directory of Expertise (Cost DX) at Walla Walla District.

As mentioned during the preliminary cost methodology section, the Federal Standard adjustment plays a key role in applied initial and periodic nourishment costs. The underlying assumptions of the Federal Standard remain constant throughout Preliminary and Final study results analysis, though MCACES allows for a more accurate and detailed application of those assumptions. Specifically, costs are now developed for two distinct hypothetical scenarios: (1) Gandys Beach and Fortescue alone maximize AANB and constitute the NED Plan or (2) Gandys Beach, Fortescue, and Villas (South) maximize AANB and constitute the NED Plan.

Cost estimates assume that Buoy 10 disposal site reaches capacity in FY2030 and surplus material after this year is transported to Artificial Island disposal site. Periodic Nourishment relies on a six-year renourishment cycle and Villas (South) has a delayed initial construction of FY2028 to limit any from narrow construction windows.

A detailed cost breakdown of each cost component is shown in Figures 24 through 34 and summary figures for both scenarios presented in Figures 35 and 36.

Figure 24: Buoy 10 Federal Standard

DREDGED MATERIAL UTILIZATION - Maintenance
ROUGH ORDER ESTIMATE for Disposal at Buoy 10

1 Medium Hopper Dredge
5.63 Months of construction duration

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
02	**RELOCATIONS**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
09	**CHANNELS AND CANALS (Except Navigation)**	**1**	**JOB**	**LS**	**$16,255,212.55**	**$4,876,563.77**	**$21,131,776.32**
09 01	CHANNELS	1	JOB	LS	$16,255,212.55	$4,876,563.77	$21,131,776.32
09 01 01	Mobilization, Demobilization and Preparatory Work	1	JOB	LS	$1,942,512.55	$582,753.77	$2,525,266.32
09 01 17	Hopper Dredging	930,000	CY	$15.39	$14,312,700.00	$4,293,810.00	$18,606,510.00
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$620,920.00**	**$186,276.00**	**$807,196.00**
30 01	PE&D	1	JOB	LS	$620,920.00	$186,276.00	$807,196.00
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$1,060,800.00**	**$318,240.00**	**$1,379,040.00**
31 01	S&I	1	JOB	LS	$1,060,800.00	$318,240.00	$1,379,040.00
	TOTAL ESTIMATED AMOUNT =				$17,936,932.55		
	TOTAL ESTIMATED CONTINGENCY =					$5,381,079.77	
	PROJECT TOTAL ESTIMATED AMOUNT =						$23,318,012.32

Figure 25: Artificial Island Federal Standard

DREDGED MATERIAL UTILIZATION - Maintenance
ROUGH ORDER ESTIMATE for Disposal at Artificial Island CDF

1 Large Hopper Dredge
5.55 Months of construction duration

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
02	**RELOCATIONS**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
09	**CHANNELS AND CANALS (Except Navigation)**	**1**	**JOB**	**LS**	**$27,477,192.91**	**$8,243,157.87**	**$35,720,350.78**
09 01	CHANNELS	1	JOB	LS	$27,477,192.91	$8,243,157.87	$35,720,350.78
09 01 01	Mobilization, Demobilization and Preparatory Work	1	JOB	LS	$3,018,192.91	$905,457.87	$3,923,650.78
09 01 17	Hopper Dredging	930,000	CY	$26.30	$24,459,000.00	$7,337,700.00	$31,796,700.00
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$620,920.00**	**$186,276.00**	**$807,196.00**
30 01	PE&D	1	JOB	LS	$620,920.00	$186,276.00	$807,196.00
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$1,047,800.00**	**$314,340.00**	**$1,362,140.00**
31 01	S&I	1	JOB	LS	$1,047,800.00	$314,340.00	$1,362,140.00
	TOTAL ESTIMATED AMOUNT =				$29,145,912.91		
	TOTAL ESTIMATED CONTINGENCY =					$8,743,773.87	
	PROJECT TOTAL ESTIMATED AMOUNT =						$37,889,686.78

Figure 24 represents the cost to dredge an estimated 930,000 CY of dredge material as part of the Delaware River Main Channel Deepening Project and dispose of all 930,000 CY of material at Buoy 10 using a medium dredge. Figure 25 represents the same maintenance effort, though all 930,000 CY of material are disposed at Artificial Island using a large dredge.

Figure 26: Groin Construction at Gandys Beach (FY2021)

DREDGED MATERIAL UTILIZATION - Initial Construction
ROUGH ORDER ESTIMATE FOR GANDY'S BEACH
GROIN

8.78 Months of construction duration

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0.00	$0.00	$0.00
02	RELOCATIONS	1	JOB	LS	$0.00	$0.00	$0.00
09	CHANNELS AND CANALS (Except Navigation Ports ar	1	JOB	LS	$0.00	$0.00	$0.00
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$3,061,565.11	$918,469.53	$3,980,034.65
17	BEACH REPLENISHMENT	1	JOB	LS	$0.00	$0.00	$0.00
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$453,500.00	$136,050.00	$589,550.00
31	CONSTRUCTION MANAGEMENT (S&I)	1	JOB	LS	$1,573,500.00	$472,050.00	$2,045,550.00
	TOTAL ESTIMATED AMOUNT =				$5,088,565.11		
	TOTAL ESTIMATED CONTINGENCY =					$1,526,569.53	
	PROJECT TOTAL ESTIMATED AMOUNT =						$6,615,134.65

Figure 27: Groin Construction at Fortescue (FY2021)

DREDGED MATERIAL UTILIZATION - Initial Construction
ROUGH ORDER ESTIMATE FOR FORTESCUE BEACH
GROIN

4.18 Months of construction duration

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0.00	$0.00	$0.00
02	RELOCATIONS	1	JOB	LS	$0.00	$0.00	$0.00
09	CHANNELS AND CANALS (Except Navigation Ports ar	1	JOB	LS	$0.00	$0.00	$0.00
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$2,565,741.96	$769,722.59	$3,335,464.54
17	BEACH REPLENISHMENT	1	JOB	LS	$0.00	$0.00	$0.00
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$453,500.00	$136,050.00	$589,550.00
31	CONSTRUCTION MANAGEMENT (S&I)	1	JOB	LS	$824,200.00	$247,260.00	$1,071,460.00
	TOTAL ESTIMATED AMOUNT =				$3,843,441.96		
	TOTAL ESTIMATED CONTINGENCY =					$1,153,032.59	
	PROJECT TOTAL ESTIMATED AMOUNT =						$4,996,474.54

Figures 26 and 27 show the estimated terminal groin construction costs for both Gandys Beach and Fortescue. The terminal groins are necessary components of the proposed alternatives and are designed to limit lateral beach erosion.

Figure 28: Initial Construction of Gandys Beach and Fortescue (FY2022)

DREDGED MATERIAL UTILIZATION - Initial Construction
ROUGH ORDER ESTIMATE FOR Gandy's Beach, Fortescue Point
BEACHFILL MATERIAL FROM Delaware River Reach E

1 Dredge(s)
7.21 Months of construction duration
5.71 Month of Beach Nourishment
1.50 Disposal at Buoy 10

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0.00	$0.00	$0.00
02	RELOCATIONS	1	JOB	LS	$0.00	$0.00	$0.00
09	CHANNELS AND CANALS (Except Navigation Ports ar	1	JOB	LS	$3,823,852.50	$1,147,155.75	$4,971,008.25
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$0.00	$0.00	$0.00
17	BEACH REPLENISHMENT	1	JOB	LS	$32,127,911.66	$9,638,373.50	$41,766,285.16
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,081,020.00	$324,306.00	$1,405,326.00
31	CONSTRUCTION MANAGEMENT (S&I)	1	JOB	LS	$1,607,100.00	$482,130.00	$2,089,230.00
	TOTAL ESTIMATED AMOUNT =				$38,639,884.16		
	TOTAL ESTIMATED CONTINGENCY =					$11,591,965.25	
	PROJECT TOTAL ESTIMATED AMOUNT =						$50,231,849.41

Figure 29: Initial Construction of Villas South & Nourishment of Gandys Beach / Fortescue (FY2028)

DREDGED MATERIAL UTILIZATION - Initial Construction
ROUGH ORDER ESTIMATE FOR Villas Beach
BEACHFILL MATERIAL FROM Delaware River Reach E
Periodic Nourishment for Gandys Beach and Fortescue Beach

1 Dredge(s)
8.98 Months of construction duration
7.91 Month of Beach Nourishment
1.07 Disposal at Buoy 10
12 Outfalls, Months of construction duration

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0.00	$0.00	$0.00
02	RELOCATIONS	1	JOB	LS	$0.00	$0.00	$0.00
09	CHANNELS AND CANALS (Except Navigation Ports ar	1	JOB	LS	$2,716,335.00	$814,900.50	$3,531,235.50
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$0.00	$0.00	$0.00
17	BEACH REPLENISHMENT	1	JOB	LS	$48,007,909.28	$14,402,372.78	$62,410,282.06
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,625,220.00	$487,566.00	$2,112,786.00
31	CONSTRUCTION MANAGEMENT (S&I)	1	JOB	LS	$2,849,600.00	$854,880.00	$3,704,480.00
	TOTAL ESTIMATED AMOUNT =				$55,199,064.28		
	TOTAL ESTIMATED CONTINGENCY =					$16,559,719.28	
	PROJECT TOTAL ESTIMATED AMOUNT =						$71,758,783.56

Figure 28 shows the Initial Construction for Gandys Beach and Fortescue in FY2022. As construction of the design templates at Gandys Beach and Fortescue do not require all 930,000 CY of dredged material, the remaining material is shipped to and disposed at Buoy 10. This additional cost is shown in line 09.

Figure 29 shows Initial Construction of Villas (South) in FY2028 with periodic nourishment of Gandys Beach and Fortescue under the same contract. Excess dredged material is again disposed at Buoy 10.

Figure 30: Periodic Nourishment of Gandys Beach and Fortescue (FY2028)

DREDGED MATERIAL UTILIZATION - Periodic Nourishment
ROUGH ORDER ESTIMATE FOR Gandy's Beach, Fortescue Point
BEACHFILL MATERIAL FROM Delaware River Reach E

1 Dredge(s)
6.94 Months of Construction duration
2.20 Month of Beach Nourishment
4.74 Months of Disposal @ Buoy 10

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0.00	$0.00	$0.00
02	RELOCATIONS	1	JOB	LS	$0.00	$0.00	$0.00
09	CHANNELS AND CANALS (Except Navigation Port	1	JOB	LS	$12,059,842.50	$3,617,952.75	$15,677,795.25
17	BEACH REPLENISHMENT	1	JOB	LS	$12,736,025.94	$3,820,807.78	$16,556,833.72
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,081,020.00	$324,306.00	$1,405,326.00
31	CONSTRUCTION MANAGEMENT (S&I)	1	JOB	LS	$1,563,700.00	$469,110.00	$2,032,810.00
	TOTAL ESTIMATED AMOUNT =				$27,440,588.44		
	TOTAL ESTIMATED CONTINGENCY =					$8,232,176.53	
	PROJECT TOTAL ESTIMATED AMOUNT =						$35,672,764.97

Figure 30 shows the periodic nourishment cost for Gandys Beach and Fortescue in the scenario that Villas (South) is not justified and the NED plan consists of only these two sites. As Buoy 10 is not estimated to reach capacity until 2030, the first periodic nourishment iteration for Gandys Beach and Fortescue would include disposing the excess dredge material at Buoy 10 using a medium dredge.

For this same scenario, all subsequent nourishments (FY2034 to FY2072) would require disposal of excess material at Artificial Island. The most cost efficient method to both nourish Gandys Beach and Fortescue, as well as dispose of excess material at Artificial Island, is to divide the operation into two separate independent contracts. A medium dredge would only dredge enough material to fulfill the nourishment requirements for Gandys Beach and Fortescue while a separate large dredge would dredge the remaining material necessary for maintaining the Delaware River main channel depth and then transfer that material to Artificial Island.

By separating the operation into two contracts, the project mobilization and demobilization costs slightly increase, but overall dredging time and material disposal unit costs are significantly reduced due the greater efficiency of a large dredge disposing material at Artificial Island in comparison to a medium dredge moving the same volume of material.

Separating the contracts also impacts the method in which the Federal Standard is applied. For example, in Figure 30, the contract to nourish Gandys Beach and Fortescue also includes the cost to dispose of all excess material at Buoy 10. In the contract shown in Figure 24, the Without Project Condition cost to dredge all 930,000 CY from the main channel and dispose of all 930,000 CY at Buoy 10 is unnecessary and no longer incurred. Therefore, the cost to nourish the beach and receive CSRM benefits is only the cost above what would have been spent anyway to maintain the channel. In other words, the true cost of nourishing the beach is only the additional cost in Figure 30 above the cost in Figure 24.

When Buoy 10 reaches capacity and contracts are divided, Federal Standard adjustment is applied slightly differently. Figure 31 shows the cost to nourish Gandys Beach and Fortescue and Figure 32 shows the cost to dredge and ship the remaining material to Artificial Island with a large dredge.

Figure 31: Periodic Nourishment of Gandys Beach and Fortescue (FY2034 to FY2072)

DREDGED MATERIAL UTILIZATION - Periodic Nourishment
ROUGH ORDER ESTIMATE FOR Gandy's Beach & Fortescue Beach
BEACHFILL MATERIAL FROM Delaware River Reach E

1 Dredge(s)
2.20 Months of Construction duration
2.20 Month of Beach Nourishment
0.00 Months of Disposal @ Artificial Island

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
02	**RELOCATIONS**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
09	**CHANNELS AND CANALS (Except Navigation Pc**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
01	CHANNELS	1	JOB	LS	$0.00	$0.00	$0.00
01	Mobilization, Demobilization and Preparatory Work	1	JOB	LS	$0.00	$0.00	$0.00
17	Hopper Dredeging	0	CY	$0.00	$0.00	$0.00	$0.00
17	**BEACH REPLENISHMENT**	**1**	**JOB**	**LS**	**$12,736,025.94**	**$3,820,807.78**	**$16,556,833.72**
17 01 02 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$6,835,763.94	$2,050,729.18	$8,886,493.12
17 01 01	MobilizationDemobilization, Gandy's Beach	1	JOB	LS	$5,398,923.22	$1,619,676.97	$7,018,600.19
17 01 02	MobilizationDemobilization, Fortescue Point	1	JOB	LS	$1,436,840.72	$431,052.22	$1,867,892.94
17 01 06	Mobilization & Demobilization, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
07	Mobilization & Demobilization, Outfall Equipment	1	JOB	LS	$0.00	$0.00	$0.00
08	Mobilization & Demobilization, Artificial Island	1	JOB	LS	$0.00	$0.00	$0.00
17 02 02 02	Site Work - Dredging and Beachfill	116,700	CY		$5,900,262.00	$1,770,078.60	$7,670,340.60
17 02 02 02 01	Dredging and Beachfill, Gandy's Beach	49,200	CY	$48.61	$2,391,612.00	$717,483.60	$3,109,095.60
17 02 02 02 02	Dredging and Beachfill, Fortescue Point	67,500	CY	$51.98	$3,508,650.00	$1,052,595.00	$4,561,245.00
17 02 02 02 06	Dredging and Beachfill, Villas Beach	0	CY	$0.00	$0.00	$0.00	$0.00
17 99	Associated General Items	1	JOB	LS	$0.00	$0.00	$0.00
06	Villas, Outfalls	1	JOB	LS	$0.00	$0.00	$0.00
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$1,060,560.00**	**$318,168.00**	**$1,378,728.00**
30 01	PE&D, Gandy's Beach	1	JOB	LS	$530,280.00	$159,084.00	$689,364.00
30 02	PE&D, Fortescue Point	1	JOB	LS	$530,280.00	$159,084.00	$689,364.00
30 06	PE&D, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$647,700.00**	**$194,310.00**	**$842,010.00**
31 01	S&I, Gandy's Beach	1	JOB	LS	$338,400.00	$101,520.00	$439,920.00
31 02	S&I, Fortescue Point	1	JOB	LS	$309,300.00	$92,790.00	$402,090.00
31 06	S&I, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
31 07	S&I, Remainder of material	1	JOB	LS	$0.00	$0.00	$0.00
	TOTAL ESTIMATED AMOUNT =				$14,444,285.94		
	TOTAL ESTIMATED CONTINGENCY =					$4,333,285.78	
	PROJECT TOTAL ESTIMATED AMOUNT =						$18,777,571.72

Figure 32: Reduced Maintenance Cost for 2 Site Scenario (FY2034 to FY2072)

DREDGED MATERIAL UTILIZATION - Periodic Maintenance
ROUGH ORDER ESTIMATE FOR Gandy's Beach & Fortescue Beach
BEACHFILL MATERIAL FROM Delaware River Reach E

1 Dredge(s)
4.68 Months of Construction duration
0.00 Month of Beach Nourishment
4.68 Months of Disposal @ Artificial Island

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
02	**RELOCATIONS**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
09	**CHANNELS AND CANALS (Except Navigation Pc**	**1**	**JOB**	**LS**	**$23,649,271.36**	**$7,094,781.41**	**$30,744,052.77**
01	CHANNELS	1	JOB	LS	$23,649,271.36	$7,094,781.41	$30,744,052.77
01	Mobilization, Demobilization and Preparatory Work	1	JOB	LS	$3,011,101.36	$903,330.41	$3,914,431.77
17	Hopper Dredeging	784,125	CY	$26.32	$20,638,170.00	$6,191,451.00	$26,829,621.00
17	**BEACH REPLENISHMENT**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
17 01 02 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$0.00	$0.00	$0.00
17 01 01	MobilizationDemobilization, Gandy's Beach	1	JOB	LS	$0.00	$0.00	$0.00
17 01 02	MobilizationDemobilization, Fortescue Point	1	JOB	LS	$0.00	$0.00	$0.00
17 01 06	Mobilization & Demobilization, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
07	Mobilization & Demobilization, Outfall Equipment	1	JOB	LS	$0.00	$0.00	$0.00
08	Mobilization & Demobilization, Artificial Island	1	JOB	LS	$0.00	$0.00	$0.00
17 02 02 02	Site Work - Dredging and Beachfill	0	CY		$0.00	$0.00	$0.00
17 02 02 02 01	Dredging and Beachfill, Gandy's Beach	0	CY	$0.00	$0.00	$0.00	$0.00
17 02 02 02 02	Dredging and Beachfill, Fortescue Point	0	CY	$0.00	$0.00	$0.00	$0.00
17 02 02 02 06	Dredging and Beachfill, Villas Beach	0	CY	$0.00	$0.00	$0.00	$0.00
17 99	Associated General Items	1	JOB	LS	$0.00	$0.00	$0.00
06	Villas, Outfalls	1	JOB	LS	$0.00	$0.00	$0.00
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$620,920.00**	**$186,276.00**	**$807,196.00**
30 01	PE&D, Gandy's Beach	1	JOB	LS	$0.00	$0.00	$0.00
30 02	PE&D, Fortescue Point	1	JOB	LS	$0.00	$0.00	$0.00
30 06	PE&D, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
30 07	PE&D, Remainder of material	1	JOB	LS	$620,920.00	$186,276.00	$807,196.00
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$906,200.00**	**$271,860.00**	**$1,178,060.00**
31 01	S&I, Gandy's Beach	1	JOB	LS	$0.00	$0.00	$0.00
31 02	S&I, Fortescue Point	1	JOB	LS	$0.00	$0.00	$0.00
31 06	S&I, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
31 07	S&I, Remainder of material	1	JOB	LS	$906,200.00	$271,860.00	$1,178,060.00
	TOTAL ESTIMATED AMOUNT =				$25,176,391.36		
	TOTAL ESTIMATED CONTINGENCY =					$7,552,917.41	
	PROJECT TOTAL ESTIMATED AMOUNT =						$32,729,308.77

For all periodic nourishments that take place after FY2030, one contract will dictate dredging of the main channel and disposal at the project location and a separate contract will dictate dredging of the main channel and disposal at Artificial Island. For the two site scenario, the cost incurred by the project is the full cost shown in Figure 31. The cost shown in Figure 32 is the cost to dredge the remaining material from the main channel (930,000 CY minus the material moved to project sites) and transfer to Artificial Island.

