Ocean City of Maryland Navigation Project

Feasibility Study
Economic Analysis

October 2021

Prepared By:
U.S. Army Corps of Engineers
Baltimore District
2 Hopkins Pl.
Baltimore, MD 21201

410-962-3511

INTRODUCTION

This economic assessment evaluates the benefits of providing navigation improvements in the Ocean City Inlet ("Inlet") area where shoaling occurs at a rate that exceeds the ability to fund maintenance dredging given current funding constraints. The analysis includes a description of the study area with existing conditions and a projection of future conditions. Economic benefits of proposed alternatives are evaluated against existing and future without-project conditions for the Ocean City inlet navigation channels.

This report includes alternatives based on Engineer Research and Development Center (ERDC) sediment transport data (2D Sediment and Hydrodynamic Model), which evaluates problems associated with shoaling at the Ocean City inlet channels. This analysis follows guidance contained in ER 1105-2-100 for estimating national economic development (NED) benefits which are presented on the basis of a 50-year period of analysis at October 2021 price levels and pursuant to EGM 20-01 plan formulation discount rate of 2.25% (FY22).

OCEAN CITY INLET

The Ocean City inlet was created during a hurricane in 1933 and shaped by the construction of the jetty system and breakwaters constructed by the Corps of Engineers beginning in the mid-1930s. The jetty system in the inlet was built to stabilize the Ocean City Inlet for navigation purposes. With respect to navigation, the project is intended to provide safe, reliable, and efficient waterborne transportation systems for commercial and recreational boat traffic between the coastal bay and the Atlantic Ocean. The inlet channel is the major artery feeding the coastal bay channels and the many marinas serving boating needs. Figure 1 shows the location of the Inlet.

In the Inlet, strong currents relocate sediment, depositing it in undesirable locations for navigation (the shoaling process). Shoaling is a process that makes a body of water shallow and subsequently too constricted for safe navigation.

EXISTING CONDITIONS

Ocean City is a resort town in Maryland and is located between the Atlantic Ocean and Isle of Wight Bay. Ocean City is a fishing community characterized by restaurants, shops and hotels. The surrounding waters are active with recreational, charter, and commercial boats. According to 2020 US Census Bureau projections, the town has a population of 6,944 and contains

Figure 1 Ocean City Inlet Location

3,585 households. Between 2010 and 2019, the town population decreased 2.2%. The median household income in Ocean City in 2018 was $54,667 (US Census Bureau, 2018 ACS) compared to $55,991 (adjusted for comparison[1]) in 2017 representing a slight decrease in purchasing power. Median household incomes in the town were lower than the median income in Maryland of $83,242 (in 2018 inflation adjusted dollars). In August 2019, the Ocean City labor participation rate of adults 16 years and older was 56.2% and an unemployment rate of 6.7% (US Bureau of Labor Statistics).

During fishing season, which is typically from May to December, Ocean City plays host to sport fishing enthusiasts who travel from as far south as Florida to compete. During the season, the transient community contributes to the economy by frequenting local business and restaurants. The economic impact of the marine industry extends beyond the fishermen to include the many fish buyers, fish processors, suppliers, and vessel repair businesses related to Ocean City fishing activity.

Ocean City attracts many different fish species during the fishing season and is colloquially known as the "White Marlin Capital of the World." Local species include monkfish, swordfish, tuna, flounder, mackerel and dogfish. Large fishing boats are also dedicated to harvesting sea clams, quahogs, and surf clams. According to the NOAA Fisheries Tool[2], Ocean City produced fish landings of all local species in 2019 of 4.7 million pounds valued at $7,300,000.

FUTURE WITHOUT-PROJECT CONDITIONS

The future without-project condition is the most likely condition if no action is taken (in the absence of the proposed plan). The future without-project condition for Ocean City Inlet is characterized as having areas where shoaling causes congestion delays and cause commercial boaters who would otherwise use the Inlet to travel out of port unload their catch When fishing vessels are grounded or stalled by the shoal in the Inlet, other vessels have to wait for the boat to clear or for high tide to happen before they can proceed through the channel. Delays increase the operating costs to commercial fishermen and also degrade the freshness of the catch, reducing its commercial value and the income produced by the fishing activity.

Shoaling and Maintenance Dredging

At its entrance to the Atlantic Ocean, the Ocean City inlet is stabilized by two jetties. The northern jetty stabilizes the south end of Fenwick Island and the Town of Ocean City. The south jetty connects landward to the north end of Assateague Island. Two breakwaters are also present at the north end of Assateague Island (west of the jetty), which used to be connected to the island, but are now separating due to erosion behind the breakwaters.

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[1] The Census Bureau recommends using CPI-U-RS adjustment factors published annually by the Bureau of Labor Statistics (BLS) to adjust 2017 median, mean, and per capita income dollar amounts to 2018 dollars by multiplying the 2017 dollar amounts by the CPI-U-RS factor of 1.02437673 Retrieved August 4, 2020 https://www.census.gov/programs-surveys/acs/guidance/comparing-acs-data/2018.html?#

[2] Retrieved from https://foss.nmfs.noaa.gov/apexfoss/f?p=215:11:3911047460461::NO:::

The constructed inlet channels include a channel 10 feet deep and 200 feet wide between the Atlantic Ocean and Sinepuxent Bay; 10 feet deep and 100-150 feet wide into the harbor; and branch channels, 6 feet deep into Sinepuxent Bay and Isle of Wight Bay (Figure 1). The inlet functions as a thoroughfare for boat traffic between the ocean and coastal bays, with Ocean City being the only Maryland State port located on the Atlantic coast for State Fishery[3] landings. In addition to the federal channels, there are numerous state and locally maintained navigation channels located in the Ocean City Inlet, harbor, Sinepuxent Bay, and Isle of Wight Bay[4].

Shoals within the inlet channel damage both commercial and recreational vessels and extend travel time for the vessels navigating the channels. Maintenance of the inlet and harbor channels is constrained by available funding, and dredge availability, and has been insufficient to maintain the channel as authorized. As a result, channel shoaling affects the efficient operation of the navigation channel and impacts boating operations by increasing damages, maintenance costs, tide-waiting delays, and fuel costs, as controlling depths in the channel become shallower following maintenance dredging. Larger boats must travel east out of the inlet, then north out and around the large ebb shoal to eventually travel south. Periodically, boats run aground within the inlet resulting in damages and lost time.

Dredging to keep the inlet accessible is currently needed several times a year and maintenance dredging will continue sporadically depending on funding. The current practice is that the USACE-owned dredges (Currituck and Murden) conduct dredging 3 to 4 times a year in order to provide some level of navigability. Based both upon limitations in funding, and limitations in dredge availability, the channel is not maintained as authorized, and instead only the most critical shoals are removed.

For purposes of the study, a without project condition is projected. Based upon USACE policy, the without project condition needs to assume that the existing navigation project is maintained as authorized, regardless of past funding, or the likelihood of future funding.

In order to develop future without project conditions, assumptions have been made, regarding the quantity of sand to be dredged, the frequency of dredging, and the method of sediment removal. Based upon past practices, it is expected that future dredging would be undertaken by the government-owned dredges, consistent with the current practice. Given the recent deposition rates since 2013, it is expected that dredging would be required three times a year, consistent with the current practice of dredging 3 to 4 time a year. The most recent survey of the channel indicates that the dredge quantity within the channel, including 2 ft of overdredge is approximately 20,000 CY. It is projected that 20,000 CY of material would be required to be dredged for each operation, three times a year.

Maintenance dredging with a government-owned hopper dredge is the most cost-effective method to maintain the channel and dredging with a commercial dredge would increase the without project cost estimates. The without project costs are based upon 3 operations annually with a per-operation

[3] Maryland Public Fishery Commercial Oyster Landings

[4] July 2018. USACE. Ocean City Harbor and Inlet Worcester County, Maryland Federal Interest Determination Report For Continuing Authority Feasibility Investigation Section 107 Small Navigation Projects

quantity of 20,000 CY, the production rate of 2,500 CY/day, the cost to operate the dredge of $20,000/day, and associated down-time for crew changes, and mobilization and demobilization cost ($6,000 for each). Applying these criteria results in an estimate of $212,000 per operation, and $636,000 annually.