With a smaller volume of dredge material to ship to Artificial Island, the maintenance cost in the With Project Condition (Figure 32) is less than the maintenance cost in the Without Project Condition (Figure 25). This decrease in cost is a benefit created by the project and the difference can be subtracted from the project periodic nourishment cost shown in Figure 31.

For the three site scenario, the only estimate not yet shown is the cost to nourish all three sites: Gandys Beach, Fortescue, and Villas (South). Figure 33 shows the periodic nourishment cost for three sites and Figure 34 shows the reduced maintenance cost in the three site scenario.

Figure 33: Periodic Nourishment of Gandys Beach, Fortescue, and Villas South (FY2034 to FY2072)

DREDGED MATERIAL UTILIZATION - Periodic Nourishment
ROUGH ORDER ESTIMATE FOR Gandy's Beach, Fortescue Point and Villas Beach (South)
BEACHFILL MATERIAL FROM Delaware River Reach E

1 Dredge(s)
3.96 Months of Construction duration
3.96 Month of Beach Nourishment
0.00 Months of Disposal @ Artificial Island

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
02	**RELOCATIONS**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
09	**CHANNELS AND CANALS (Except Navigation Pc**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
01	CHANNELS	1	JOB	LS	$0.00	$0.00	$0.00
01	Mobilization, Demobilization and Preparatory Work	1	JOB	LS	$0.00	$0.00	$0.00
17	Hopper Dredeging	0	CY	$0.00	$0.00	$0.00	$0.00
17	**BEACH REPLENISHMENT**	**1**	**JOB**	**LS**	**$18,143,767.36**	**$5,443,130.21**	**$23,586,897.57**
17 01 02 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$8,273,289.36	$2,481,986.81	$10,755,276.17
17 01 01	MobilizationDemobilization, Gandy's Beach	1	JOB	LS	$5,398,923.22	$1,619,676.97	$7,018,600.19
17 01 02	MobilizationDemobilization, Fortescue Point	1	JOB	LS	$1,436,840.72	$431,052.22	$1,867,892.94
17 01 06	Mobilization & Demobilization, Villas Beach	1	JOB	LS	$1,437,525.42	$431,257.63	$1,868,783.05
07	Mobilization & Demobilization, Outfall Equipment	1	JOB	LS	$0.00	$0.00	$0.00
08	Mobilization & Demobilization, Artificial Island	1	JOB	LS	$0.00	$0.00	$0.00
17 02 02 02	Site Work - Dredging and Beachfill	179,500	CY		$9,870,478.00	$2,961,143.40	$12,831,621.40
17 02 02 02 01	Dredging and Beachfill, Gandy's Beach	49,200	CY	$48.61	$2,391,612.00	$717,483.60	$3,109,095.60
17 02 02 02 02	Dredging and Beachfill, Fortescue Point	67,500	CY	$51.98	$3,508,650.00	$1,052,595.00	$4,561,245.00
17 02 06	Dredging and Beachfill, Villas Beach	62,800	CY	$63.22	$3,970,216.00	$1,191,064.80	$5,161,280.80
17 99	Associated General Items	1	JOB	LS	$0.00	$0.00	$0.00
06	Villas, Outfalls	1	JOB	LS	$0.00	$0.00	$0.00
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$1,436,840.00**	**$431,052.00**	**$1,867,892.00**
30 01	PE&D, Gandy's Beach	1	JOB	LS	$447,720.00	$134,316.00	$582,036.00
30 02	PE&D, Fortescue Point	1	JOB	LS	$447,720.00	$134,316.00	$582,036.00
30 06	PE&D, Villas Beach	1	JOB	LS	$541,400.00	$162,420.00	$703,820.00
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$1,077,700.00**	**$323,310.00**	**$1,401,010.00**
31 01	S&I, Gandy's Beach	1	JOB	LS	$338,400.00	$101,520.00	$439,920.00
31 02	S&I, Fortescue Point	1	JOB	LS	$362,800.00	$108,840.00	$471,640.00
31 06	S&I, Villas Beach	1	JOB	LS	$376,500.00	$112,950.00	$489,450.00
31 07	S&I, Remainder of material	1	JOB	LS	$0.00	$0.00	$0.00
	TOTAL ESTIMATED AMOUNT =				$20,658,307.36		
	TOTAL ESTIMATED CONTINGENCY =					$6,197,492.21	
	PROJECT TOTAL ESTIMATED AMOUNT =						$26,855,799.57

Figure 34: Reduced Maintenance Cost for 3 Site Scenario (FY2034 to FY2072)

DREDGED MATERIAL UTILIZATION - Periodic Maintenance
ROUGH ORDER ESTIMATE FOR Gandy's Beach, Fortescue Point and Villas Beach (South)
BEACHFILL MATERIAL FROM Delaware River Reach E

1 Dredge(s)
4.21 Months of Construction duration
0.00 Month of Beach Nourishment
4.21 Months of Disposal @ Artificial Island

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 30%	Total Estimated Amount
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
02	**RELOCATIONS**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
09	**CHANNELS AND CANALS (Except Navigation Pc**	**1**	**JOB**	**LS**	**$21,579,320.29**	**$6,473,796.09**	**$28,053,116.38**
01	CHANNELS	1	JOB	LS	$21,579,320.29	$6,473,796.09	$28,053,116.38
01	Mobilization, Demobilization and Preparatory Work	1	JOB	LS	$3,007,270.29	$902,181.09	$3,909,451.38
17	Hopper Dredeging	705,625	CY	$26.32	$18,572,050.00	$5,571,615.00	$24,143,665.00
17	**BEACH REPLENISHMENT**	**1**	**JOB**	**LS**	**$0.00**	**$0.00**	**$0.00**
17 01 02 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$0.00	$0.00	$0.00
17 01 01	MobilizationDemobilization, Gandy's Beach	1	JOB	LS	$0.00	$0.00	$0.00
17 01 02	MobilizationDemobilization, Fortescue Point	1	JOB	LS	$0.00	$0.00	$0.00
17 01 06	Mobilization & Demobilization, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
07	Mobilization & Demobilization, Outfall Equipment	1	JOB	LS	$0.00	$0.00	$0.00
08	Mobilization & Demobilization, Artificial Island	1	JOB	LS	$0.00	$0.00	$0.00
17 02 02 02	Site Work - Dredging and Beachfill	0	CY		$0.00	$0.00	$0.00
17 02 02 02 01	Dredging and Beachfill, Gandy's Beach	0	CY	$0.00	$0.00	$0.00	$0.00
17 02 02 02 02	Dredging and Beachfill, Fortescue Point	0	CY	$0.00	$0.00	$0.00	$0.00
17 02 06	Dredging and Beachfill, Villas Beach	0	CY	$0.00	$0.00	$0.00	$0.00
17 99	Associated General Items	1	JOB	LS	$0.00	$0.00	$0.00
06	Villas, Outfalls	1	JOB	LS	$0.00	$0.00	$0.00
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$620,920.00**	**$186,276.00**	**$807,196.00**
30 01	PE&D, Gandy's Beach	1	JOB	LS	$0.00	$0.00	$0.00
30 02	PE&D, Fortescue Point	1	JOB	LS	$0.00	$0.00	$0.00
30 06	PE&D, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
30 07	PE&D, Remainder of material	1	JOB	LS	$620,920.00	$186,276.00	$807,196.00
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$829,700.00**	**$248,910.00**	**$1,078,610.00**
31 01	S&I, Gandy's Beach	1	JOB	LS	$0.00	$0.00	$0.00
31 02	S&I, Fortescue Point	1	JOB	LS	$0.00	$0.00	$0.00
31 06	S&I, Villas Beach	1	JOB	LS	$0.00	$0.00	$0.00
31 07	S&I, Remainder of material	1	JOB	LS	$829,700.00	$248,910.00	$1,078,610.00
	TOTAL ESTIMATED AMOUNT =				$23,029,940.29		
	TOTAL ESTIMATED CONTINGENCY =					$6,908,982.09	
	PROJECT TOTAL ESTIMATED AMOUNT =						$29,938,922.38

Similar to the two site scenario explained above, the reduced maintenance cost benefit for the project is the decrease in cost from Figure 34 to Figure 25. This decrease in cost is applied to the incurred project cost in Figure 33.

Figures 35 and 36 show the total 50-year project cost breakdown for both scenarios.

Figure 35: Summary Cost for Two Site Scenario

PY	PV Factor	Year Date	Type	Project Cost	Fed. Std.	Fed. Std Cost	Adj. Cost	PV Cost
-1	1.00000	2021	Groin Construc.	$4,996,475		$0	$4,996,475	$4,996,475
-1	1.00000	2021	Groin Construc.	$6,615,135		$0	$6,615,135	$6,615,135
0	1.00000	2022	Init. Construc.	$50,231,849	Buoy 10	$23,318,012	$26,913,836	$26,913,836
0	1.00000	2022	IDC*	$2,988,521		$0	$2,988,521	$2,988,521
1	0.97205	2023						
2	0.94489	2024						
3	0.91848	2025						
4	0.89281	2026						
5	0.86786	2027						
6	0.84361	2028	Periodic Nourish.	$35,672,765	Buoy 10	$23,318,012	$12,354,753	$10,422,573
7	0.82003	2029						
8	0.79712	2030						
9	0.77484	2031						
10	0.75318	2032						
11	0.73214	2033						
12	0.71168	2034	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$9,691,019
13	0.69179	2035						
14	0.67245	2036						
15	0.65366	2037						
16	0.63539	2038						
17	0.61764	2039						
18	0.60038	2040	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$8,175,425
19	0.58360	2041						
20	0.56729	2042						
21	0.55143	2043						
22	0.53602	2044						
23	0.52104	2045						
24	0.50648	2046	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$6,896,858
25	0.49233	2047						
26	0.47857	2048						
27	0.46519	2049						
28	0.45219	2050						
29	0.43956	2051						
30	0.42727	2052	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$5,818,247
31	0.41533	2053						
32	0.40372	2054						
33	0.39244	2055						
34	0.38147	2056						
35	0.37081	2057						
36	0.36045	2058	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$4,908,322
37	0.35038	2059						
38	0.34059	2060						
39	0.33107	2061						
40	0.32181	2062						
41	0.31282	2063						
42	0.30408	2064	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$4,140,702
43	0.29558	2065						
44	0.28732	2066						
45	0.27929	2067						
46	0.27149	2068						
47	0.26390	2069						
48	0.25652	2070	Periodic Nourish.	$18,777,572	Artificial Island	$5,160,378	$13,617,194	$3,493,131
49	0.24935	2071						
50	0.24239	2072						
TOTAL ESTIMATED AMOUNT								**$95,060,244**
AVERAGE ANNUAL COST								**$3,607,354**
ROUNDED								**$3,607,000**

Figure 36: Summary Cost for Three Site Scenario

PY	PV Factor	Year Date	Type	Project Cost	Fed. Std.	Fed. Std Cost	Adj. Cost	PV Cost
-1	1.00000	2021	Groin Construc.	$4,996,475		$0	$4,996,475	$4,996,475
-1	1.00000	2021	Groin Construc.	$6,615,135		$0	$6,615,135	$6,615,135
0	1.00000	2022	Init. Construc.	$50,231,849	Buoy 10	$23,318,012	$26,913,836	$26,913,836
0	1.00000	2022	IDC*	$2,988,521		$0	$2,988,521	$2,988,521
1	0.97205	2023						
2	0.94489	2024						
3	0.91848	2025						
4	0.89281	2026						
5	0.86786	2027						
6	0.84361	2028	Periodic + Init.	$71,758,784	Buoy 10	$23,318,012	$48,440,771	$40,865,043
6	0.84361	2028	IDC*	$463,143		$0	$463,143	$390,711
7	0.82003	2029						
8	0.79712	2030						
9	0.77484	2031						
10	0.75318	2032						
11	0.73214	2033						
12	0.71168	2034	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$13,454,244
13	0.69179	2035						
14	0.67245	2036						
15	0.65366	2037						
16	0.63539	2038						
17	0.61764	2039						
18	0.60038	2040	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$11,350,114
19	0.58360	2041						
20	0.56729	2042						
21	0.55143	2043						
22	0.53602	2044						
23	0.52104	2045						
24	0.50648	2046	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$9,575,052
25	0.49233	2047						
26	0.47857	2048						
27	0.46519	2049						
28	0.45219	2050						
29	0.43956	2051						
30	0.42727	2052	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$8,077,594
31	0.41533	2053						
32	0.40372	2054						
33	0.39244	2055						
34	0.38147	2056						
35	0.37081	2057						
36	0.36045	2058	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$6,814,327
37	0.35038	2059						
38	0.34059	2060						
39	0.33107	2061						
40	0.32181	2062						
41	0.31282	2063						
42	0.30408	2064	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$5,748,623
43	0.29558	2065						
44	0.28732	2066						
45	0.27929	2067						
46	0.27149	2068						
47	0.26390	2069						
48	0.25652	2070	Periodic Nourish.	$26,855,800	Artificial Island	$7,950,764	$18,905,035	$4,849,587
49	0.24935	2071						
50	0.24239	2072						
TOTAL ESTIMATED AMOUNT								**$142,639,263**
AVERAGE ANNUAL COST								**$5,412,887**
ROUNDED								**$5,413,000**

Coastal Storm Risk Management (CSRM) Benefits

In addition to updating the results to an FY2018 Federal Discount Rate of 2.75%, the With Project Condition simulations also updated the periodic nourishment cycle from 8 years to 6 years and delayed construction of Villas (South) to Project Year 6 or FY2028.

Land Loss benefit calculations were also added for each of the three incrementally justified sites. Though not shown in Table 27 below, Land Loss benefits were not expected to be substantial for the previously screened sites of Pierces Point, Del Haven, Reeds Beach, or Villas North.

Table 27 shows the Average Annual Damages, Average Annual Damages Reduced, and Land Loss Reduced for each of the three incrementally justified sites with an Intermediate Relative Sea Level Change (RSLC) curve:

Table 27: Average Annual Benefits by Site

Site	Average Annual Damages	Average Annual Damages Reduced	Residual Damages	Average Annual Land Loss	Total Average Annual Benefits
Fortescue	$4,548,473	$2,787,121	38.7%	$32,216	$2,819,337
Gandys Beach	$2,537,563	$2,383,056	6.1%	$0	$2,383,056
Villas (South)	$2,137,963	$2,091,495	2.2%	$425,831	$2,517,326
TOTAL	**$9,223,999**	**$7,261,672**	**21.3%**	**$458,047**	**$7,719,719**
TOTAL (ROUNDED)					**$7,720,000**

Each of the three sites remain fairly similar in their contribution to Average Annual Damages reduced, though Fortescue has the highest remaining Residual Damages due to the presence of back bay inundation impacts. The contribution of Land Loss damages to overall Average Annual Benefits is described in the following section.

Land Loss Benefit Category

The methodology for the evaluation of land loss benefit category is based on guidance from IWR Report 91-2-6 *National Economic Development Procedures Manual: Coastal Storm Damage and Erosion* as well as ER 1165-2-130 *Water Resources Policies and Authorities: Federal Participation in Shore Protection*.

As per ER 1165-2-130, Land Loss prevention benefits are "benefits from prevention of public and/or private land loss due to shore erosion. Prevention of losses of developed private land should be categorized as storm damage reduction benefits. Prevention of losses of undeveloped private land (including privately-owned marshes or wetlands) is a benefit category in which there is no Federal interest (i.e., non-Federal interests are assigned all costs of preventing losses of undeveloped private land), even though the shore may be public. Prevention of loss of Federal and/or non-Federal public land will reflect the special use to which the land is dedicated and the value of the output produced by that use (e.g., lands dedicated to non-Federal park and conservation areas will normally be valued on the basis of loss of recreation output)."

IWR Report 91-R-6 further clarifies that "anticipated damages from land loss due to erosion may be computed for the private lands as the market value of the average annual area expected to be lost. This should be determined from an analysis of adjacent nearshore lands of similar character for the land use conditions expected in the absence of the project."

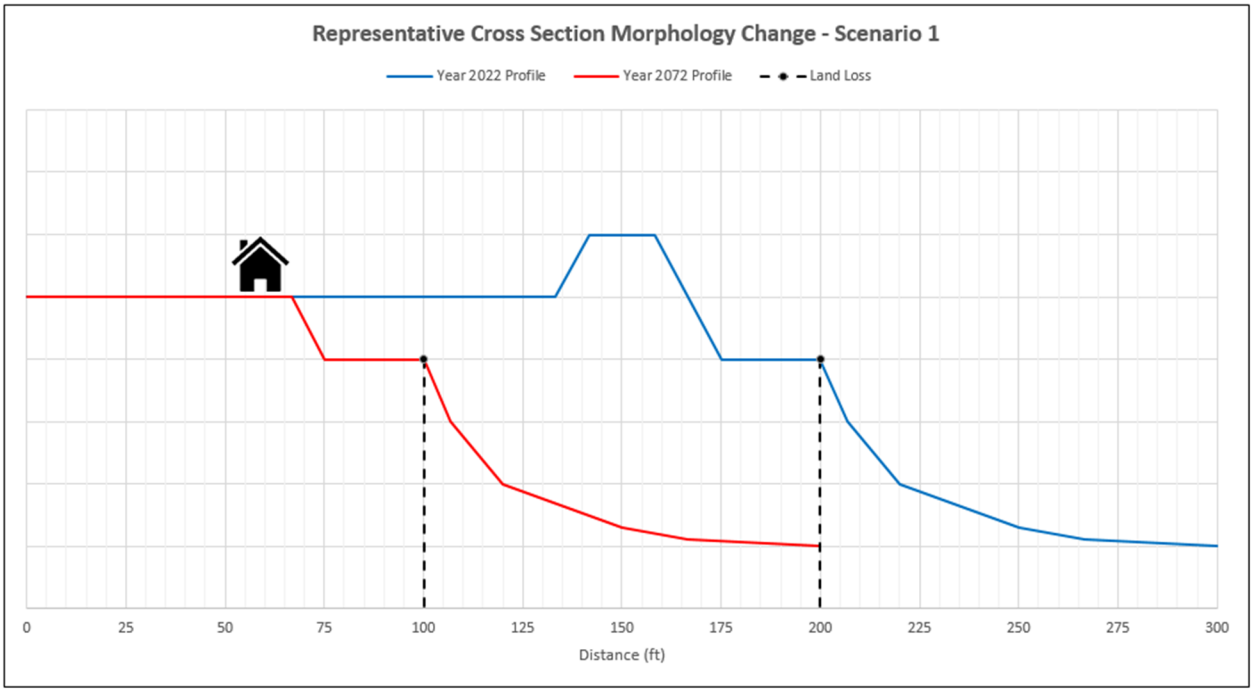
In addition, due to parameters within the Beach-fx model used to calculate Average Annual Damages from coastal storm impacts (inundation, wave attack, erosion), land loss is limited to the shoreward extent of the most seaward row of structures. As Damage Elements (structures) can only be temporarily condemned in the Beach-fx model (except through maximizing the number of rebuilds), land loss cannot be assumed to extend beyond the point where erosion would reduce the structural integrity of the damage element. To avoid any analysis contradiction where land loss extends beyond the structure, but the Damage Element is not removed from the active Beach-fx inventory, quantified land loss is halted at the seaward extent of the structure.