DATA COLLECTION

On December 17, 2018, a survey was conducted by representatives of the Ocean City municipality. A total of 342 questionnaires[5] were disseminated electronically to boat owners believed to use the Inlet for recreational or commercial purposes. A total of 221 boat owners responded to the survey yielding a 64.6% response rate. The purpose of the locally administered survey was to gain insight into the problems faced by inlet users, and determine the types, drafts, and purposes of the vessels using the inlet. Data acquired from the survey is used for the Ocean City Inlet and Harbor Navigation Project analysis. Commercial activity in the Inlet represents 23 percent of the 221 responding boat owners. The remaining 77 percent of respondents report recreational and sport fishing as their primary endeavor. Several records were considered outliers and excluded from the analysis[6] The final sample of commercial users consisted of 43 records.

Commercial vessel operators report experiencing navigation difficulty and vessel damages usually around buoys 11 and 12 due to the formation of shoaling. Figure 2 shows bathymetric data for the Ocean City Inlet, including the most problematic (shallow) area to vessels navigating the inlet. Vessels primarily experience navigation related restrictions in the vicinity of lighted buoys 11 and 12, where depths can be six feet (MLLW) or less at times. At these points, boats are often delayed as they await sufficient tide to continue around the shoal. Fisherman using the Inlet also reported having to travel 43 miles from Ocean City to Cape May, New Jersey in order to unload and sell their catch because the shoaling problem prohibits safe dockage. Figure 3 provides a view of the inlet and sedimentation within.

[5] Questionnaire is attached as an appendix to this document

[6] Records reporting vessel dimensions greater than or less than what was reasonably expected were excluded, for example one respondent reported light loaded draft of 6000 feet. Another excluded record reported vessel length of 1 foot.

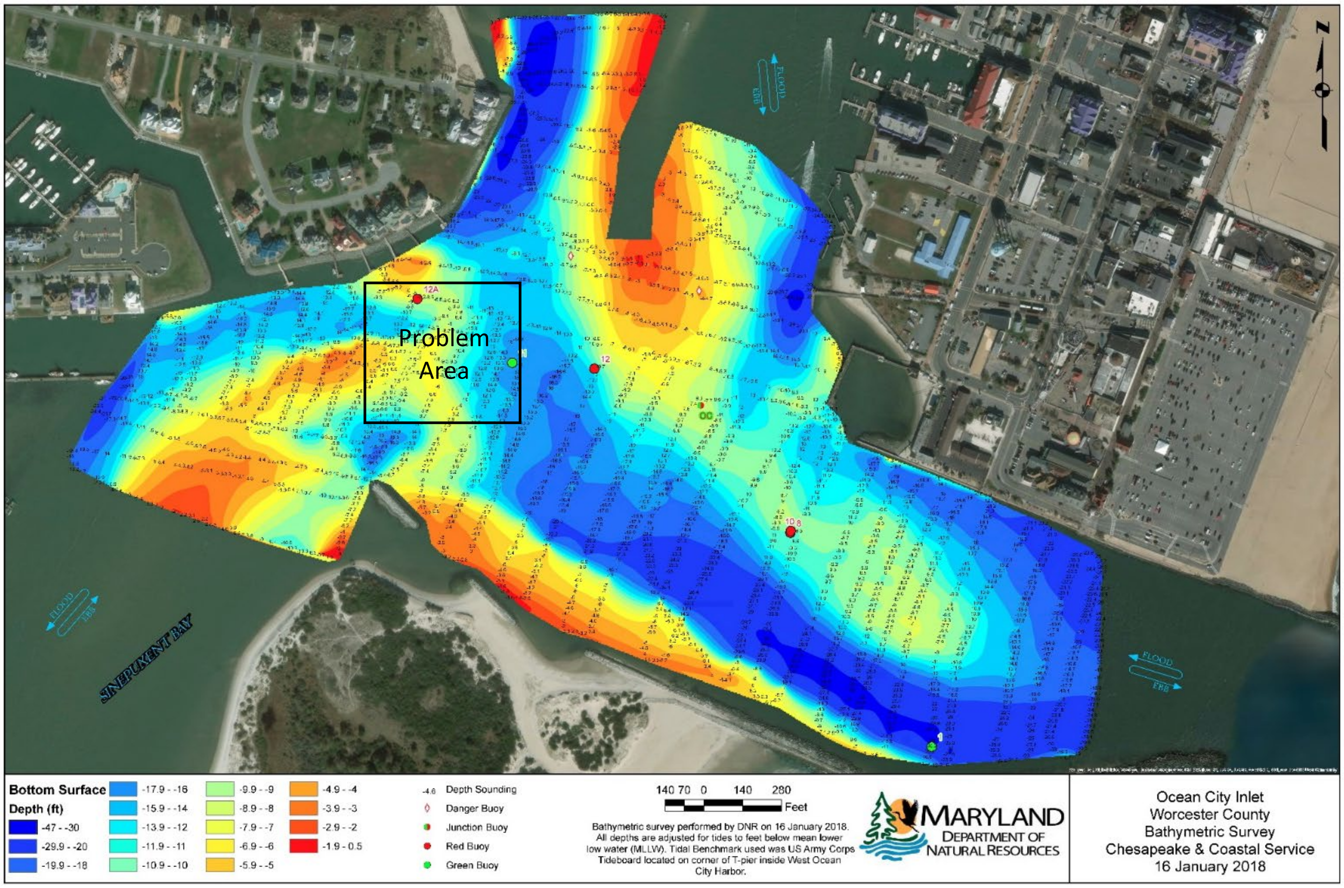

Figure 2. Bathymetry (2018) showing shoaling in the inlet channel upon entrance to the harbor (2018).

Figure 3 Ocean City Inlet Images

A. View of the Ocean City Inlet and jetties from the Atlantic Ocean (photo: National Park Service).
B. View of the inlet and Route 50 Bridge from the northeast.
C. View from the Atlantic Ocean of the ebb shoal and sedimentation in the Sinepuxent and Isle of Wight Bays (2005).
D. Aerial view of the ebb shoal and sedimentation in the back bays (photo: Google Earth, Terrametrics 2017).

Table 1 presents information on the fleet distribution of survey respondents engaged in commercial uses of their vessels. Summary data from the survey shows commercial users of the Inlet represents approximately 20 percent of the 221 responding boat owners. The remaining portion of respondents report recreational and sport fishing as their primary endeavor. Several records were considered outliers and excluded from the analysis having records reporting vessel dimensions greater than or less than what was reasonably expected, for example one respondent reported light loaded draft of 6000 feet. Several vessels of the commercial fleet where owners reported light loaded drafts greater than 12-feet were excluded and the final sample used in the analysis consisted of 43 records for commercial vessels.

Table 1. Ocean City Commercial Fleet Distribution by Draft (from 2018 Survey)

Light (Unloaded) Draft of Boats	Number of Vessels	Length of Boats	Net Tonnage
3ft	3	27-72ft	74
5ft	8	31-65ft	192
6ft	1	55ft	30
7ft	2	50-55ft	90
9ft	2	72ft	124
10ft	1	98ft	134
12ft	26	75-100ft	2080

Result of Current Operations

Current depths are inadequate for maximal use of the harbor, particularly for larger vessels, and some tidal delays and grounding risk remain. Shoaling will continue, and tidal delays, grounding damages, and operating inefficiencies will increase. The authorized controlling depth in the harbor is 10 feet. However, the shoaling has increased at a rate that surpasses maintenance ability[7]. Shallow depths can reach -7ft MLLW at problematic areas in the inlet. Assuming a depth of 10 feet MLLW there remains some tidal delays, grounding damages, and other operating inefficiencies for commercial users of the harbor. It is reasonable to assume that vessels with unloaded drafts greater than 10 ft would not safely maneuver the Inlet. The survey showed that 9 out of 17 vessels with drafts 10 ft or less report incurring costs resulting from scraping and grounding due to existing conditions in Ocean City Harbor and Inlet Channels.