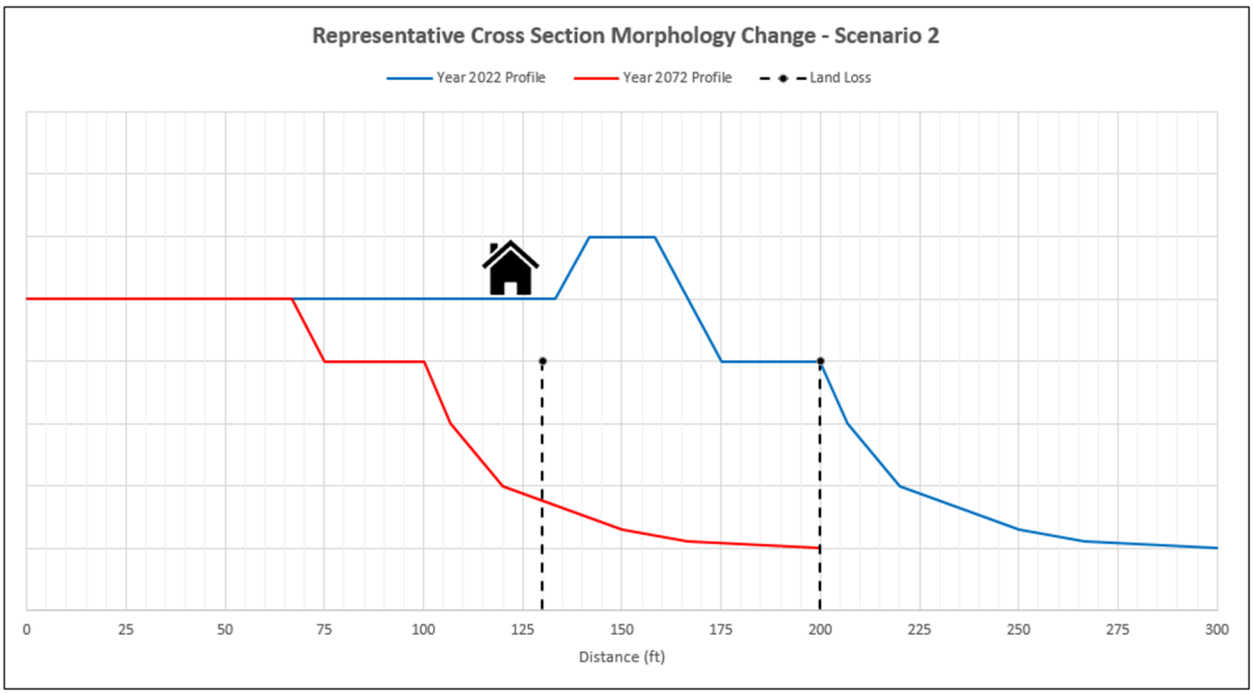
The area of land loss is calculated by determining the square footage difference in land from Year 2022 to Year 2072 with Intermediate Relative Sea Level Change (RSLC). Precisely, the difference in area from the seaward berm edge in Year 2022 to the seaward berm edge in Year 2072. Only the portion of land that intersects a developed, private lot (up until the seaward extent of the structure) is counted towards land loss prevention benefits. Additionally, if an existing developed private lot extends seaward of the Year 2022 berm edge then that loss in value is not counted. The average location of the seaward berm edge was calculated using Beach-fx profile morphology changes over 300 iterations for each site.

Figure 37 shows a representative Beach-fx profile cross section change over a 50 year period of analysis. In the first scenario, the Damage Element at that cross section of the beach is located landward of the Year 2072 erosion line. Therefore, any private land located between the Year 2022 and Year 2072 boundaries would count towards land loss. In the second scenario, the structure is located seaward of the Year 2072 erosion line. As such, land loss quantification ends at the most seaward edge of the structure.

Land loss prevention results will be counted as a coastal storm damage reduction benefits.

Figure 37: Beach-fx Profile Morphology Cross Section Change Scenarios





Structures in Fortescue and Gandys Beach are often built right up to, and in some cases seaward of, the existing berm limit. This results in significant erosion damages, but limits the quantifiable land loss calculations for this study. Villas (South) comprises the vast majority of land loss damages for the study totaling 93.4% of the land loss reduction benefit category.

Figure 38: Fortescue Land Loss – Aerial Imagery Example

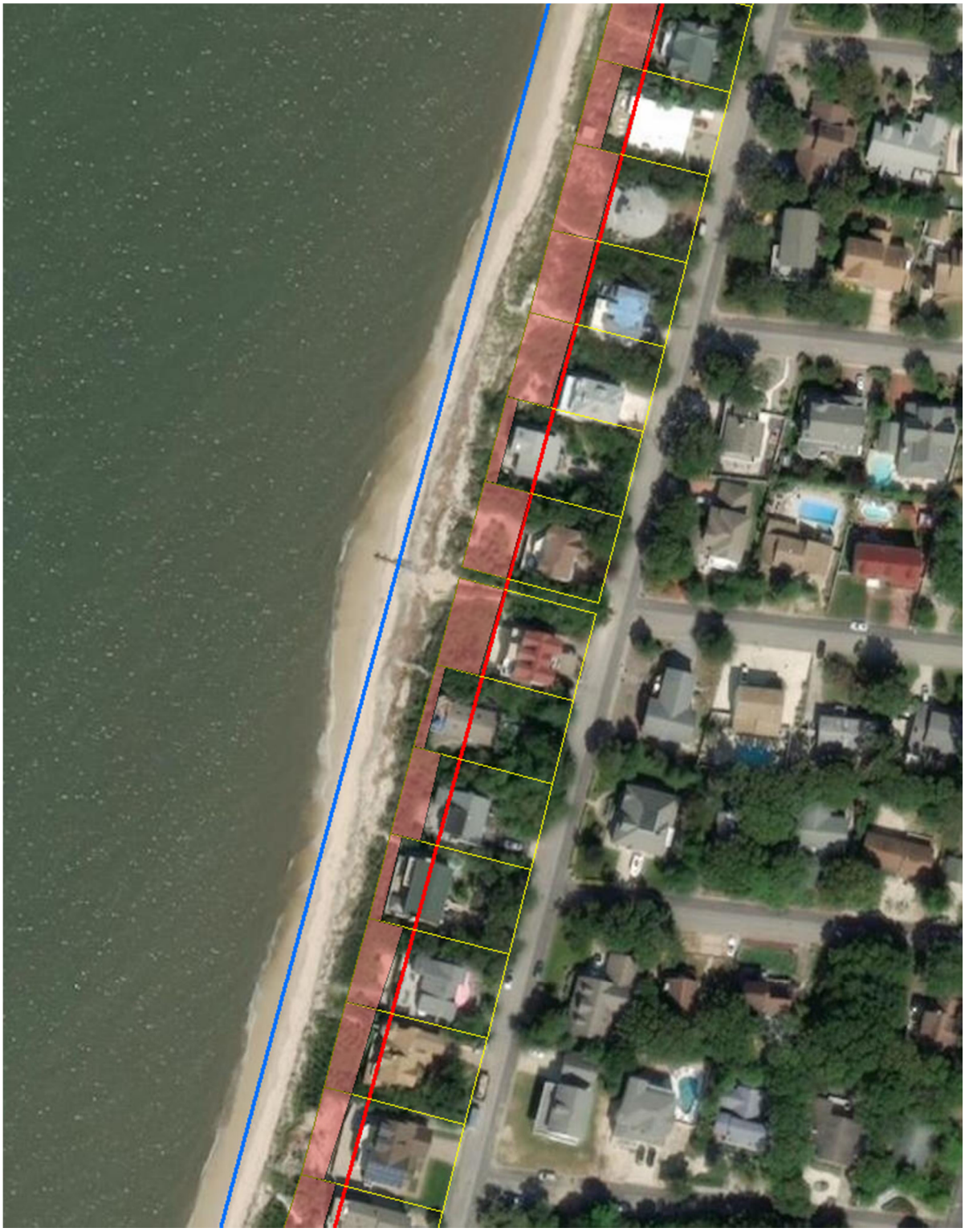
Figure 38 above shows the Beach-fx estimated erosion in Fortescue over the project period of analysis. The blue line represents the Base Year (FY2022) berm limit and the red line represents the Future Year (FY2072) berm limit with Intermediate RSLC. The yellow polygons represent privately owned and developed shoreline properties in Fortescue, NJ.

Using the methodology outlined in the previous section, all of the privately owned, developed shoreline that falls between the FY2022 and FY2072 berm limits while also falling seaward of the structure, is shaded in red. As the figure shows, while erosion is significant in Fortescue and greatly impacts the structure inventory, only a small percentage of land satisfies all the criteria for quantifiable land loss.

Gandys Beach has a similar inventory arrangement with structures on or over the existing berm limit.

Villas (South), however, has a different inventory setup. While erosion is also a major damage driver, many structures are built landward of the existing berm limit. This allows the addition of land loss reduction benefits without double counting structure-related erosion damages.

Figure 39: Villas (South) Land Loss – Aerial Imagery Example



The market value for affected land parcels in Fortescue, Gandys Beach, and Villas (South) is calculated by aggregating a large sample of developed, nearshore parcels and identifying their land appraisal value through recent property sales. Zillow.com provided data on estimated market value and recent property sales.

From the three study locations, there are a total of 196 nearshore properties. Only 97 nearshore properties were found to have developed, privately-owned lots between the FY2022 and FY2072 berm limits, but with structures landward of the existing berm limit. Therefore, the land loss benefits for the other 99 properties (including all properties in Gandys Beach) are already included in the erosion-related damage calculations and no additional land loss damages were added.

To estimate the market value of the 97 nearshore properties eligible for additional land loss benefit quantification, recent market value appraisals were identified for 23 properties in Fortescue and 40 properties in Villas (South). Gandys Beach comprised 41 of the original 196 nearshore properties and was not included in the sampling as no nearshore parcels were eligible.

In total, the market value sample consisted of 63 properties from a total 155 lots, or 40.6%.

Table 28 shows the total nearshore properties, the properties eligible for additional land loss damage evaluation, the total sample of recent market value appraisals, and the median value per square foot.

Table 28: Land Loss Sample – Summary Data

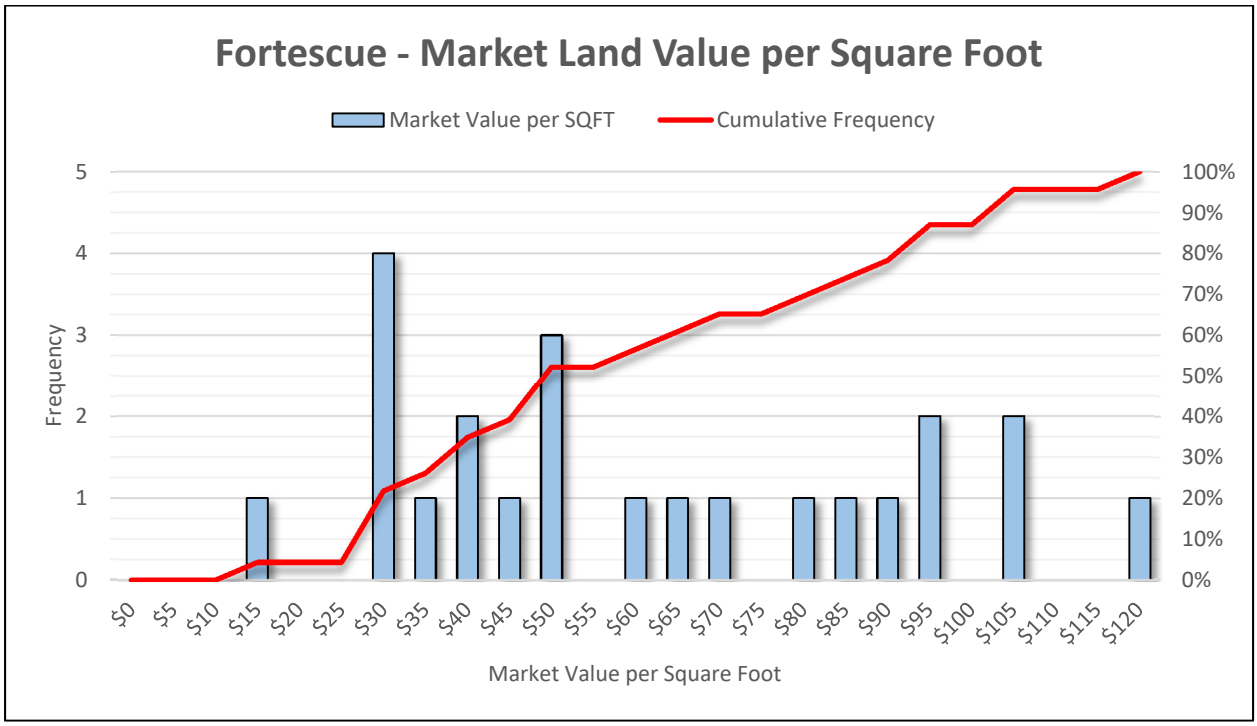
Site	Nearshore	Eligible	Sample	Median Value per SQFT
Fortescue	59	6	23	$48.49
Gandys Beach	41	0	0	N/A
Villas (South)	96	91	40	$70.08
TOTAL	**196**	**97**	**63**	**$56.06**

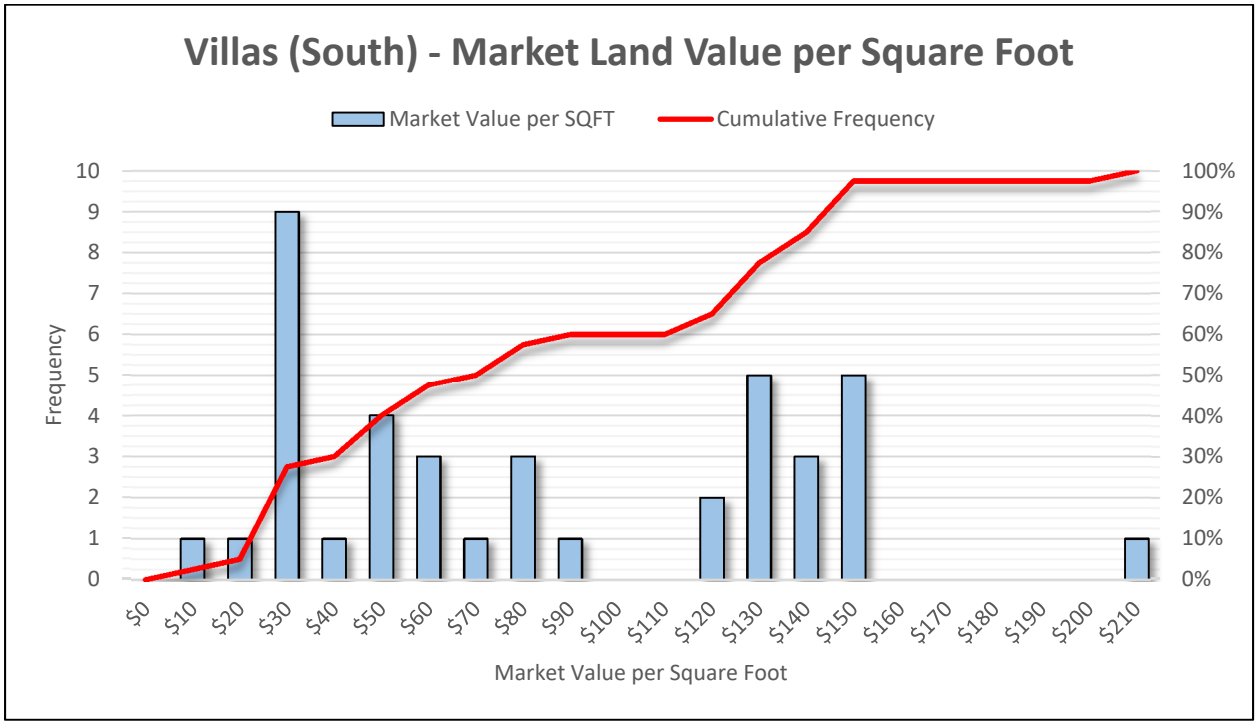
Figure 40 on the following page shows the Market Value per Square Foot distributions for Fortescue and Villas (South).

Fortescue has a fairly uniform distribution of market value per square foot with a small clustering in the $30 - $50 range. The property sample from Fortescue has a median value per square foot of $48.49.

Villas (South) has a more bimodal distribution with clusters around the $30 - $50 range and also the $120 - $150 range showing greater variability in the population. The median value per square foot for Villas (South) falls between these two modes at $70.08.

Figure 40: Market Value per Square Foot for Fortescue and Villas (South)





As discussed in Table 28, from the 196 eligible oceanfront parcels across the study area, 97 parcels were eligible for additional land loss damage calculations. From these 97 parcels, the total land loss is measured using the area of the parcels between the Year 2022 berm limit and the Year 2072 berm limit, excluding area landward of the structure or seaward of the Year 2022 berm limit.

The total land loss was calculated for all 97 parcels and then multiplied by the median market value per square foot for their respective locations. The total land loss value is spread equally over the entire period of analysis and discounted back to present value. Land loss is spread evenly as knowledge uncertainty and natural variability in the study area, even with the aid of an event-based Monte Carlo simulation model such as Beach-fx, makes assigning specific damages in specific years at specific locations difficult.

Table 29 shows summary data for land loss calculation in Fortescue and Villas (South) while Table 31 shows the present value and average annual breakdown for each site.

Table 29: Land Loss Benefits Summary Table

Site	Parcels	Land Loss (SQFT)	Median Value per SQFT	Total Land Loss	Present Value Land Loss	Average Annual Land Loss
Fortescue	6	33,217	$48.49	$1,610,824	$869,741	$32,216
Villas (South)	91	303,811	$70.08	$21,291,566	$11,496,232	$425,831
TOTAL	**97**	**337,028**	**-**	**$22,902,390**	**$12,365,973**	**$458,048**

Villas (South), as exemplified in Figure 39, represents the significant majority of additional land loss damage avoidance benefits. Villas (South) contains 93.8% of eligible parcels with 93.0% of land loss benefits.

In regards to overall contribution to Average Annual Benefits, supplemental land loss damages avoided in Fortescue contribute only an additional 1.1% of benefits. As most structures in Fortescue are located directly on or over the existing berm limit, the vast majority of damages are already captured through erosion-related impacts in Beach-fx and do not require additional benefit quantification.

For Villas (South), structures are often built landward of the existing berm limit and land loss benefits contribute 16.9% additional benefits. While still minor compared to overall erosion-related impacts, supplemental land loss benefits provide a better understanding of overall CSRM benefits at this location.

Figure 41 shows the full cost schedule breakdown with an applied FY2018 Federal Discount Rate of 2.75%.

Figure 41: Land Loss Summary Benefits – Present Value Breakdown

Villas (South)

FY	PY	PV Factor	LandLoss	Present Value
2022	0	1.00000	$0	$0
2023	1	0.97324	$425,831	$414,434
2024	2	0.94719	$425,831	$403,342
2025	3	0.92184	$425,831	$392,547
2026	4	0.89717	$425,831	$382,041
2027	5	0.87315	$425,831	$371,816
2028	6	0.84978	$425,831	$361,865
2029	7	0.82704	$425,831	$352,180
2030	8	0.80491	$425,831	$342,754
2031	9	0.78336	$425,831	$333,581
2032	10	0.76240	$425,831	$324,653
2033	11	0.74199	$425,831	$315,964
2034	12	0.72213	$425,831	$307,507
2035	13	0.70281	$425,831	$299,277
2036	14	0.68400	$425,831	$291,267
2037	15	0.66569	$425,831	$283,472
2038	16	0.64787	$425,831	$275,885
2039	17	0.63053	$425,831	$268,501
2040	18	0.61366	$425,831	$261,315
2041	19	0.59723	$425,831	$254,321
2042	20	0.58125	$425,831	$247,515
2043	21	0.56569	$425,831	$240,890
2044	22	0.55055	$425,831	$234,443
2045	23	0.53582	$425,831	$228,168
2046	24	0.52148	$425,831	$222,062
2047	25	0.50752	$425,831	$216,118
2048	26	0.49394	$425,831	$210,334
2049	27	0.48072	$425,831	$204,705
2050	28	0.46785	$425,831	$199,226
2051	29	0.45533	$425,831	$193,894
2052	30	0.44314	$425,831	$188,705
2053	31	0.43128	$425,831	$183,654
2054	32	0.41974	$425,831	$178,739
2055	33	0.40851	$425,831	$173,955
2056	34	0.39757	$425,831	$169,299
2057	35	0.38693	$425,831	$164,768
2058	36	0.37658	$425,831	$160,358
2059	37	0.36650	$425,831	$156,066
2060	38	0.35669	$425,831	$151,889
2061	39	0.34714	$425,831	$147,824
2062	40	0.33785	$425,831	$143,868
2063	41	0.32881	$425,831	$140,017
2064	42	0.32001	$425,831	$136,270
2065	43	0.31144	$425,831	$132,623
2066	44	0.30311	$425,831	$129,073
2067	45	0.29500	$425,831	$125,619
2068	46	0.28710	$425,831	$122,257
2069	47	0.27942	$425,831	$118,985
2070	48	0.27194	$425,831	$115,800
2071	49	0.26466	$425,831	$112,701
2072	50	0.25758	$425,831	$109,685
TOTAL PRESENT VALUE				**$11,496,232**
ROUNDED				**$11,496,000**
TOTAL AVERAGE ANNUAL				**$425,831**
ROUNDED				**$426,000**

Fortescue

FY	PY	PV Factor	LandLoss	Present Value
2022	0	1.00000	$0	$0
2023	1	0.97324	$32,216	$31,354
2024	2	0.94719	$32,216	$30,515
2025	3	0.92184	$32,216	$29,698
2026	4	0.89717	$32,216	$28,903
2027	5	0.87315	$32,216	$28,130
2028	6	0.84978	$32,216	$27,377
2029	7	0.82704	$32,216	$26,644
2030	8	0.80491	$32,216	$25,931
2031	9	0.78336	$32,216	$25,237
2032	10	0.76240	$32,216	$24,561
2033	11	0.74199	$32,216	$23,904
2034	12	0.72213	$32,216	$23,264
2035	13	0.70281	$32,216	$22,642
2036	14	0.68400	$32,216	$22,036
2037	15	0.66569	$32,216	$21,446
2038	16	0.64787	$32,216	$20,872
2039	17	0.63053	$32,216	$20,313
2040	18	0.61366	$32,216	$19,770
2041	19	0.59723	$32,216	$19,241
2042	20	0.58125	$32,216	$18,726
2043	21	0.56569	$32,216	$18,224
2044	22	0.55055	$32,216	$17,737
2045	23	0.53582	$32,216	$17,262
2046	24	0.52148	$32,216	$16,800
2047	25	0.50752	$32,216	$16,350
2048	26	0.49394	$32,216	$15,913
2049	27	0.48072	$32,216	$15,487
2050	28	0.46785	$32,216	$15,072
2051	29	0.45533	$32,216	$14,669
2052	30	0.44314	$32,216	$14,276
2053	31	0.43128	$32,216	$13,894
2054	32	0.41974	$32,216	$13,522
2055	33	0.40851	$32,216	$13,160
2056	34	0.39757	$32,216	$12,808
2057	35	0.38693	$32,216	$12,465
2058	36	0.37658	$32,216	$12,132
2059	37	0.36650	$32,216	$11,807
2060	38	0.35669	$32,216	$11,491
2061	39	0.34714	$32,216	$11,184
2062	40	0.33785	$32,216	$10,884
2063	41	0.32881	$32,216	$10,593
2064	42	0.32001	$32,216	$10,309
2065	43	0.31144	$32,216	$10,034
2066	44	0.30311	$32,216	$9,765
2067	45	0.29500	$32,216	$9,504
2068	46	0.28710	$32,216	$9,249
2069	47	0.27942	$32,216	$9,002
2070	48	0.27194	$32,216	$8,761
2071	49	0.26466	$32,216	$8,526
2072	50	0.25758	$32,216	$8,298
TOTAL PRESENT VALUE				**$869,741**
ROUNDED				**$870,000**
TOTAL AVERAGE ANNUAL				**$32,216**
ROUNDED				**$32,000**

Recommended Plan Results and Risk Analysis

Tables 30 and 31 show the Average Annual Net Benefits and Benefit-Cost Ratio for both Recommended Plan scenarios: (1) Gandys Beach and Fortescue only or (2) Gandys Beach, Fortescue, and Villas (South).

Table 30: Two Site Average Annual Net Benefits and Benefit-Cost Ratio

ITEM	AAD Without Project	AAD With Project	AAD Reduced	Land Loss Reduced	Total AAB
Fortescue	$4,548,473	$1,761,352	$2,787,121	$32,216	$2,819,337
Gandys Beach	$2,537,563	$154,507	$2,383,056	$0	$2,383,056
SUBTOTAL	**$7,086,036**	**$1,915,859**	**$5,170,177**	**$32,216**	**$5,202,393**
AAC	-	-	-	-	$3,570,623
AANB	-	-	-	-	$1,631,769
AANB (Round)	-	-	-	-	**$1,632,000**
BCR	-	-	-	-	**1.5**

With only Fortescue and Gandys Beach included in the proposed alternative, the study has $1,632,000 in Average Annual Net Benefits with a 1.5 Benefit-Cost Ratio.

Table 31: Three Site Average Annual Net and Benefit-Cost Ratio

ITEM	AAD Without Project	AAD With Project	AAD Reduced	Land Loss Reduced	Total AAB
Fortescue	$4,548,473	$1,761,352	$2,787,121	$32,216	$2,819,337
Gandys Beach	$2,537,563	$154,507	$2,383,056	$0	$2,383,056
Villas (South)	$2,137,963	$46,467	$2,091,495	$425,831	$2,517,326
SUBTOTAL	**$9,223,999**	**$1,962,326**	**$7,261,672**	**$458,047**	**$7,719,719**
AAC	-	-	-	-	$5,360,717
AANB	-	-	-	-	$2,359,002
AANB (Round)	**-**	**-**	**-**	**-**	**$2,359,000**
BCR	**-**	**-**	**-**	**-**	**1.4**

By adding Villas (South) dune and berm construction to the proposed alternative, the Average Annual Benefits increase by $2,517,326 with only a $1,790,094 increase in Average Annual Cost. This results in a net increase of $727,233 to Average Annual Net Benefits for the proposed alternative and sets the three site alternative as the Recommended Plan.

Relative Sea Level Change (RSLC) Sensitivity Analysis

Each of the three incrementally justified sites were analyzed under the Low, Intermediate, and High Relative Sea Change (RSLC) curves for the Recommended design. This sensitivity analysis is performed to quantify project performance and residual risk under all three curves as well as evaluate the economic performance of the Recommended Plan under each RSLC curve.

Table 32: Relative Sea Level Change (RSLC) Impact on Project Performance

HIGH	AAD Without Project	AAD With Project	AAD Reduced	Residual Damage	Land Loss Reduced	Total AAB
Fortescue	$5,984,401	$2,509,770	$3,474,630	41.9%	$40,163	$3,514,793
Gandys Beach	$3,005,634	$233,737	$2,771,897	7.8%	$0	$2,771,897
Villas (South)	$3,944,058	$66,920	$3,877,138	1.7%	$789,390	$4,666,528
SUBTOTAL	**$12,934,093**	**$2,810,428**	**$10,123,665**	21.7%	**$829,553**	**$10,953,218**
AAC	-	-	-	-	-	$6,432,860
AANB	-	-	-	-	-	$4,520,357
AANB (Round)	-	-	-	-	-	**$4,520,000**
BCR	-	-	-	-	-	**1.7**

INT	AAD Without Project	AAD With Project	AAD Reduced	Residual Damage	Land Loss Reduced	Total AAB
Fortescue	$4,548,473	$1,761,352	$2,787,121	38.7%	$32,216	$2,819,337
Gandys Beach	$2,537,563	$154,507	$2,383,056	6.1%	$0	$2,383,056
Villas (South)	$2,137,963	$46,467	$2,091,495	2.2%	$425,831	$2,517,326
SUBTOTAL	**$9,223,999**	**$1,962,326**	**$7,261,672**	21.3%	**$458,047**	**$7,719,719**
AAC	-	-	-	-	-	$5,360,717
AANB	-	-	-	-	-	$2,359,002
AANB (Round)	-	-	-	-	-	**$2,359,000**
BCR	-	-	-	-	-	**1.4**

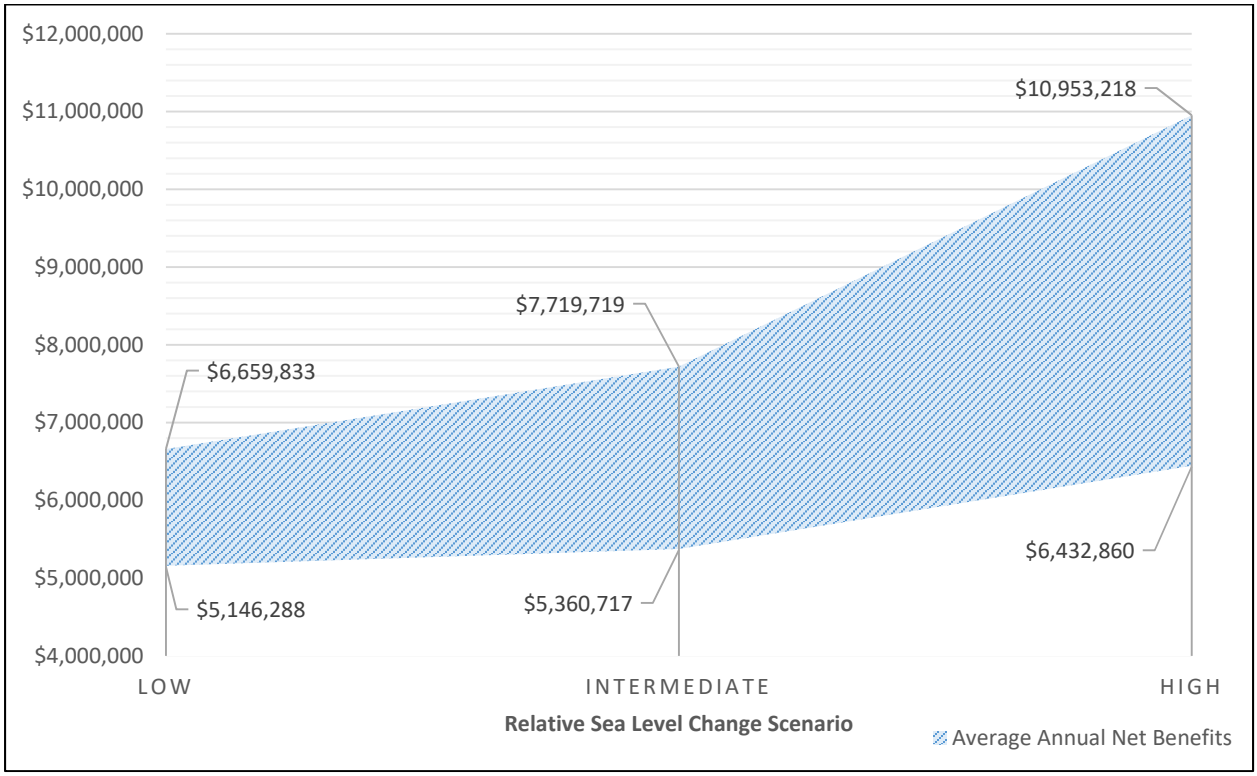
LOW	AAD Without Project	AAD With Project	AAD Reduced	Residual Damage	Land Loss Reduced	Total AAB
Fortescue	$4,079,953	$1,569,367	$2,510,586	38.5%	$29,020	$2,539,606
Gandys Beach	$2,386,774	$138,411	$2,248,363	5.8%	$0	$2,248,363
Villas (South)	$1,599,595	$44,376	$1,555,219	2.8%	$316,645	$1,871,864
SUBTOTAL	**$8,066,322**	**$1,752,153**	**$6,314,169**	21.7%	**$345,664**	**$6,659,833**
AAC	-	-	-	-	-	$5,146,288
AANB	-	-	-	-	-	$1,513,545
AANB (Round)	-	-	-	-	-	**$1,514,000**
BCR	-	-	-	-	-	**1.3**

Project performance remains fairly uniform throughout all three RSLC scenarios. While absolute residual damages increase as the relative sea level change scenario moves from Low to Intermediate to High, the overall percentage of residual damages is mostly steady around 21%.

Rising sea level associated with the High RSLC curve is particularly impactful for the residual damages experienced at Fortescue as this site has the greatest vulnerability to inundation damages. The site may experience even greater inundation-related damages than specified in this study as structures outside the study area and away from the shoreline become inundated with water from the low lying marshland.

Economic performance of the Recommended Plan is strong through all three RSLC scenarios, though the Low RSLC curve does project to have $845,000 less in Average Annual Net Benefits, or 36%. Figure 42 shows the Average Annual Net Benefits totals for the each of the three RSLC scenarios.

Figure 42: Relative Sea Level Change (RSLC) Impact on Average Annual Net Benefits



As Figure 42 shows, the Average Annual Cost (bottom numbers) increases as projected future sea level rises, but the increase in AAC is eclipsed by the increase in Average Annual Damages reduced (top numbers), resulting in a net increase in Average Annual Net Benefits.

FY2020 PRICE LEVEL AND DISCOUNT RATE ADJUSTMENT

Beach-fx model results and corresponding costs, presented in FY2018 Price Level and Federal Discount Rate of 2.75%, are updated to the current FY2020 Price Level and Federal Discount Rate of 2.75%. The update to FY2020 values does not impact study conclusions nor alter any associated study risk, but does provide the most up-to-date information available for the study area and Recommended Plan.

Figure 43 below shows the FY2018 revised certified cost estimates with a 27% contingency. Values are updated to an FY2020 Price Level and annualized with the FY2020 Federal Discount Rate in Table 33:

Figure 43: FY2020 Price Level Certified Cost Estimates

Groin Construction at Gandys Beach (FY2021)

8.78 Months of Construction
Oct-19 Price Level
27.0% Contingency

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$0	$0	$0
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$4,003,000	$1,080,810	$5,083,810
17	BEACH REPLENISHMENT	1	JOB	LS	$0	$0	$0
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$766,000	$206,820	$972,820
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$1,708,000	$461,160	$2,169,160
-	**TOTAL ESTIMATED AMOUNT**				**$6,477,000**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$1,748,790**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$8,225,790**
-	**ROUNDED**						**$8,226,000**

Groin Construction at Fortescue (FY2021)

4.18 Months of Construction
Oct-19 Price Level
27.0% Contingency

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$0	$0	$0
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$3,386,000	$914,220	$4,300,220
17	BEACH REPLENISHMENT	1	JOB	LS	$0	$0	$0
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$763,000	$206,010	$969,010
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$894,000	$241,380	$1,135,380
-	**TOTAL ESTIMATED AMOUNT**				**$5,043,000**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$1,361,610**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$6,404,610**
-	**ROUNDED**						**$6,405,000**

Initial Construction of Gandys Beach and Fortescue (FY2022)

1	Medium Dredges	1.5	Months of Disposal at Buoy 10				
7.21	Months of Total Construction	Oct-19	Price Level				
5.71	Months of Beach Nourishment	27.0%	Contingency		46%	Real Estate Contingency	
Number	**Product Description**	**Quantity**	**UOM**	**Unit Price**	**Estimated Amount**	**Contingency 27%**	**Total Estimated Amount**
01	LANDS AND DAMAGES	1	JOB	LS	$2,231,500	$1,033,526	$3,265,026
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$3,921,000	$1,058,670	$4,979,670
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$0	$0	$0
17	BEACH REPLENISHMENT	1	JOB	LS	$33,151,000	$8,950,770	$42,101,770
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,782,000	$481,140	$2,263,140
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$1,744,000	$470,880	$2,214,880
-	**TOTAL ESTIMATED AMOUNT**				**$42,829,500**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$11,994,986**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$54,824,486**
-	**ROUNDED**						**$54,824,000**

Initial Construction of Villas South & Nourishment of Gandys Beach and Fortescue (FY2028)

1	Medium Dredges	1.07	Months of Disposal at Buoy 10				
8.98	Months of Total Construction	Oct-19	Price Level				
7.91	Months of Beach Nourishment	27.0%	Contingency		46%	Real Estate Contingency	
Number	**Product Description**	**Quantity**	**UOM**	**Unit Price**	**Estimated Amount**	**Contingency 27%**	**Total Estimated Amount**
01	LANDS AND DAMAGES	1	JOB	LS	$2,231,500	$1,033,526	$3,265,026
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$2,785,000	$751,950	$3,536,950
10	BREAKWATERS AND SEAWALLS	1	JOB	LS	$0	$0	$0
17	BEACH REPLENISHMENT	1	JOB	LS	$49,513,000	$13,368,510	$62,881,510
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$2,596,000	$700,920	$3,296,920
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$3,093,000	$835,110	$3,928,110
-	**TOTAL ESTIMATED AMOUNT**				**$60,218,500**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$16,690,016**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$76,908,516**
-	**ROUNDED**						**$76,909,000**

Note: Real Estate has a higher contingency at 46.32%. Real Estate costs have been divided between construction in FY2022 and construction in FY2028.

Periodic Nourishment of Gandys Beach, Fortescue, and Villas South (FY2034 to FY2072)

1 Medium Dredges
3.96 Months of Total Construction
3.96 Months of Beach Nourishment
0 Months of Disposal at Artifical Island
Oct-19 Price Level
27.0% Contingency

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$0	$0	$0
17	BEACH REPLENISHMENT	1	JOB	LS	$19,179,936	$5,178,583	$24,358,518
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$2,237,891	$604,230	$2,842,121
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$1,180,873	$318,836	$1,499,709
-	**TOTAL ESTIMATED AMOUNT**				**$22,598,699**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$6,101,649**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$28,700,348**
-	**ROUNDED**						**$28,700,000**

Buoy 10 Federal Standard

1 Medium Dredges
5.63 Months of Total Construction
Oct-18 Price Level
27.0% Contingency

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$17,043,027	$4,601,617	$21,644,644
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,066,253	$287,888	$1,354,141
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$1,162,294	$313,819	$1,476,113
-	**TOTAL ESTIMATED AMOUNT**				**$19,271,574**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$5,203,325**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$24,474,899**
-	**ROUNDED**						**$24,475,000**

The cost tables shown below reflect dredging of the Delaware River main channel costs in the Future Without Project Condition scenario (930,000 CY), the cost in the Future With Project Condition scenario (705,625 CY), and the resulting cost decrease.