Vessel Damage

Commercial vessels experience damages due to existing conditions in Ocean City Inlet associated with the shoal. A count of 9 commercial vessel owners with drafts of 10ft or less report damages totaling $40,220. Table 2 below shows costs incurred by draft size.

Table 2 Costs Incurred by Draft Size

Draft	Total Costs
3ft	$1,000
5ft	$13,900
7ft	$320
10ft	$25,000

[7] July 2018. USACE. Ocean City Harbor and Inlet Worcester County, Maryland Federal Interest Determination Report For Continuing Authority Feasibility Investigation Section 107 Small Navigation Projects

Fuel Costs

Several vessel owners with drafts of 10ft or less are based in the Inlet and Harbor and report issues they encounter while navigating. Additional fuel cost is related to the time spent by watermen waiting for the tide to shift to avoid the shoals in the Inlet. The maximum delay time experienced by the eleven survey respondents experiencing delays due to groundings is 12 hours per trip and the average wait time is 4.5 hours. At the first channel depth of 10 feet, 11 vessels (10ft draft or less) experience tide delays. The fishing season runs from May to November where respondents report taking a maximum of 185 trips per year. Respondents report engine fuel is consumed at an average rate of 1-gallon per hour while idling at sea. The US Energy Information Administration lists the average price of diesel fuel per gallon in the US East Coast for October 2020 as $2.58. Costs associated with additional fuel consumption is calculated as follows:

(vessels delayed) x (time delayed) x (trips per year) x (gallons of fuel use per hour) x (dollars per gallon)

Additional fuel costs associated with waiting for tide or waiting for another vessel to pass amount to $23,626 each year.

Labor Costs

Labor costs are calculated based on lost productivity while having to wait for tide or for vessels to pass as reported by survey respondents. The value of the watermen's time is estimated using 1/3 of the current average manufacturing wage in the state of Maryland, as required by current federal guidance. The October 2020 average wage of a production worker in manufacturing in the state of Maryland is $21.22 (Bureau of Labor Statistics), 1/3 of which is $7 per hour. Survey results find that respondents take a maximum of 185 trips per year. At first channel depth of 10 feet, 11 vessels experience tide delays. There is an average of 4 crew members per vessel, including the Captain. Labor costs are calculated as follows for the relevant loaded draft sizes:

(vessels delayed) x (average crew size) x (average hourly delay per trip) x (trips per year) x (hourly wage)

Labor costs associated with delays amounts to $256,410 annually. Labor and fuel costs associated with congestion delays for Inlet users of draft sizes 10ft or less are summarized in Table 3.

Table 3 Congestion Delay Costs Without Project

	Number of Vessels	Crew Size	Delay Time	Number of Trips per Year	Hourly Wage	Annual Value
Labor Costs	11	4	4.5	185	$7.00	$256,410

	Number of Vessels	Fuel Use (Gallons/hr)	Delay Time	Number of Trips per Year	Fuel Price per gallon	Annual Value
Fuel Costs	11	1	4.5	185	$2.58	$23,626

ALTERNATIVES

1. Alternative 1 - No Action
2. Alternative 2 – Extension of Existing Breakwaters, with Inlet Channel Realignment
3. Alternative 3 – Connection and Extension of Existing Breakwaters, with Inlet Channel Realignment

Alternative 1 - No Action (Future-Without Project Condition)

Without a permanent solution to reduce shoaling in the Ocean City Inlet and Harbor, navigation related hazards would persist. Dredging to keep the inlet accessible is currently needed several times per year and maintenance dredging would continue sporadically dependent upon funding. With no action, commercial boaters would continue to incur damages and lose revenue due to groundings, light-loading, and increased fuel and maintenance costs from tide-waiting delays, as controlling depths in the channel become shallower in the years following the maintenance dredging. Commercial boaters may choose not to operate in the area due to navigation related restrictions.

Alternative 2 – Extension of Existing Breakwaters, with Inlet Channel Realignment

Recently surveyed bathymetry (2018) for the inlet indicates an area within the inlet that is relatively deep (greater than 16 feet MLLW). For this alternative, the authorized location of the federal channel would be realigned (relocated) to coincide with deeper water. In conjunction with realignment, it is anticipated that approximately 3,000 cubic yards of material would need to be removed from the inlet. Due to deepening of the channel, it is estimated that this alternative would decrease maintenance dredging to a 5-year cycle since it would take longer for the channel to shoal to a point where navigation restrictions are present for current channel users at existing shoaling rates.