Artificial Island Federal Standard (FWOP)

1	Large Dredge	27.0%	Contingency
5.55	Months of Total Construction	930,000	Cubic Yards
Oct-19	Price Level		

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$28,809,274	$7,778,504	$36,587,778
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,066,253	$287,888	$1,354,141
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$1,148,030	$309,968	$1,457,998
-	**TOTAL ESTIMATED AMOUNT**				**$31,023,556**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$8,376,360**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$39,399,916**
-	**ROUNDED**						**$39,400,000**

Artificial Island Federal Standard (FWP)

1	Large Dredge	27.0%	Contingency
4.21	Months of Total Construction	705,625	Cubic Yards
Oct-18	Price Level		

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$22,625,560	$6,108,901	$28,734,461
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$1,066,253	$287,888	$1,354,141
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$909,096	$245,456	$1,154,552
-	**TOTAL ESTIMATED AMOUNT**				**$24,600,908**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$6,642,245**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$31,243,153**
-	**ROUNDED**						**$31,243,000**

Artificial Island Federal Standard (Reduced Maintenance Benefit)

1	Large Dredge	27.0%	Contingency
1.34	Months of Total Construction	224,375	Cubic Yards
Oct-18	Price Level		

Number	Product Description	Quantity	UOM	Unit Price	Estimated Amount	Contingency 27%	Total Estimated Amount
01	LANDS AND DAMAGES	1	JOB	LS	$0	$0	$0
02	RELOCATIONS	1	JOB	LS	$0	$0	$0
09	CHANNELS AND CANALS	1	JOB	LS	$6,183,714	$1,669,603	$7,853,317
30	PLANNING, ENGINEERING, AND DESIGN	1	JOB	LS	$0	$0	$0
31	CONTRUCTION MANAGEMENT	1	JOB	LS	$238,934	$64,512	$303,446
-	**TOTAL ESTIMATED AMOUNT**				**$6,422,648**		
-	**TOTAL ESTIMATED CONTINGENCY**					**$1,734,115**	
-	**PROJECT TOTAL ESTIMATED AMOUNT**						**$8,156,763**
-	**ROUNDED**						**$8,157,000**

Table 33: FY2020 Revised Certified Cost Schedule

PY	PV Factor	Year Date	Type	Project Cost	Fed. Std.	Fed. Std Cost	Adj. Cost	PV Cost
-1	1.0000	2021	Groin Const.	$8,225,790		$0	$8,225,790	$8,225,790
-1	1.0000	2021	Groin Const.	$6,404,610		$0	$6,404,610	$6,404,610
0	1.0000	2022	Initial Const.	$54,824,486	Bouy 10	$24,474,899	$30,349,587	$30,349,587
0	1.0000	2022	Interest During Const.	$2,545,087		$0	$2,545,087	$2,545,087
1	0.9732	2023						
2	0.9472	2024						
3	0.9218	2025						
4	0.8972	2026						
5	0.8732	2027						
6	0.8498	2028	Initial & Periodic	$76,908,516	Bouy 10	$24,474,899	$52,433,617	$44,557,297
6	0.8498	2028	Interest During Const.	$454,471		$0	$454,471	$386,203
7	0.8270	2029						
8	0.8049	2030						
9	0.7834	2031						
10	0.7624	2032						
11	0.7420	2033						
12	0.7221	2034	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$14,835,229
13	0.7028	2035						
14	0.6840	2036						
15	0.6657	2037						
16	0.6479	2038						
17	0.6305	2039						
18	0.6137	2040	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$12,606,754
19	0.5972	2041						
20	0.5813	2042						
21	0.5657	2043						
22	0.5506	2044						
23	0.5358	2045						
24	0.5215	2046	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$10,713,029
25	0.5075	2047						
26	0.4939	2048						
27	0.4807	2049						
28	0.4679	2050						
29	0.4553	2051						
30	0.4431	2052	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$9,103,771
31	0.4313	2053						
32	0.4197	2054						
33	0.4085	2055						
34	0.3976	2056						
35	0.3869	2057						
36	0.3766	2058	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$7,736,247
37	0.3665	2059						
38	0.3567	2060						
39	0.3471	2061						
40	0.3379	2062						
41	0.3288	2063						
42	0.3200	2064	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$6,574,146
43	0.3114	2065						
44	0.3031	2066						
45	0.2950	2067						
46	0.2871	2068						
47	0.2794	2069						
48	0.2719	2070	Periodic Nourish.	$28,700,348	Artificial Island	$8,156,763	$20,543,585	$5,586,610
49	0.2647	2071						
50	0.2576	2072						
TOTAL ESTIMATED AMOUNT								**$159,624,361**
AVERAGE ANNUAL COST								**$5,912,633**
ROUNDED								**$5,913,000**

As the OMRR&R responsibilities of the non-Federal sponsor are not expected to change between the Future Without Project Condition scenario and the Future With Project Condition scenario, the assumed project OMRR&R is effectively $0.

Interest During Construction is computed by multiplying the years of construction with the FY2020 Federal Discount Rate and with the Total Initial Construction cost. As the Gandys Beach and Fortescue groins are constructed concurrently, the longer construction period (Gandys Beach) was used for IDC calculation purposes.

Table 34 shows the impact to final study results:

Table 34: FY2018 to FY2020 Transition

FY2018	AAD Without Project	AAD With Project	AAD Reduced	Land Loss Reduced	Total AAB
Fortescue	$4,548,473	$1,761,352	$2,787,121	$32,216	$2,819,337
Gandys Beach	$2,537,563	$154,507	$2,383,056	$0	$2,383,056
Villas (South)	$2,137,963	$46,467	$2,091,495	$425,831	$2,517,326
SUBTOTAL	**$9,223,999**	**$1,962,326**	**$7,261,672**	**$458,047**	**$7,719,719**
AAC	-	-	-	-	$5,360,717
AANB	-	-	-	-	$2,359,002
AANB (Round)	**-**	**-**	**-**	**-**	**$2,359,000**
BCR	**-**	**-**	**-**	**-**	**1.4**

FY2020	AAD Without Project	AAD With Project	AAD Reduced	Land Loss Reduced	Total AAB
Fortescue	$4,864,669	$1,883,795	$2,980,873	$34,456	$3,015,329
Gandys Beach	$2,713,966	$165,248	$2,548,718	$0	$2,548,718
Villas (South)	$2,286,587	$49,697	$2,236,890	$455,433	$2,692,323
SUBTOTAL	**$9,865,222**	**$2,098,741**	**$7,766,481**	**$489,889**	**$8,256,370**
AAC	-	-	-	-	$5,912,633
AANB	-	-	-	-	$2,343,737
AANB (Round)	**-**	**-**	**-**	**-**	**$2,344,000**
BCR	**-**	**-**	**-**	**-**	**1.4**

FY2020 (7%)	AAD Without Project	AAD With Project	AAD Reduced	Land Loss Reduced	Total AAB
Fortescue	$4,141,874	$2,130,841	$2,011,033	$34,456	$2,045,489
Gandys Beach	$2,051,977	$212,886	$1,839,091	$0	$1,839,091
Villas (South)	$1,043,542	$64,262	$979,280	$455,433	$1,434,713
SUBTOTAL	**$7,237,392**	**$2,407,989**	**$4,829,403**	**$489,889**	**$5,319,292**
AAC	-	-	-	-	$8,181,555
AANB	-	-	-	-	-$2,862,262
AANB (Round)	**-**	**-**	**-**	**-**	**-$2,862,000**
BCR	**-**	**-**	**-**	**-**	**0.7**

The update to FY2020 Price Level and FY2020 Federal Discount Rate of 2.75% resulted in a net decrease of $15,000 Average Annual Net Benefits though the Benefit-Cost Ratio remained steady at 1.4. Final FY2020 results stand at $2,344,000 Average Annual Net Benefits.

For a sensitivity analysis, study results are also shown at the 7% Federal Discount Rate. Due to the reliance on mitigating erosion-related damages as the primary benefit source, many of the calculated damages avoided occur later in the study period of analysis. As these damages occur later, a higher discount rate will more heavily discount the present value of these benefits and reduce the quantified Average Annual Benefits. This is shown in the above table with AAB dropping $2,937,000 (or relative 36% decrease). Conversely, as many of the costs are set in Project Year 0 (Initial Construction), the change in discount rate increases annual costs, elevating the AAC by $2,269,000 (or relative 38% increase). Both of these changes at 7% drive down the AANB to -$2,862,000 and the BCR to 0.7.

CONCLUSION

The New Jersey Delaware Bay shoreline is highly susceptible to hurricane and storm damage from erosion, inundation, and wave attack damage drivers. Residential homes are the most strongly affected damageable asset category in this region, with some commercial properties also experiencing significant impact. The Beach-fx economic analysis results have demonstrated that, in the absence of a federal project, significant economic damage from coastal forces can be expected over the next 50 years.

The Recommended Plan, which includes three sites (Gandys Beach, Fortescue, and Villas (South)), has been determined using technical expertise, professional judgment, and rigorous certified modeling to maximize net benefits in the reduction of coastal storm damage. With reduced erosion, inundation, and wave damages to coastal infrastructure, the Average Annual Net Benefits for the Recommended Plan in present value dollars is $2,344,000, with a Benefit-Cost Ratio of 1.4. Additionally, each individual site proposed as part of the Recommend Plan has positive Average Annual Net Benefits and a BCR greater than 1.0.

REAL ESTATE PLAN
FOR THE
New Jersey Beneficial Use of Dredged Material
for the Delaware River (DMU)
Cumberland and Cape May Counties, New Jersey
January 2019
Amended November 2019

1. GENERAL

This Real Estate Plan is in support of the New Jersey Beneficial Use of Dredged Material for the Delaware River (DMU), State of New Jersey Area Feasibility Study, 30% Design/Recommended Plan. The plan is tentative in nature for planning purposes only and is intended to match the level of detail available in the main feasibility investigation report. Therefore, the final real property lines, estimates of value and rights required for project construction and operation and maintenance are subject to change even after approval of this report. Due to the nature of shore protection projects, it is difficult to assert complete certainty regarding future project real estate requirements based solely on 30% designs for a particular snapshot in time. For the project areas included in this feasibility report, changes in project designs from the 10% to the 30% design stage have resulted in marked changes in the real estate requirements due to changes in project work limits. Since the entire real estate process will be repeated once the project reaches the pre-construction 100% design phase, projected real estate requirements under this report will match the 30% design detail level only. Areas for which further investigations are required during and after design completion will be noted. A Risk Analysis is included in this report under Item Number 19. Risk Analysis, in order to comply with a risk-based assessment model for current project planning guidelines.

The initial study authority for the New Jersey DMU is the October 26, 2005 resolution of the Committee on Environment and Public Works of the United States Senate. The resolution reads as follows:

Resolved by the Committee on Environmental and Public Works of the United States Senate, that the Secretary of the Army is requested to review the report of the Chief of Engineers on the Delaware River between Philadelphia, Pennsylvania and Trenton, New Jersey, and Philadelphia to the Sea, published as House Document 358, Eighty Third Congress, Second Session (1954), and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable in the interest of beneficial use of dredged material resulting from the aforementioned project, including transfer and transport facilities for the drying, rehandling, and transferring of dredged material, as it relates to comprehensive watershed and regional sediment management (RSM), ecosystem restoration, navigation, stream restoration, water quality, restoration of coal and other mined area, cover material for sanitary landfills and other allied purposes.

In response to Hurricane Sandy in October 2012, Congress passed the Disaster Relief Appropriations Act (PL 113-2, 2013) which authorized supplemental appropriations to Federal agencies for expenses related to the consequences of Hurricane Sandy. Chapter 4 of PL 113-2 identified USACE-specific actions which included two interim reports to Congress, a project performance evaluation report and a comprehensive study to address the flood risks of vulnerable coastal populations in areas affected by Hurricane Sandy within the boundaries of the North Atlantic Division of USACE. The aforementioned New Jersey DMU study was identified in the Second Interim Report as an “Ongoing Study” for reducing flooding and storm damage risks in the area affected by Hurricane Sandy. The Feasibility Cost-Sharing Agreement was signed between the USACE, Philadelphia District and the New Jersey Non-Federal Sponsor (NFS), New Jersey Department of Environmental Protection (NJDEP), on February 27, 2014.

The study area includes the State of New Jersey portion of the Delaware River Watershed, the Delaware River itself, portions of the Delaware Bay, and multiple tributaries of the Delaware River which contribute to localized flooding. The north/south boundaries of the study area extend from Trenton, NJ to Cape May Point, NJ. The centerline of the Delaware River and Bay represents the western study area boundary, extending approximately 135 miles from the Atlantic Ocean upstream to the head of tide at Trenton, NJ. All of the recommended plan New Jersey locations included in the feasibility report are located in the Southern Reach, Zone 6, and are listed on the chart included in Figure 1.

The primary problems identified in this study are shoreline erosion, waves, and storm surge caused by coastal storms (along with sea-level change (SLC)) causing flood-related damages along the Delaware River/Bay shoreline of New Jersey.

The primary purpose of this study is to investigate the beneficial use of dredged material to minimize erosion, wave and storm-surge related damages and increase resiliency along the New Jersey shoreline. The recommended plan for this project includes three locations in New Jersey: Gandys Beach, Fortescue and Villas (South).

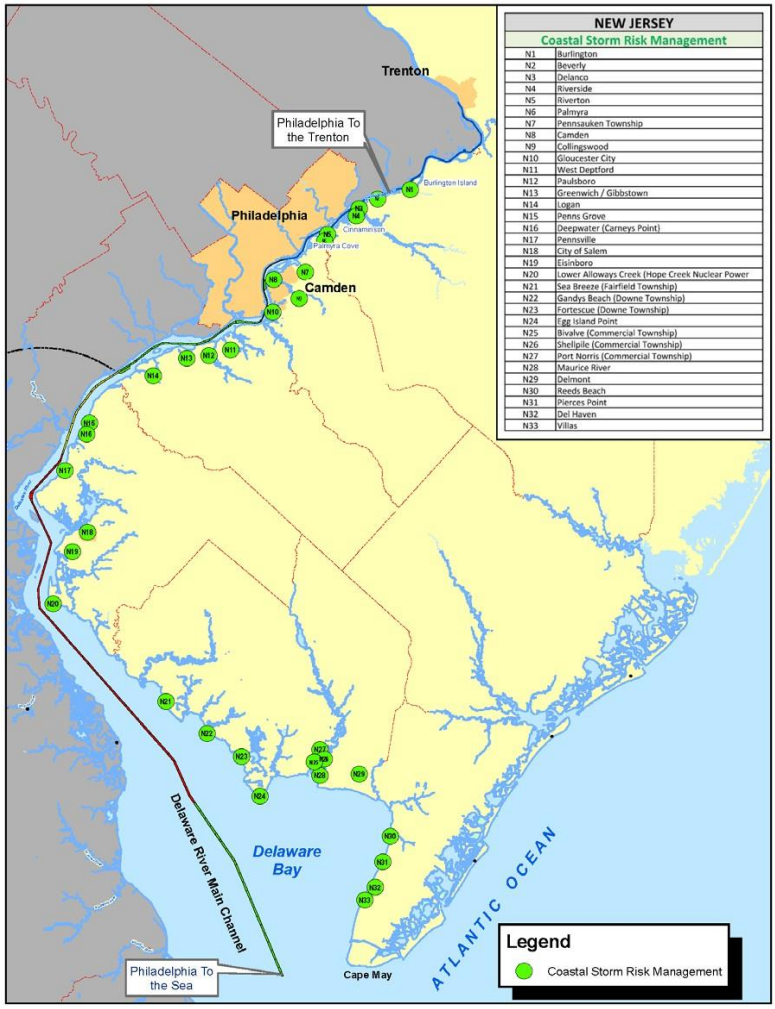


Figure 1 – Study Locations and Recommended Plan Sites (New Jersey)

The recommended plan consists of beach berm restoration with groins at Gandys Beach and Fortescue and beach berm and dune restoration at Villas (South).

Gandys Beach: At Gandys Beach, the recommended plan calls for a berm only beachfill with the parameters shown below. The design extends in front of all currently developed property bayward of Cove Road and will tie into a newly constructed terminal groin at the northwest end of Gandys Beach. Natural shoreline erosion has caused Delaware Bay to flank the town, requiring the addition of a northwestern terminal groin to prevent project-end losses due to on-going erosion. The groin construction will also involve reconstruction of the adjacent revetment to mitigate the risk of flanking of the new structure. The southeastern end will taper into the existing shoreline.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Groin	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)	Construction Berm Width (feet)
2,507	N/A	786	0	3,293	NW End	6.0'	25.0'	45.0'	Varies

Fortescue: At Fortescue, the recommended plan calls for a berm only beachfill with the parameters shown below. The full width of the design extends in front of all developed structures bayward of Delaware and Jersey Avenues, tying into a reconstructed groin at the northwest end of the town (adjacent to the existing timber stem stone groin and Fortescue Creek). The reconstructed terminal groin will tie into the existing shoreline and extend bayward approximately 270 feet. The southeastern end will taper to the existing shoreline.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Groin	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)	Construction Berm Width (feet)
4,564	N/A	1,251	0	5,815	NW End	6.0'	25.0'	45.0'	Varies

Villas (South): At Villas (South), the recommended plan calls for a dune and berm beachfill with the parameters shown below. The design will tie into the existing shoreline at Francis Avenue and extend north to West Greenwood Avenue, with tapers at each end to tie the beachfill into existing conditions. There are 11 stormwater outfalls within the project footprint that will be extended as part of the current recommended plan.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)	Construction Berm Width (feet)
7,442	7,442	1,000	1,072	9,514	12.0'	25'	5.0'	25.0'	20'	Varies

Varying volumes of dredged material are required at each of the placement locations, depending on the length of shoreline to be nourished and the existing beach profile. In order to maintain the integrity of design beachfill alternatives, beachfill nourishment must be included in the project design. If periodic nourishment is not performed throughout the life of the project, the

longshore and cross shore sediment transport mechanisms, separate from storm induced erosion, would act to erode the design beach. A 6-year periodic nourishment cycle is anticipated to maintain optimal coastal storm risk management (CSRM). This nourishment cycle is in line with the proposed operation and maintenance (O&M) dredging to be performed in Lower Reach E (the proposed project dredged material source area for the recommended plan); however, it will be further refined during plan optimization.

2. REAL ESTATE REQUIREMENTS

a. Description of Land, Easements, Rights-of-Way and Access Road Requirements for Project

Based on the information available, the current recommended plan requires two (2) types of easements for the combined projects. Currently, all mobilization and construction activities, including lay down and storage of contractor materials and equipment, are assumed to be located within the project area Limit of Construction for the entire project. Since two of the project areas may contain a private road leading to a portion of the project area, a Road/Access Easement (Standard Estate No. 11) may be required for at least one area.

The standard Perpetual Beach Storm Damage Reduction Easement (Standard Estate No. 26) is required for the construction of the beach berm and/or dune system and terminal groins on the beachfront properties that are above the mean high water line or that include riparian grants, including any owned by the local municipalities. Properties requiring Standard Estate No. 26 also include parcels located below the mean high water line currently subject to riparian grants. Easements must be acquired over the areas below the mean high water line covered by riparian grants for construction, operation and maintenance work required by the Non-Federal Sponsor and the Government over the life of the project. See Section 6 entitled "Navigational Servitude" for further explanation of this easement acquisition requirement. The use of the pier/structure variant of Standard Estate No. 26 may also be required. See Section 2.c Non-Standard Estates for further explanation.

No borrow area easements are required, since the material required for construction is to be obtained through required maintenance dredging of navigation areas.

	Easements Required		**Parcels/Rights In-Hand**		**Outstanding Easements**	
Project Area	**HSDR+**	**Road***	**HSDR**	**Road**	**HSDR**	**Road**
Gandys Beach	43	1	0	0	43	1
Fortescue	62	1	2	0	60	1
Villas (South)	57	0	2	0	55	0
TOTALS:	**162**	**2**	**4**	**0**	**158**	**2**

+Hurricane Storm Damage Reduction
*Potential requirement – not included on LERRD Charts for 30% REP.

N22 – GANDYS BEACH

Gandys Beach is the northernmost project area under the current recommended plan. A review of the project drawing provided resulted in the following real estate required for the current 30% design template.

Total Potential Perpetual HSDR Easements Required:	43
Less Total NFS-Owned Parcels:	0
Total Outstanding Potential HSDR Easements Required:	43

A Perpetual Road Easement may be required since at least one of the roads required for construction, operations and maintenance access may be privately-owned. A final determination of road ownership will be completed if the study continues. Several of the outstanding parcels required are listed as "streetends" on the project parcel list. These are the ends of public roads that terminate in the project and are within the project construction, operations and maintenance limit.

N23 – FORTESCUE

Fortescue is just south of Gandys Beach. A review of the project drawing provided resulted in the following real estate required for the current 30% design template.