Additionally, this alternative would include extending the existing breakwaters at the north end of Assateague Island with 300 feet of stone (leaving a gap between the easternmost breakwaters) and constructing a 200-foot addition to the breakwater to the northwest (Figure 4). This would result in a dis-continuous structure at the northwest end of Assateague Island, which would extend toward the Sinepuxent Bay Federal Channel

The purpose of the extension of the breakwaters is to reduce erosion that has occurred south of the existing breakwaters, thereby removing that sediment from the inlet. The breakwater extension to the northwest would constrict the flow through the Sinepuxent Channel, resulting in increased water velocity through the channel. This would serve to scour sediment and reduce sediment deposition and shoaling in the most problematic areas around buoys 11 and 12.

Similar to material removed from the inlet on a regular basis for Assateague Island restoration, the material dredged from the Ocean City Inlet channel can be placed in the nearshore environment of Assateague Island in approved locations for the Assateague Island Restoration Project. However, other disposal locations are still being evaluated, including Skimmer Island as a locally preferred plan.

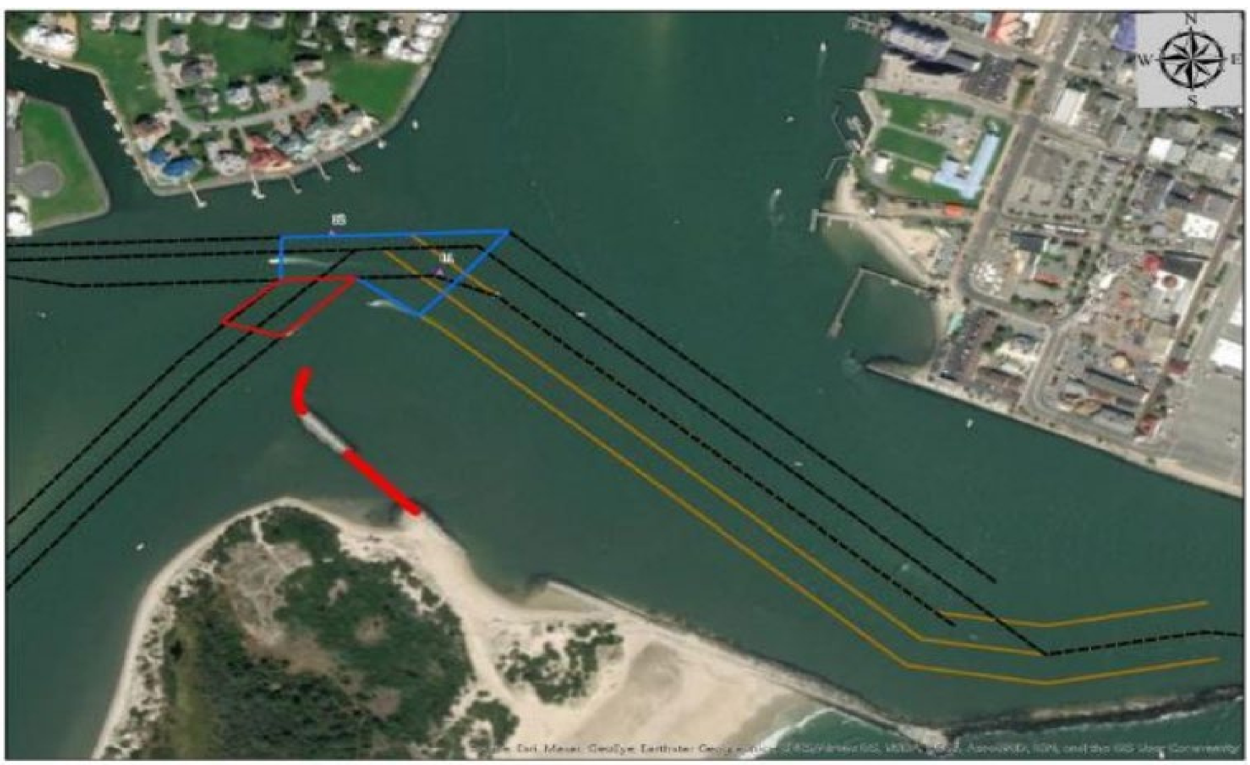

Figure 4 Alternative 2- extension of existing breakwaters, with realignment.