Total Potential Perpetual HSDR Easements Required:	62
Less Total NFS-Owned Parcels:	2
Total Outstanding Potential HSDR Easements Required:	60

A Perpetual Road Easement may be required since at least one of the roads required for construction, operations and maintenance access may be privately-owned. A final determination of road ownership will be completed if the study continues. Several of the outstanding parcels required are listed as "streetends" on the project parcel list. These are the ends of public roads that terminate in the project and are within the project construction, operations and maintenance limit.

N33 – VILLAS (SOUTH)

Villas (South) is the southernmost project are under the current recommended plan. A review of the project drawing provided resulted in the following possible real estate required.

Total Potential Perpetual HSDR Easements Required:	57
Less Total NFS-Owned Parcels:	2
Total Outstanding Potential HSDR Easements Required:	55

No anticipated Perpetual Road Easement is required, since local roads are shown to be public. Several of the outstanding parcels required are listed as "streetends" on the project parcel list. These are the ends of public roads that terminate in the project and are within the project construction, operations and maintenance limit.

a. Standard Estates

A standard Perpetual Beach Storm Damage Reduction Easement (Standard Estate No. 26, EC 405-1-11, Exhibit 5-29) is required for the construction of the beach berm and/or dune plus terminal groins for upland beachfront properties above the MHWL and those covered by riparian grants. Neither Gandys nor Fortescue recommended plans contain a dune. Therefore, the optional [dune] references will not be included in the easement language for those project areas. The [dune] language is required for the Villas (South) recommended plan.

A standard Perpetual Road Easement (Standard Estate No. 11, EC 405-1-11, Exhibit 5-29) is required for construction and operations and maintenance access for project areas containing private roadways, as needed.

PERPETUAL BEACH STORM DAMAGE REDUCTION EASEMENT
(Standard Estate No. 26)

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract No. __) for use by the (Project Sponsor), its representatives, agents, contractors, and assigns, to construct; preserve; patrol; operate; maintain; repair; rehabilitate; and replace; a public beach [a dune system] and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms [and dunes]; to nourish and renourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic renourishment and maintenance of the (Project Name), together with the right of public use and access; [to plant vegetation on said dunes and berms; to erect, maintain and remove silt screens and sand fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas;] to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement (except_____); [reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune overwalk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the (designated representative of the Project Sponsor) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further] reserving to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

PERPETUAL ROAD EASEMENT
(Standard Estate No. 11)

A (perpetual [exclusive] [non-exclusive] and assignable) (temporary) easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos._____,_____and_____) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees,

underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

b. Non-Standard Estates

The beachfront residential structures in both Gandys Beach and Fortescue are situated on the beach in such a manner that many of them are partially in the bay, raised and heavily fortified against the tides (Figure 2, below).

Figure 2 – A Portion of Gandys Beach Project Area Showing Structure Placements

Decks on pilings are attached to various structures. Since the recommended plan for both the Gandys Beach and Fortescue project areas consists of only berm placement, existing piers are not a hazard to the planned project and, at the current 30% design, are considered acceptable to remain in place. However, the current Standard Estate No. 26 permits the removal of any and all structures in the easement area. A modification of the easement language is required in order to allow approved beach structures to remain in the easement area after the project has been constructed. A non-standard estate for pier and boardwalk structures that do not interfere with construction, operation, maintenance, or periodic nourishment that were damaged or destroyed by Hurricane Sandy was approved by HQUSACE on July 11, 2014. Per Real Estate Policy Guidance Letter No. 31 – Real Estate Support to Civil Works Planning dated January 11, 2019, a copy of the non-standard Pier and Structure Hurricane Storm Damage Reduction Easement as attached as Exhibit A will be sent under separate memorandum for Division and Headquarters review and approval of its use as appropriate for the NJ-DMU project.

c. Current Ownership

A tax data list of all parcels required for the construction and operation and maintenance for each of the proposed projects is attached to the report as Exhibit B.

d. Real Estate Mapping

Project mapping for each project area is attached as Exhibit C. The project mapping as attached includes project work limits, tax parcels, and aerial photos of the project areas. Mapping with greater detail will be provided upon project and funding approval, and the provision of more detailed project design.

3. EXISTING FEDERAL PROJECTS

There are no existing Federal projects in the project areas.

4. EXISTING FEDERALLY OWNED LANDS

There are no Federally-owned lands in the project areas.

5. LANDS OWNED BY THE NON-FEDERAL SPONSOR

There are currently four (4) parcels owned by the State of New Jersey within the project areas: two upland parcels located in the northern third of the Villas (South) project area and two parcels located at the northernmost end of the Fortescue project area. Submerged lands below the MHWL of the Delaware River not encumbered by riparian grants are owned by the State of New Jersey and managed by NJDEP, Bureau of Tidelands.

6. NAVIGATIONAL SERVITUDE

Per the March 19, 2014 CECC-R Memo entitled "Availability of Navigation Servitude for Coastal Storm Damage Reduction Projects," the determination of the applicability of Federal Navigation Servitude for the construction of coastal storm damage reduction measures by the United States under a Federal cost-shared project is done on a case-by-case basis and requires a two-step review process: a legal opinion of applicability completed by the District and a review for concurrence through the Real Estate Law Section of the Office of the Chief Counsel, staffed through Division Counsel.

In order to align real estate timelines with current project-planning best practices, the request for concurrence through Division Counsel will occur concurrently with this REP. NAB Office of Counsel provided a determination memorandum dated 19 October 2018 and entitled "Legal Opinion on the Use of Federal Navigation Servitude for Coastal Storm Damage Reduction Projects at Three Locations Along the Delaware Bay Pursuant to the New Jersey Beneficial Use of Dredged Material for the Delaware Feasibility Study; Gandys Beach, Fortescue, and Villas South, New Jersey." Per the NAB-OC opinion document:

"It is the District opinion that navigation servitude may be invoked for construction of the proposed coastal storm damage reduction project, in utilization of the federal channel to be dredged,

and in the CSRM footprint below MHW." Therefore, although the State of New Jersey owns/controls all lands below the MLLW and has navigational servitude and jurisdiction over lands between the MWHL and MLLW, no authorization for entry will be required from the NFS and no credit or reimbursement will be afforded the NFS for these areas.

It should be noted that there may be riparian grants issued by the State of New Jersey to some private owners which extend beyond the MHWL and MLLW. If lands covered by riparian grants are found to be included in the project area, the State of New Jersey must either demonstrate that they still retain the rights required to operate and maintain the project areas or acquire the rights required to conduct ongoing operations and maintenance activities required under a future Project Partnership Agreement.

7. INDUCED FLOODING

No induced flooding is anticipated due to the proposed project features.

8. BASELINE COST ESTIMATE FOR REAL ESTATE

The detailed Real Estate Cost Estimate in MCACES format is included in Exhibit D. The Perpetual Beach Storm Damage Reduction Easement (127 possible private-property easements in total) value was estimated to be $1,990,000 (LERRD only), including the application of offsetting project benefits. Streetends, paper streets, municipally-owned, and NFS-owned parcels are not included in the LERRD value estimate below since they are all considered public property. The two possible perpetual road easements are not included in the parcel totals or the appraisal estimate, since they may not be privately-owned parcels. Additional ownership research will be conducted, if required, upon the completion of more detailed project plans.

The State of New Jersey does not distinguish special benefits from general benefits. Therefore, the appraisal approach for properties in New Jersey assumes that the proposed project will create non-speculative, reasonably calculable benefits that increase the property's value, regardless of whether those benefits are enjoyed to a lesser or greater degree by others in the community and that otherwise would not exist due to erosion. The appraisal estimate provided for this report is based on a 30% design template and reflects the same 30% level of detail of the Real Estate Plan. In order to account for the additional risk present when determining real estate requirements for a 30% design, a higher-than-normal contingency of 50% has been included in the Baseline Cost Estimate summarized below.

ID	Location	Total Easements	$ RE Interest Acquired	$ Potential Damages	Total RE Estimate
D22	Gandys Beach	31	$ -	$ -	$ -
D33	Fortescue	53	$ -	$ -	$ -
N33	Villas (South)	43	$ 1,421,931	$ 568,772	$ 1,990,703
	Totals:	127	$ 1,421,931	$ 568,772	$ 1,990,703
				Say:	**$ 1,990,000**

Based on all of the factors discussed in this section, the total estimated Baseline Cost for Real Estate for the project is $6,368,520, summarized as follows:

Acquisition/Administrative Costs:		
Privately-Owned	127 Properties	$ 863,600
Commercial	0 Properties	$ ----
Publically-Owned	35 Properties	$ 238,000
Condemnation Costs:		
Privately-Owned	20 Properties	$ 1,180,000
Commercial	0 Properties	$ -----
P.L. 91-646 Assistance:		$ 0.00
Real Estate Payments:		
Privately-Owned	127 Properties	$ 1,990,000
Commercial	0 Properties	$ -----
Publically-Owned	35 Properties	$ 0.00
Associated Admin/Review Costs		$ 81,000
Contingency (50%)		$ 2,015,920

TOTAL: $6,368,520*

*The Baseline Cost for Real Estate shown does not include possible utilities relocations. There are eleven (11) outfalls located within the Villas (South) project area. See Section 15. Utility and Facility Relocations for additional information.

9. PUBLIC LAW 91-646 RELOCATIONS

No P.L. 91-646 relocations are anticipated for this project at this time.

10. MINERAL ACTIVITY

There is no present or anticipated mining and drilling activity in the vicinity of the project that may affect the operation thereof.

11. TIMBER RIGHTS

There is no present or anticipated timber harvesting activity in the vicinity of the project that may affect the operation thereof.

12. ASSESSMENT OF NON-FEDERAL SPONSOR ACQUISITION CAPABILITY

The Non-Federal Sponsor, NJDEP, has indicated that the required real estate acquisition would be accomplished by their office. The Assessment of the Non-Federal Sponsor's Real Estate Acquisition Capability is attached at the end of this report as Exhibit E.

13. ZONING

The enactment of zoning ordinances is not proposed to facilitate acquisition.

14. ACQUISITION SCHEDULE

The Non-Federal Sponsor will officially initiate real estate acquisition activities after final execution of the Project Partnership Agreement (PPA). Due to there not yet being a date specific schedule for this project, the following estimated LERRD acquisition schedule indicates the length of time required for each step in the standard acquisition process. As there is currently no estimated PPA signing date, the following is a generic, worst-case scenario real estate timeline. Once an anticipated signing date for the PPA is identified, a more specific schedule will be prepared.

a.	PPA Execution	Start Date
b.	Forward Maps to Sponsor	Within 1 week of Start Date
c.	Survey and Title Work	Within 14 weeks of sponsor map receipt
d.	Appraisals receipt	Within 10 weeks of survey and title
e.	Review Appraisals	Within 4 weeks of appraisal receipt
f.	Negotiations	Within 9 weeks after appraisal review
g.	Closings	Within 6 weeks of completion of Negotiations
h.	Possession	Within 1 day of closings
i.	Certification of Real Estate	Within 1 week of possession; requires the transmittal of the Non-Federal Sponsor's Authorization for Entry for Construction and Certificate of Authority
	Approximate Total	1 year

Condemnations are anticipated for 20 properties required for this project. Condemnations may take up to six total months from initiation of negotiation to possession, adding approximately three months to the entire acquisition process.

15. UTILITY AND FACILITY RELOCATIONS

There are no relocations of utilities or facilities identified for either the Gandys Beach or Fortescue project areas at this time. The Villas (South) project area contains eleven (11) outfalls that would require extending under the current 30% design. If later, more-detailed project plans still require the extension of the outfalls, Attorney's Opinions of Compensability will be completed. The risk that these outfalls will be compensable is included in the 50% contingency added to the real estate costs for this project.

16. ENVIRONMENTAL CONCERNS

There is no known or suspected on-site contamination and the real estate cost estimates contained in this Real Estate Plan do not reflect the presence of contamination.

17. ATTITUDES OF THE LANDOWNERS

Discussions with landowners and stakeholders to date have produced the typical mix of support and non-support of the project. Common areas of concern are opening the beach area to the public, having the public on beaches behind their houses, and loss of control of the beach area. However, there is general support for the project.

18. NOTIFICATION TO NON-FEDERAL SPONSOR

The Non-Federal Sponsor, the New Jersey Department of Environmental Protection (NJDEP), will be notified in writing regarding the risks associated with the acquisition of land prior to execution of the PPA once a Feasibility Study is approved and the project is authorized and funded.

19. RISK ANALYSIS

The real estate plan was formulated to reflect the current 30% design. The following should be kept in mind when considering the real estate requirements covered under this REP:

a. More than 20 condemnations required. There is always a risk that current landowners, particularly those located in areas with completely private beaches, will be opposed to this project. Common objections to coastal storm damage reduction projects generally involve the loss of a private beach, loss of view and/or sea breeze, loss of immediate access from the property to the beach and the admittance of the public onto the beach. Due to the extreme fortification and erosion in the Gandys and Fortescue project areas, landowners may lose direct access to the water for fishing or other pier activities from decks and structures attached to their houses and fully in the water.

Outcome: Additional cost to project for real estate and additional time required for acquisition.

b. The beach areas below the MHWL currently shown as being under the control of the State of New Jersey may be covered by riparian grants that do not permit the NFS to enter onto the property for Project O&M purposes. In other coastal storm risk management projects, some riparian grants unknown to the NFS were located during shoreline title searches.

Outcome: Additional real estate acquisition required and additional real estate costs.

c. The Villas (South) project area limit line continues to require the extension of the eleven (11) outfalls located in the dune/berm area.

Outcome: Additional real estate planning costs for Attorney's Opinions of Compensability and additional project real estate costs.

In order to account for the risks outlines above, a 50% contingency has been added to the total real estate costs for this project.

Real Estate Plan Prepared by:

_____

Heather Sachs
Realty Specialist

Approved by:

_____

SUSAN K. LEWIS
Chief, Real Estate Division
USACE – Baltimore District

Prepared by:

_____

DEED OF DEDICATION AND PERPETUAL STORM

DAMAGE REDUCTION EASEMENT

THIS DEED OF DEDICATION AND PERPETUAL STORM DAMAGE REDUCTION EASEMENT is made this _____ day of _____ 20__ BY AND

BETWEEN

whose address is

referred to herein as Grantor,

AND

THE MUNICIPALITY OF [_____], a Municipal Corporation of the State of New Jersey whose post office address is [address], AND **THE STATE OF NEW JERSEY** referred to herein collectively as the Grantees,

WITNESSETH

WHEREAS, Grantor is the owner of that certain tract of land, located in the [Municipality] of _____, County of _____, State of New Jersey, and identified as Block _____ , Lot _____, on the official tax map of the [of _____, hereinafter the "Property," and Grantor holds the requisite interest to grant this Deed of Easement; and,

Option 1: Use the following Whereas clause.

WHEREAS, Grantor's Property previously included a pier structure commonly known as _____(the "Pier") which was damaged or destroyed as a result of Superstorm Sandy and/or a fire on September 12, 2013; and,

Option 2: Use the following Whereas clause.

WHEREAS, Grantor's Property currently includes a pier structure commonly known as _____(the "Pier"); and,

WHEREAS, the Grantees recognize that the beach at [Municipality], New Jersey is subject to constant erosion and degradation, thereby destroying a valuable natural resource and threatening the safety and property of the Grantor and of all of the citizens of the State; and,

WHEREAS, the Grantees desire to participate with each other and the United States Army Corps of Engineers to construct the [Project Segment] Storm Damage Reduction Project, as defined in the [Date of] Project Cooperation Agreement [in its absence, the Chiefs Report] between the Department of the Army and the State of New Jersey, hereinafter the "Project"; and,

WHEREAS, construction of the Project includes periodic renourishment, which may be performed solely by the Grantees or in conjunction with the United States Army Corps of Engineers; and,

WHEREAS, in order to accomplish part of the Project, Grantees need a Perpetual Storm Damage Reduction Easement on portions of said Property herein described; and,

WHEREAS, the United States Army Corps of Engineers will not participate in the Project unless the Grantees acquire the real property interest herein described in all real property needed for the Project; and,

WHEREAS, the [Municipality] shall consider this Deed of Easement in establishing the full assessed value of any lands subject to such restrictions; and,

WHEREAS, the Grantor desires to cooperate in allowing the Project to take place on a portion of said Property; and,

WHEREAS, with respect to the Pier, it is the intent of the Grantor to grant an easement for the beach area below the Pier and only to an area above the surface of the beach necessary for Grantees to undertake the actions authorized by this Deed of Easement and it is not the intent of Grantor to grant any easement or other rights on, over or above the Pier (the "Pier Easement Area"); and,

WHEREAS, the Grantor acknowledges that it will benefit from the successful implementation of the Project; and,

WHEREAS, the Grantor acknowledges that after successful implementation of the Project the beach and dune are still subject to the forces of nature which can result in both erosion and accretion of the beach and dune;

NOW, THEREFORE, in consideration for the benefits to be received by the Grantor from the successful implementation of the Project, the Grantor grants and conveys to Grantee an irrevocable, assignable, perpetual and permanent easement as set forth herein:

GRANT OF EASEMENT: A perpetual and assignable easement and right-of-way for the [Project Segment] Storm Damage Reduction Project in, on, over and across that portion of land of the Property, known as Block __, Lot(s) ___ on the [Municipality] official tax map, described on the attached metes and bounds description with plot plan attached hereto as Exhibit A for use by the State of New Jersey, the [Municipality], and the United States Army Corps of Engineers and its contractors, and each of their representatives, agents, contractors and assigns to:

a. Construct, preserve, patrol, operate, maintain, repair, rehabilitate, and replace a public beach, dune system, and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand,

to accomplish any alterations of the contours on said land, to construct berms and dunes, and to nourish and re-nourish periodically;

b. Move, temporarily store and remove equipment and supplies;

c. Erect and remove temporary structures;

d. Perform any other work necessary and incident to the construction, periodic renourishment, and maintenance of the [Project Segment] Storm Damage Reduction Project together with the right of public use and access;

e. Post signs, plant vegetation on said dunes and berms;

f. Erect, maintain, and remove silt screens and snow fences;

g. Facilitate preservation of dune and vegetation through the limitation of access to dune areas; and

h. Trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures, and obstacles within the limits of the easement (except the Pier as more particularly described in the blueprints and documents attached as Exhibit B hereto)];

subject however to existing easements for utilities and pipelines, existing public highways, existing paved public roads and existing public streets.

Grantor reserves the right [Choose: (1) to reconstruct, operate, maintain, repair, and replace the Pier (2) to operate, maintain, repair, and replace the Pier] for all land uses including, but not limited to recreation, entertainment and/or commercial uses in accordance with any applicable Federal, State, or local laws or regulations, provided that the Pier shall not violate the integrity of the dune, beach, or other storm damage reduction measures in shape, dimension or function, and that prior written approval of the plans and specifications for [Choose (1) any construction, repair, or replacement (2) any repair or replacement] of the Pier that requires grading, excavation or any other activity affecting the dune or beach is obtained from the [Muncipality], the State of New Jersey, and the District Engineer, U.S. Army Engineer District [Name], which may be conditioned upon such terms, conditions, and requirements as the [Muncipality], the State of New Jersey, and the District Engineer, U.S. Army Engineer District [Name] may determine to be necessary to protect the [Project Segment] Storm Damage Reduction Project including, but not limited to, a requirement to implement impact avoidance, minimization, and mitigation measures to restore the dune, beach, or other storm damage reduction measures to their previous condition.

The Grantor further reserves to the Grantor, the Grantor's heirs, successors and assigns the right to construct a dune overwalk structure in accordance with any applicable Federal, State, or local laws or regulations, provided that such structure shall not violate the integrity of the dune in shape, dimension, or function, and that prior approval of the plans and specifications for such structures must be obtained from the [Municipality] and the State of New Jersey, and provided further that such structures are to be considered subordinate to the construction, operation, maintenance,

Comment [PMR1]: Only include the word "private" to modify dune if the property owners demands it.

repair, rehabilitation, and replacement of the [Project Segment] Storm Damage Reduction Project. The Grantor further reserves to the Grantor, the Grantor's heirs, successors, and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby conveyed to the Grantees.