Alternative 3– Connection and Extension of Existing Breakwaters, with Inlet Channel Realignment

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Additionally, this alternative would include connecting the existing breakwaters at the north end of Assateague Island with 300-feet of stone and constructing a 200-foot addition to the breakwater to the northwest (Figure 5). This would result in a continuous structure at the northwest end of Assateague Island, which would extend toward the Sinepuxent Bay Federal Channel

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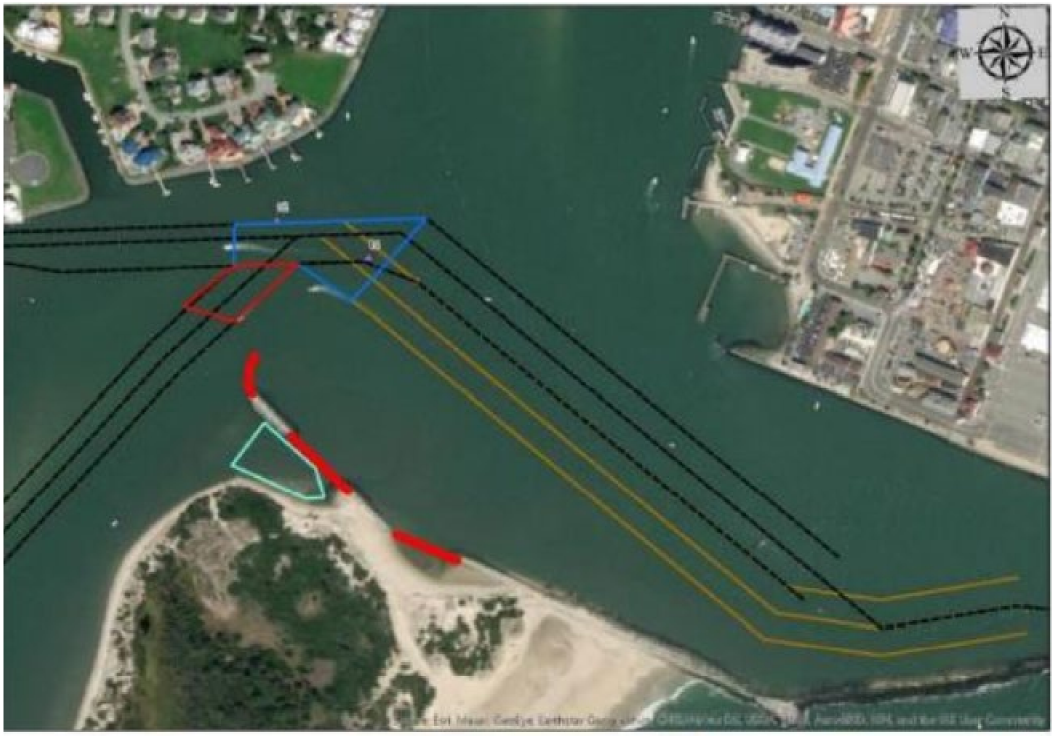

Figure 5 Alternative 3 - connection and extension of existing breakwaters, with realignment.

BENEFITS

Calculation of Avoided Costs

Project benefits are considered costs avoided which are calculated by comparing the without-project against the with-project condition Project benefits are determined by the differences in future O&M dredging costs:

WITH-PROJECT MAINTENANCE DREDGING

Maintenance dredging with a government-owned hopper dredge is the most cost-effective method to maintain the channel and dredging with a commercial dredge would increase the without project cost estimates. As established above, the without project maintenance costs are and $636,000 annually.