Duration of Easement: The easement granted hereby shall be in perpetuity, and in the event that the [Municipality] or the State of New Jersey shall become merged with any other geo-political entity or entities, the easement granted hereby shall run in favor of surviving entities. The covenants, terms, conditions and restrictions of this Deed of Easement shall be binding upon, and inure to the benefit of the parties hereto and their respective personal representatives, heirs, successors and assigns and shall continue as a servitude running in perpetuity with the land.

Municipality to Maintain Beach: [Municipality]. The Municipality agrees, consistent with all Federal, State and local statutes and regulations, that at all times it shall use its best, good-faith efforts to cause the beach area abutting Grantor's lands to be maintained, consistent with any applicable Federal, State or local laws or regulations, notwithstanding any action or inaction of the State of New Jersey, Department of Environmental Protection or the United States Army Corps of Engineers to maintain the beach area.

Character of Property: Notwithstanding the foregoing, nothing herein is intended or shall be deemed to change the overall character of the Property as private property; nothing herein shall be deemed to grant to the Grantee or otherwise permit the Grantee or any other person to cross over or use any part of the Property which is not within the Easement Area; nothing herein is intended or shall be deemed to alter the boundary lines or setback lines of the Property.

By the acceptance of this Deed of Easement, the Municipality agrees, to the extent allowed by applicable law, that the Lands burdened by the easement herein described shall not be excluded from the calculation of minimum square footage requirements when construing applications under the Zoning Ordinance of the Municipality.

Miscellaneous:

1. The enforcement of the terms of this Easement shall be at the discretion of the Grantees and any forbearance by Grantees to exercise their rights under this Easement in the event of any violation by Grantor shall not be deemed or construed to be a waiver by Grantees of such term or of any subsequent violation or of any of Grantee's rights under this Easement. No delay or omission by Grantees in the exercise of any right or remedy upon any violation by Grantor shall impair such rights or remedies or be construed as a waiver of such rights or remedies.

2. The interpretation and performance of this Deed of Easement shall be governed by the laws of the State of New Jersey.

3. If any provision of this Deed of Easement or the application thereof to any person or circumstance is found to be invalid, the remainder of the provisions of this Easement or the application of such provision to persons

or circumstances other than those to which it is found to be invalid, as the case may be, shall not be affected thereby.

4. Any notice, demand, request, consent, approval or communication under this Deed of Easement shall be sent by regular first class mail, postage prepaid and by Certified Mail, Return Receipt Requested, addressed to the mailing addresses set forth above or any other address of which the relocating party shall notify the other, in writing.

5. The captions in this Deed of Easement have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon its construction or interpretation.

6. Structures not part of the Project or permitted under this Deed are not authorized.

7. Grantor represents and warrants that he/she/it holds the requisite ownership interest and authority to execute this Deed of Easement; and has made this Deed of Easement for the full and actual consideration as set forth herein.

8. This Deed may be executed in counterparts by the respective Parties, which together will constitute the original Deed.

IN WITNESS WHEREOF, with the parties understanding and agreeing to the above, they do hereby place their signatures on the date at the top of the first page.

Accepted by the
Property Owner, GRANTOR

Witnessed by:

_____
GRANTOR

_____
NOTARY PUBLIC OF THE
STATE OF NEW JERSEY

Date _____

STATE OF NEW JERSEY, _____ SS.:

COUNTY OF _____

I CERTIFY that on _____ 20__,

personally came before me and this person acknowledged under oath, to my satisfaction that this person (or if more than one, each person);

1) is named in and personally signed this Deed of Easement;

2) signed, sealed and delivered this Deed of Easement as his or her act and deed;

_____
NOTARY PUBLIC OF THE
STATE OF NEW JERSEY

Accepted by the
[Municipality], GRANTEE

Witnessed by:

BY:_____
(Name of Official)

_____
NOTARY PUBLIC OF THE
STATE OF NEW JERSEY

Date _____

Accepted by the
State of New Jersey, GRANTEE

Witnessed by:

BY:_____
(Name of Official)

_____
NOTARY PUBLIC OF THE
STATE OF NEW JERSEY

Date _____

	A	B	C	D	E	F	G
1	**Villas**	30% Design Parcel List					
2	Lower Township						
3	Cape May County						
4							
5	**PAMS Pin**	**Municipality Cod**	**Block**	**Lot**	**Municipality**	**Property Location**	**Owner Name**
6	0505_298_1	505	298	1	LOWER TWP	BEACH SPRUCE TO RIDGE	TOWNSHIP OF LOWER
7	0505_319_1.01	505	319	1.01	LOWER TWP	1 BEACH AVENUE	Private Owner
8	0505_319_1.02	505	319	1.02	LOWER TWP	7 BEACH AVENUE	Private Owner
9	0505_319_1.03	505	319	1.03	LOWER TWP	9 BEACH AVENUE	Private Owner
10	0505_319_1.04	505	319	1.04	LOWER TWP	11 BEACH AVENUE	Private Owner
11	0505_319_1.05	505	319	1.05	LOWER TWP	13 BEACH AVENUE	Private Owner
12	0505_319_1.07	505	319	1.07	LOWER TWP	3 BEACH AVENUE	Private Owner
13	0505_319_1.08	505	319	1.08	LOWER TWP	5 BEACH AVENUE	Private Owner
14	0505_349.01_1.C1	505	349.01	1.C1	LOWER TWP	5 DELAWARE BAY DR UNIT A	Private Owner
15	0505_349.01_1.C2	505	349.01	1.C2	LOWER TWP	5 DELAWARE BAY DR UNIT B	Private Owner
16	0505_349.07_1	505	349.07	1 (INCL 2)	LOWER TWP	302 BIRCH ROAD	Private Owner
17	0505_349.07_3	505	349.07	3	LOWER TWP	301 ARBOR ROAD	Private Owner
18	0505_350.03_1	505	350.03	1	LOWER TWP	BEECHWOOD AVENUE	Private Owner
19	0505_360.01_1	505	360.01	1, 2, 3 & 4	LOWER TWP	16 ROSEWOOD AVENUE	Private Owner
20	0505_369.01_1	505	369.01	1	LOWER TWP	513 VILLAGE ROAD	Private Owner
21	0505_369.01_2	505	369.01	2, 3, & 4	LOWER TWP	511 VILLAGE ROAD	Private Owner
22	0505_373.01_1	505	373.01	1-4, 9-23 ODD	LOWER TWP	500 VILLAGE ROAD	Private Owner
23	0505_373.01_28	505	373.01	28	LOWER TWP	503 BEECHWOOD AVENUE	Private Owner
24	0505_385.01_1	505	385.01	1	LOWER TWP	BEACH AVENUE	TOWNSHIP OF LOWER
25	0505_377.01_1	505	377.01	1 & 2	LOWER TWP	504A BEECHWOOD AVENUE	STATE OF NJ DEP
26	0505_377.01_31	505	377.01	31	LOWER TWP	502 BEECHWOOD AVENUE	Private Owner
27	0505_377.01_5	505	377.01	5, 6, 7 & 8	LOWER TWP	2665 BAY DRIVE	STATE OF NJ DEP
28	0505_381.01_1	505	381.01	1	LOWER TWP	2673 BAY DRIVE	Private Owner
29	0505_381.01_2	505	381.01	2	LOWER TWP	2675 BAY DRIVE	Private Owner
30	0505_381.01_3	505	381.01	3	LOWER TWP	2677 BAY DRIVE	Private Owner
31	0505_385.02_1.01	505	385.02	1.01	LOWER TWP	2681 BAY DRIVE	Private Owner
32	0505_305.02_1.03	505	385.02	1.03	LOWER TWP	2683 BAY DRIVE	Private Owner
33	0505_384.02_1.04-C.A	505	385.02	1.04-C.A	LOWER TWP	2685 BAY DRIVE - UNIT A	Private Owner
34	0505_384.02_1.04-C.B	505	385.02	1.04-C.B	LOWER TWP	2685 BAY DRIVE - UNIT B	Private Owner
35	0505_390_1.01	505	390	1.01	LOWER TWP	2687 BAY DRIVE	Private Owner
36	0505_391.01_1	505	391.01	1	LOWER TWP	2689 BAY DRIVE	Private Owner
37	0505_394_1	505	394	1	LOWER TWP	2691 BAY DRIVE	Private Owner
38	0505_394_2	505	394	2 (INCL 3-8)	LOWER TWP	2693 BAY DRIVE	Private Owner
39	0505_398_1	505	398	1	LOWER TWP	2695 BAY DRIVE	Private Owner
40	0505_494.02_2.01	505	494.02	2.01 & 2.11	LOWER TWP	2697 BAY DRIVE	Private Owner
41	0505_494.02_2.02	505	494.02	2.02 & 2.12	LOWER TWP	2699 BAY DRIVE	Private Owner
42	0505_494.02_2.03	505	494.02	2.03 & 2.13	LOWER TWP	2703 BAY DRIVE	Private Owner
43	0505_494.02_2.04	505	494.02	2.04 & 2.14	LOWER TWP	2711 BAY DRIVE	Private Owner
44	0505_494.02_2.06	505	494.02	2.06	LOWER TWP	2723 BAY DRIVE	Private Owner
45	0505_494.02_2.07	505	494.02	2.07 & 2.15	LOWER TWP	2727 BAY DRIVE	Private Owner
46	0505_494.02_2.08	505	494.02	2.08 & 2.16	LOWER TWP	2729 BAY DRIVE	Private Owner
47	0505_494.02_2.09	505	494.02	2.09 & 2.17	LOWER TWP	2731 BAY DRIVE	Private Owner

	A	B	C	D	E	F	G
48	0505_494.02_2.10	505	494.02	2.10 & 2.18	LOWER TWP	2733 BAY DRIVE	Private Owner
49	0505_512.05_1	505	512.06	1	LOWER TWP	W SIDE OF SHORE ROAD	Private Owner
50	0505_512.14_31	505	512.14	31	LOWER TWP	2701 SHORE DRIVE	Private Owner
51	0505_512.02_2.01	505	512.02	2.01	LOWER TWP	1011 SHORE DRIVE	Private Owner
52	0505_519_1.02	505	519	1.02	LOWER TWP	BEACH BETWEEN 512.02/2.01 AND AVALON DRIVE - NO OWNER SHOWN	
53	PAPER STREET	505	NONE	NONE	LOWER TWP	BEACH AREA BETWEEN AREA JUST NORTH OF WILDWOOD AVENUE AND JUST SOUTH OF SHADELAND AVENUE	
54	PAPER STREET	505	NONE	NONE	LOWER TWP	ROW @ END OF SHORE DRIVE TO BEACH AT SOUTHERN END OF SHORE DRIVE	
55	**STREETENDS:**						
56	WILDWOOD						
57	VILLAGE ROAD						
58	BEECHWOOD AVENUE						
59	OAKDALE AVENUE						
60	BROADWAY						
61	CEDARDALE AVENUE						
62	HOLLYWOOD AVENUE						
63	SHADELAND AVENUE						
64							
65		Parcels Owned by State of New Jersey/NFS				2 Parcels	
66		Paper streets, streetends and locality-owned				12 Parcels	
67		Privately-owned				43 Parcels	
68					**TOTAL:**	**57 Parcels**	

	A	B	C	D	E	F	G	H	I	J	K
1	**Gandys Beach**	30% Design Parcel List									
2	Downe Township										
3	Cumberland County										
4											
5	**PAMS Pin**	**Municipality Code**	**Block**	**Lot**	**Municipality**	**Property Location**	**Owner Name**				
6	0604_8_1	604	8	1	DOWNE TWP	953-1085 MONEY ISLAND RD	Private Owner				
7	0604_1_36	604	1	36	DOWNE TWP	270 COVE RD	Private Owner				
8	0604_1_35	604	1	35	DOWNE TWP	268 COVE RD	Private Owner				
9	0604_1_34	604	1	34	DOWNE TWP	266 COVE RD	Private Owner				
10	0604_1_33	604	1	33	DOWNE TWP	264 COVE RD	Private Owner				
11	0604_1_32	604	1	32	DOWNE TWP	262 COVE RD	Private Owner				
12	0604_1_31	604	1	31	DOWNE TWP	260 COVE RD	Private Owner				
13	0604_1_30	604	1	30	DOWNE TWP	258 COVE RD	Private Owner				
14	0604_1_22	604	1	22	DOWNE TWP	242 COVE RD	Private Owner				
15	0604_1_21	604	1	21	DOWNE TWP	240 COVE RD	Private Owner				
16	0604_1_20	604	1	20	DOWNE TWP	238 COVE RD	Private Owner				
17	0604_1_19	604	1	19	DOWNE TWP	236 COVE RD	Private Owner				
18	0604_1_18	604	1	18	DOWNE TWP	234 COVE RD	Private Owner				
19	0604_1_17	604	1	17	DOWNE TWP	232 COVE RD	Private Owner				
20	0604_1_14	604	1	14	DOWNE TWP	226 COVE RD	Private Owner				
21	0604_1_13	604	1	13	DOWNE TWP	224 COVE RD	Private Owner				
22	0604_1_8	604	1	8	DOWNE TWP	214 COVE RD	Private Owner				
23	0604_1_7	604	1	7	DOWNE TWP	212 COVE RD	Private Owner				
24	0604_1_4	604	1	4	DOWNE TWP	206 COVE RD	Private Owner				
25	0604_1_3	604	1	3	DOWNE TWP	204 COVE RD	Private Owner				
26	0604_1_2	604	1	2	DOWNE TWP	202 COVE RD	Private Owner				
27	0604_1_1	604	1	1	DOWNE TWP	200 COVE RD	Private Owner				
28	0604_57_1	604	57	1	DOWNE TWP	S COVE RD	Private Owner				
29	0604_57_2	604	57	2	DOWNE TWP	198 COVE RD	Private Owner				
30	0604_57_4	604	57	4	DOWNE TWP	192 COVE RD	Private Owner				
31	0604_57_5	604	57	5	DOWNE TWP	190 COVE RD	Private Owner				
32	0604_57_6	604	57	6	DOWNE TWP	188 COVE RD	Private Owner				
33	0604_57_7	604	57	7	DOWNE TWP	186 COVE RD	Private Owner				
34	0604_57_8	604	57	8	DOWNE TWP	184 COVE RD	Private Owner				
35	0604_57_23	604	57	23	DOWNE TWP	GANDYS BEACH	TOWNSHIP OF DOWNE				
36	0604_57_11	604	57	11	DOWNE TWP	174 COVE RD	TOWNSHIP OF DOWNE				
37	0604_57_12	604	57	12	DOWNE TWP	172 COVE RD	TOWNSHIP OF DOWNE				
38	0604_57_13	604	57	13	DOWNE TWP	170 COVE RD	TOWNSHIP OF DOWNE				
39	0604_57_14	604	57	14	DOWNE TWP	168 COVE RD	TOWNSHIP OF DOWNE				
40	0604_57_15	604	57	15	DOWNE TWP	166 COVE RD	Private Owner				
41	0604_57_16	604	57	16	DOWNE TWP	164 COVE RD	TOWNSHIP OF DOWNE				
42	0604_57_17	604	57	17	DOWNE TWP	160 COVE RD	TOWNSHIP OF DOWNE				
43	0604_57_18	604	57	18	DOWNE TWP	158 COVE RD	Private Owner				
44	COVE ROAD	604	NONE	NONE	PORTION OF COVE ROAD AT NORTHERN END OF PROJ AREA, ABOVE B8/L1						
45	PAPER STREET	604	NONE	NONE	PAPER STREET LOCATED BETWEEN B1/L31 AND B1/L30, FROM COVE ROAD TO THE BEACH						
46	STREETEND	604	NONE	NONE	GANDY ROAD; BETWEEN B1/L1 AND B57/L2, FROM COVE ROAD TO THE WATER						
47	PAPER STREET	604	NONE	NONE	PAPER STREET LOCATED BETWEEN B57/L12 AND B57/L13, FROM COVE ROAD TO THE BEACH						
48	PAPER STREET	604	NONE	NONE	PORTION OF PAPER STREET LOCATED BETWEEN B1/L21 AND B1/L20						
49											
50		Parcels Owned by State of New Jersey/NFS				0 Parcels					
51		Paper streets, streetends and locality-owned				12 Parcels					
52		Privately-owned				31 Parcels					
53					**TOTAL:**	**43 Parcels**					

	A	B	C	D	E	F	G	H	I	J	K
1	**Fortescue Beach**	30% Design Parcel List									
2	Downe Township										
3	Cumberland County										
4											
5	**PAMS Pin**	**Municipality Code**	**Block**	**Lot**	**Municipality**	**Property Location**	**Owner Name**				
6	0604_63_2	604	63	2	DOWNE TWP	FORTESCUE	STATE OF NJ				
7	0604_63_3	604	63	3	DOWNE TWP	58 DELAWARE AVE	NJ DEPT OF ENVIRONMENTAL PROTECTION				
8	0604_63_4	604	63	4	DOWNE TWP	60 DELAWARE AVE	TOWNSHIP OF DOWNE				
9	0604_63_5	604	63	5	DOWNE TWP	62 DELAWARE AVE	Private Owner				
10	0604_63_6	604	63	6	DOWNE TWP	64 DELAWARE AVE	Private Owner				
11	0604_63_7	604	63	7	DOWNE TWP	FORTESCUE	Private Owner				
12	0604_63_8	604	63	8	DOWNE TWP	66 DELAWARE AVE	Private Owner				
13	0604_63_9	604	63	9	DOWNE TWP	68 DELAWARE AVE	TOWNSHIP OF DOWNE				
14	0604_63_10	604	63	10	DOWNE TWP	70 DELAWARE AVE	Private Owner				
15	0604_63_11	604	63	11	DOWNE TWP	72 DELAWARE AVE	Private Owner				
16	0604_63_12	604	63	12	DOWNE TWP	74-92 DELAWARE AVE	Private Owner				
17	0604_63_13	604	63	13	DOWNE TWP	94 DELAWARE AVE	Private Owner				
18	0604_63_14	604	63	14	DOWNE TWP	96 DELAWARE AVE	Private Owner				
19	0604_63_15	604	63	15	DOWNE TWP	98 DELAWARE AVE	Private Owner				
20	0604_63_16	604	63	16	DOWNE TWP	102 DELAWARE AVE	Private Owner				
21	0604_63_17	604	63	17	DOWNE TWP	110 DELAWARE AVE	Private Owner				
22	0604_63_18	604	63	18	DOWNE TWP	114 DELAWARE AVE	Private Owner				
23	0604_63_19	604	63	19	DOWNE TWP	116 DELAWARE AVE	Private Owner				
24	0604_63_25	604	63	25	DOWNE TWP	130 DELAWARE AVE	Private Owner				
25	0604_63_26	604	63	26	DOWNE TWP	132 DELAWARE AVE	TOWNSHIP OF DOWNE				
26	0604_63_28	604	63	28	DOWNE TWP	NO INFORMATION IN SYSTEM - PER AERIAL, APPEARS TO BE PART OF LOT 27					
27	0604_74_1	604	74	1	DOWNE TWP	144 NEW JERSEY AVE	Private Owner				
28	0604_74_8	604	74	8	DOWNE TWP	156 NEW JERSEY AVE	Private Owner				
29	0604_74_9	604	74	9	DOWNE TWP	160 NEW JERSEY AVE	Private Owner				
30	0604_74_30.01	604	74	30.01	DOWNE TWP	RIPARIAN	Private Owner				
31	0604_74_41	604	74	41	DOWNE TWP	234 NEW JERSEY AVE	Private Owner				
32	0604_74_43.01	604	74	43.01	DOWNE TWP	RIPARIAN	Private Owner				
33	0604_74_43	604	74	43	DOWNE TWP	240 NEW JERSEY AVE	Private Owner				
34	0604_74_44	604	74	44	DOWNE TWP	254 NEW JERSEY AVE	Private Owner				
35	0604_74_45	604	74	45	DOWNE TWP	256 NEW JERSEY AVE	Private Owner				
36	0604_74_46	604	74	46	DOWNE TWP	258 NEW JERSEY AVE	Private Owner				
37	0604_74_49	604	74	49	DOWNE TWP	264 NEW JERSEY AVE	Private Owner				
38	0604_74_49.01	604	74	49.01	DOWNE TWP	NO INFORMATION IN SYSTEM					
39	0604_74_50	604	74	50	DOWNE TWP	266 NEW JERSEY AVE	Private Owner				
40	0604_74_52	604	74	52	DOWNE TWP	NO INFORMATION IN SYSTEM					
41	0604_74_53	604	74	53	DOWNE TWP	NO INFORMATION IN SYSTEM					
42	0604_74_56	604	74	56	DOWNE TWP	278 NEW JERSEY AVE	Private Owner				
43	0604_74_57	604	74	57	DOWNE TWP	282 NEW JERSEY AVE	Private Owner				
44	0604_74_60	604	74	60	DOWNE TWP	286 NEW JERSEY AVE	Private Owner				
45	0604_74_61	604	74	61	DOWNE TWP	288 NEW JERSEY AVE	Private Owner				
46	0604_74_62	604	74	62	DOWNE TWP	290 NEW JERSEY AVE	Private Owner				
47	0604_74_63	604	74	63	DOWNE TWP	292 NEW JERSEY AVE	Private Owner				

	A	B	C	D	E	F	G	H	I	J	K
48	0604_92_1	604	92	1	DOWNE TWP	294 NEW JERSEY AVE	Private Owner				
49	0604_92_2	604	92	2	DOWNE TWP	296 NEW JERSEY AVE	Private Owner				
50	0604_92_4	604	92	4	DOWNE TWP	300 NEW JERSEY AVE	Private Owner				
51	0604_92_5	604	92	5	DOWNE TWP	302 NEW JERSEY AVE	Private Owner				
52	0604_92_5_01	604	92	5.01	DOWNE TWP	304 NEW JERSEY AVE	Private Owner				
53	0604_92_5_02	604	92	5.02	DOWNE TWP	306 NEW JERSEY AVE	Private Owner				
54	0604_92_6	604	92	6	DOWNE TWP	310 NEW JERSEY AVE	Private Owner				
55	0604_92_7	604	92	7	DOWNE TWP	312 NEW JERSEY AVE	Private Owner				
56	0604_92_8	604	92	8	DOWNE TWP	314 NEW JERSEY AVE	Private Owner				
57	0604_92_11	604	92	11	DOWNE TWP	320 NEW JERSEY AVE	Private Owner				
58	0604_92_16	604	92	15	DOWNE TWP	326 NEW JERSEY AVE	Private Owner				
59	0604_92_16	604	92	16	DOWNE TWP	330/334 NEW JERSEY AVE	Private Owner				
60	0604_92_18	604	92	18	DOWNE TWP	338 NEW JERSEY AVE	Private Owner				
61	0604_92_19	604	92	19	DOWNE TWP	342 NEW JERSEY AVE	Private Owner				
62	0604_92_20	604	92	20	DOWNE TWP	344 NEW JERSEY AVE	Private Owner				
63	0604_92_21	604	92	21	DOWNE TWP	346 NEW JERSEY AVE	Private Owner				
64	0604_92_23	604	92	23	DOWNE TWP	350 NEW JERSEY AVE	TOWNSHIP OF DOWNE				
65	0604_92_24	604	92	24	DOWNE TWP	NEW JERSEY AVE	TOWNSHIP OF DOWNE				
66	PAPER STREET	604	NONE	NONE	DOWNE TWP	PAPER STREET LOCATED BETWEEN B63/L28 AND B74/L1 (JERSEY AVE TO BEACH)					
67	PAPER STREET	604	NONE	NONE	DOWNE TWP	PAPER STREET LOCATED BETWEEN B74/L57 AND B74/L60 (JERSEY AVE TO BEACH)					
68											
69		Parcels Owned by State of New Jersey/NFS				2 Parcels					
70		Paper streets, streetends and locality-owned				7 Parcels					
71		Privately-owned				53 Parcels					
72					**TOTAL:**	**62 Parcels**					

GANDYS BEACH

NOTE:

1. LANDWARD EDGE OF BERM BASED ON EXISTING BULKHEAD LINE, EXISTING RUBBLE REVETMENT, OR WHERE BERM TIES INTO EXISTING GRADE AT ELEV +6.0.

1 PLAN - GANDYS 2 OF 2
SCALE: AS SHOWN

SCALE IN FEET
100 0 100 200

DELAWARE RIVER & BAY
NJ
DREDGE MATERIAL
UTILIZATION
PLAN - GANDYS BEACH 2 OF 2
FOR PLANNING PURPOSES ONLY

SHEET NUMBER
C-103

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
PHILADELPHIA, PA 19107-3390
www.nap.usace.army.mil

DESIGNED BY: PTF
DRAWN BY: PTF
CHK. BY: DAK
DWG SCALE: 1" = 150'
FILE NAME: 37747_R08-11-GSB\FAIR-SHOTS\BEACH 2 OF 2.dwg
ISSUED BY:
REVISED BY:
PROJ. NUMBER:
SOLICITATION NUMBER:
CONTRACT NUMBER:
ISSUE/RELEASE DATE: 10/09/2020

MARK	ACTION	BY	DATE
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DESCRIPTION

US Army Corps of Engineers ® Philadelphia District

NOTE:

1. LANDWARD EDGE OF BERM BASED ON EXISTING BULKHEAD LINE OR WHERE BERM TIES INTO EXISTING GRADE AT ELEV +6.0.

1 PLAN - GANDYS 1 OF 2
SCALE: AS SHOWN

SCALE IN FEET
100 0 100 200

PLAN NORTH

DELAWARE RIVER & BAY
NJ
DREDGE MATERIAL UTILIZATION
PLAN - GANDYS BEACH 1 OF 2
FOR PLANNING PURPOSES ONLY

C-102
SHEET NUMBER

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
PHILADELPHIA, PA 19107-3390
www.nap.usace.army.mil

DESIGNED BY: PTP
DRAWN BY: CNB
CHECKED BY: PTP
REVIEWED BY: HERFERT
PROJ. NUMBER:
SOLICITATION NUMBER:
CONTRACT NUMBER:
DWG SCALE: 1" = 88'
FILE NAME: SHEET AREA [1] DGN: NJN-GANDYS BEACH 1 OF 2.dwg

MARK	ACTION	BY	DATE
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US Army Corps of Engineers
Philadelphia District


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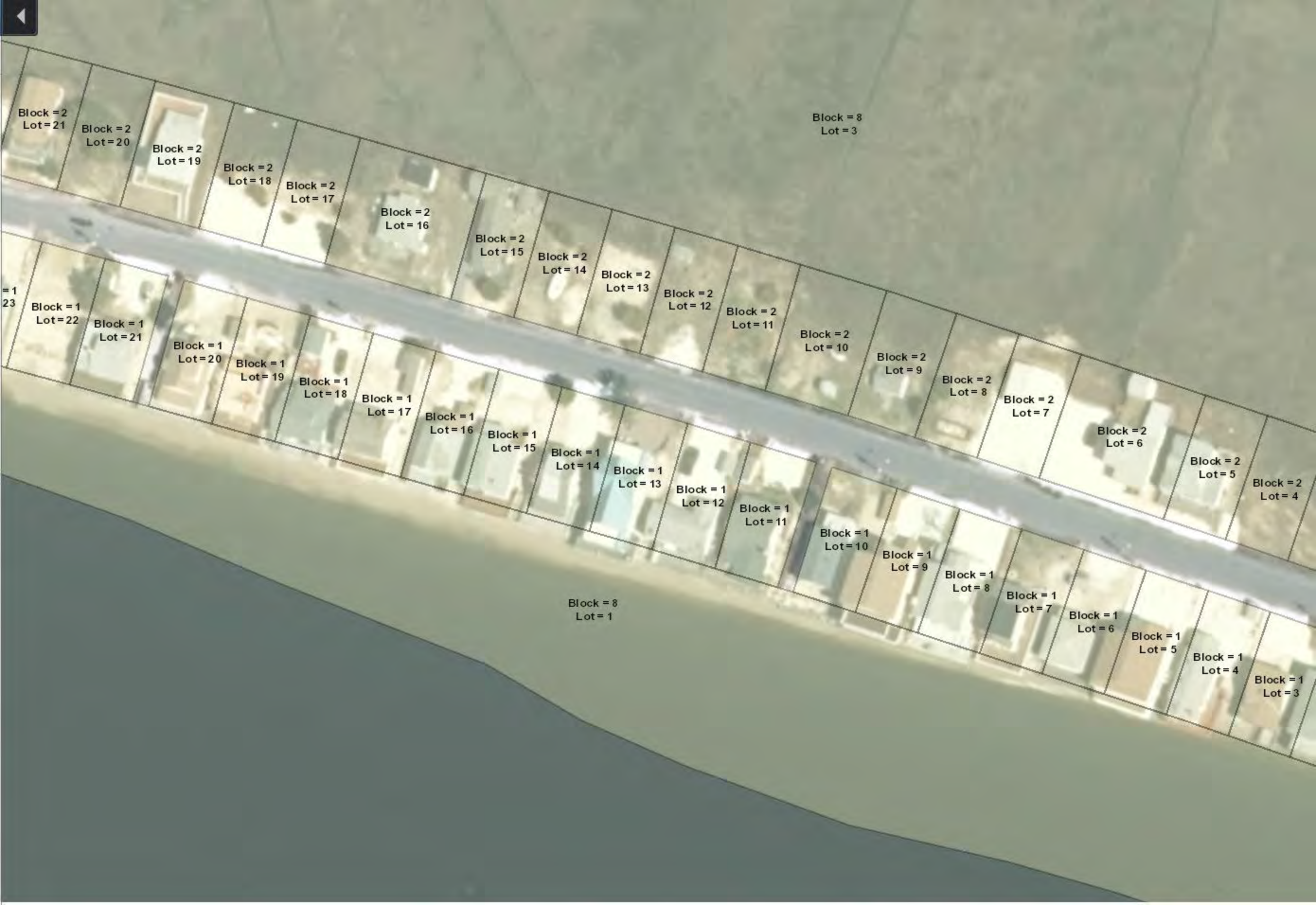
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FORTESCUE

PLAN
NORTH

1 PLAN - FORTESCUE 2 OF 2
SCALE: AS SHOWN

SCALE IN FEET
100 0 100 200

NOTE:
1. LANDWARD EDGE OF BERM BASED ON EXISTING BULKHEAD LINE OR WHERE BERM TIES INTO EXISTING GRADE AT ELEV +6.0.

DELAWARE RIVER & BAY
NJ
DREDGE MATERIAL
UTILIZATION
PLAN - FORTESCUE 2 OF 2
FOR PLANNING PURPOSES ONLY

SHEET NUMBER
C-105

U.S. ARMY CORPS OF ENGINEERS
NAP-PLANNING BRANCH
PHILADELPHIA, PA 19107-3390
www.nap.usace.army.mil

DESIGNED BY: JTF
DRAWN BY: JTF
CHKD BY: DAN
REVIEWED BY: JTF
SUBMITTED BY: HDPDEP
PROJ. NUMBER:
SOLICITATION NUMBER:
CONTRACT NUMBER:
DWG SCALE: 1" = 88'
PLOT SCALE: 1:1
PLOT NAME: DRAWINGS\DELAWARE\DELAWARE\DELAWARE DUNES\DELAWARE DUNES.dwg

NO.	ACTION	MAN	BY	DATE
-	-	-	-	-

US Army Corps of Engineers
Philadelphia District

NOTE:

1. LANDWARD EDGE OF BERM BASED ON EXISTING BULKHEAD LINE OR WHERE BERM TIES INTO EXISTING GRADE AT ELEV +6.0.

1 PLAN - FORTESCUE 1 OF 2
SCALE: AS SHOWN

SCALE IN FEET
100 0 100 200

RE: 1/C-105

MATCH LINE

RE: 1/C-105

MARK	ACTION	BY	DATE	DESCRIPTION
-	-	-	-	-

US Army Corps of Engineers Philadelphia District

DESIGNED BY: JTF | DRAWN BY: JTF | CHKD BY: DM | REVIEWED BY: TEXTORIS | APPROVED BY: HERPERS | RELEASE DATE: - | PROJ. NUMBER: - | SOLICITATION NUMBER: - | CONTRACT NUMBER: - | FILE NAME: C104 PLAN-FORTESCUE 1 OF 2.dwg | DWG SCALE: 1" = 88' | SHEET SIZE: 30"x42" ARCH D

U.S. ARMY CORPS OF ENGINEERS
NAP-PLANNING DIVISION
PHILADELPHIA, PA 19107-3390
www.nap.usace.army.mil

DELAWARE RIVER & BAY
NJ
DREDGE MATERIAL
UTILIZATION
PLAN - FORTESCUE 1 OF 2
FOR PLANNING PURPOSES ONLY

SHEET NUMBER
C-104


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State Ave
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Cape May Villas

VILLAS (SOUTH)

Legend

- Cape May Villas affected parcels
- Cape May Co. parcels

N

400 200 0 400 Feet

US Army Corps of Engineers
Baltimore District

Cape May Villas

Legend

- Cape May Villas affected parcels
- Cape May Co. parcels

N

400 200 0 400 Feet

US Army Corps of Engineers
Baltimore District

Feasibility Study Cost Estimate-MCACES Format
Real Estate Acquisition Requirements
Delaware River Dredged Material Beneficial Utilitzation Study (DMU), State of New Jersey Study Area
Cumberland and Cape May Counties, New Jersey - January 2019
Exhibit D

	Private			Commercial			Public			Requirement		
	#	$/per	req	#	$/per	req	#	$/per	req	Base	Contingency	Total
0102------- ACQUISITIONS												
010201--- By Government												
010202--- By Non-Federal Sponsor (NFS)												
01020201 Survey and Legal Descriptions	127	750	95,250	0		0	35	750	26,250	121,500	24,300	145,800
01020102 Title Evidence	127	900	114,300	0		0	35	900	31,500	145,800	29,160	174,960
01020203 Negotiations	127	1,200	152,400	0		0	35	1,200	42,000	194,400	38,880	233,280
010203--- By Government on Behalf of NFS												
010204--- Review of NFS												
01020401 Survey and Legal Descriptions	127	150	19,050	0		0	35	150	5,250	24,300	4,860	29,160
01020402 Title Evidence	127	150	19,050	0		0	35	150	5,250	24,300	4,860	29,160
01020403 Negotiations	127	150	19,050	0		0	35	150	5,250	24,300	4,860	29,160
SUBTOTAL										534,600	106,920	641,520
0103------- CONDEMNATIONS												
010301--- By Government												
010302--- By Non-Federal Sponsor (NFS)	20	57,000	1,140,000	0		0	0		0	1,140,000	570,000	1,710,000
010303--- By Government on Behalf of NFS												
010304--- Review of NFS	20	2,000	40,000	0		0	0		0	40,000	20,000	60,000
SUBTOTAL										1,180,000	590,000	1,770,000
0105------- APPRAISALS												
010501--- By Government												
010502--- By Non-Federal Sponsor (NFS)	127	3,000	381,000	0		0	35	3,000	105,000	486,000	243,000	729,000
010503--- By Government on Behalf of NFS												
010504--- Review of NFS	127	500	63,500	0		0	35	500	17,500	81,000	40,500	121,500
SUBTOTAL										567,000	283,500	850,500
0106------- PL 91-646 ASSISTANCE												
010601--- By Government												
010602--- By Non-Federal Sponsor (NFS)			0			0			0	0	0	0
010603--- By Government on Behalf of NFS												
010604--- Review of NFS	0		0	0		0	0		0	0	0	0
SUBTOTAL										0	0	0
0107------- TEMPORARY PERMITS/LICENSES/RIGHTS-OF-WAY												
010701--- By Government			0			0			0	0	0	0
010702--- By Non-Federal Sponsor (NFS)			0			0			0	0	0	0
010703--- By Government on Behalf of NFS			0			0			0	0	0	0
010704--- Review of NFS	0		0	0		0	0		0	0	0	0
010705--- Other			0			0			0	0	0	0
010706--- Damage Claims			0			0			0	0	0	0
SUBTOTAL										0	0	0
0115------- REAL ESTATE PAYMENTS												
011501--- Land Payments												
01150101 By Government										0	0	0
01150102 By Non-Federal Sponsor (NFS)	43		1,990,000						0	1,990,000	995,000	2,985,000
01150103 By Government on Behalf of NFS										0	0	0
01150104 Review of NFS	127	500	63,500				35	500	17,500	81,000	40,500	121,500
011502--- PL 91-646 Assistance Payments										0	0	0
01150201 By Government										0	0	0
01150202 By Non-Federal Sponsor (NFS)										0	0	0
01150203 By Government on Behalf of NFS										0	0	0
01150204 Review of NFS										0	0	0
011503--- Damage Payments										0	0	0
01150301 By Government										0	0	0
01150302 By Non-Federal Sponsor (NFS)										0	0	0
01150303 By Government on Behalf of NFS										0	0	0
01150304 Review of NFS										0	0	0
SUBTOTAL										2,071,000	1,035,500	3,106,500
Account 02 Facility/Utility Relocations (Construction cost only)											0	0
TOTAL LERRD										**$4,352,600**	**$2,015,920**	**$6,368,520**

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

Project: Delaware River Dredged Material Beneficial Utilization Study, State of New Jersey Study Area, Cumberland and Cape May Counties, New Jersey

Non-Federal Sponsor: New Jersey Department of Environmental Protection (NJDEP)

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?

Yes. The non-Federal sponsor (NFS), the NJDEP, has acquisition authority in the project area.

b. Does the sponsor have the power of eminent domain for this project?

No. Although the State of New Jersey does have the power of eminent domain, the delegated authority to the NFS' department was rescinded more than 10 years ago. Nevertheless, the NFS has indicated that assistance would be requested from the New Jersey Division of Law, currently assisting with eminent domain actions for ongoing shore protection projects in southern New Jersey or contracted from the local municipalities involved, through a State Aid Agreement, to acquire the necessary real estate interests. The local municipalities do have the power of eminent domain.

c. Does the sponsor have "quick-take" authority for this project?

No. The NFS does not have "quick-take" authority for this project. If a local municipality were to acquire the real estate, they would file a Declaration of Taking and deposit the estimated just compensation with the court. Possession would be granted within a period of 72 hours to 45 days, depending on whether preliminary objection resolution is required.

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary?

No.

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?

The NFS does not have condemnation authority for this project, but there are no lands/interests that may not be condemned by the local municipalities.

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended?

No. The NFS is familiar with the requirements of P.L. 91-646.

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training?

N/A

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?

Yes.

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule?

Yes. The NFS has indicated that assistance would be requested from the local municipalities to acquire the necessary real estate interests. The NFS will utilize State Aid agreements as necessary to enlist the assistance of local townships.

e. Can the sponsor obtain contractor support, if required, in a timely fashion?

Yes.

f. Will the sponsor likely request USACE assistance in acquiring real estate?

No.

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?

Yes.

b. Has the sponsor approved the project/real estate schedule/milestones?

Yes.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects?

Yes.

b. With regard to this project, the sponsor is anticipated to be fully capable.

V. Coordination:

a. Has this assessment been coordinated with the sponsor? Yes

b. Does the sponsor concur with this assessment? Yes

Prepared by:

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