The proposed project is intended to reduce the required O&M dredging associated with the existing project. The proposed project is expected to change the maintenance dredging requirements from three to four times per year, to once every 5 years, with a quantity of 4,000 CY per operation. In order to estimate the with-project dredging costs, similar assumptions as the without-project were made that the dredging would be undertaken by government owned dredge, with comparable assumptions on production rates, costs, and mobilization / demobilization costs. Applying these criteria, it is estimated that dredging costs would be $52,000, every five years.

Both Alternative 2 and Alternative 3 would provide identical cost reduction benefits. Benefits are calculated based on reducing maintenance dredging frequency to once every five years. With project realignments to deeper waters, the number of vessels experiencing damages is reduced zero, and the number of vessels experiencing delays is reduced zero vessels. Table 4 shows the present value of without-project annualized costs.

Costs avoided are considered benefits and are calculated by estimating the difference in costs incurred between the without-project and with-project conditions. The present value of the benefits streams is calculated over the 50-year period of analysis and annualized at the current discount rate of 2.25%. Table 4 shows the present value of without-project annual costs are $636,000 and Table 5 shows with project annual costs with a 5-year dredging cycle is $10,000.

Table 4 Ocean City Inlet & Harbor Without-Project Conditions (Dredging Maintenance) Present Values Annualized (Discount Rate 2.250%; Price Level Oct-2021)

Evaluation Period	Dredging Cost	PV Factor	PV of Total Cost
1	636,000	0.9756	$620,488
2	636,000	0.9518	$605,354
3	636,000	0.9286	$590,589
4	636,000	0.9060	$576,185
5	636,000	0.8839	$562,131
6	636,000	0.8623	$548,421
7	636,000	0.8413	$535,045
8	636,000	0.8207	$521,995
9	636,000	0.8007	$509,263
10	636,000	0.7812	$496,842
11	636,000	0.7621	$484,724
12	636,000	0.7436	$472,902
13	636,000	0.7254	$461,367
14	636,000	0.7077	$450,114
15	636,000	0.6905	$439,136
16	636,000	0.6736	$428,425
17	636,000	0.6572	$417,976
18	636,000	0.6412	$407,782
19	636,000	0.6255	$397,836
20	636,000	0.6103	$388,132
21	636,000	0.5954	$378,666
22	636,000	0.5809	$369,430
23	636,000	0.5667	$360,419
24	636,000	0.5529	$351,629
25	636,000	0.5394	$343,052

Evaluation Period	Dredging Cost	PV Factor	PV of Total Cost
26	636,000	0.5262	$334,685
27	636,000	0.5134	$326,522
28	636,000	0.5009	$318,558
29	636,000	0.4887	$310,789
30	636,000	0.4767	$303,208
31	636,000	0.4651	$295,813
32	636,000	0.4538	$288,598
33	636,000	0.4427	$281,559
34	636,000	0.4319	$274,692
35	636,000	0.4214	$267,992
36	636,000	0.4111	$261,456
37	636,000	0.4011	$255,079
38	636,000	0.3913	$248,857
39	636,000	0.3817	$242,788
40	636,000	0.3724	$236,866
41	636,000	0.3633	$231,089
42	636,000	0.3545	$225,452
43	636,000	0.3458	$219,954
44	636,000	0.3374	$214,589
45	636,000	0.3292	$209,355
46	636,000	0.3211	$204,249
47	636,000	0.3133	$199,267
48	636,000	0.3057	$194,407
49	636,000	0.2982	$189,665
50	636,000	0.2909	$185,039
Present Value of Costs for Continuation of Existing Project:			**$18,038,430**
Capital Recovery Factor (CRF)			**0.0353**
Average Annual Cost = (PV of Total Costs) x (CRF)			**$636,000**

Table 5 Ocean City Inlet & Harbor With-Project Conditions Present Values Annualized (Discount Rate 2.250%; Price Level Oct-2021)

Evaluation Period	Dredging Cost	PV Factor	PV of Total Cost
1	0	0.9756	$0
2	0	0.9518	$0
3	0	0.9286	$0
4	0	0.9060	$0
5	52,000	0.8839	$45,960
6	0	0.8623	$0
7	0	0.8413	$0

Evaluation Period	Dredging Cost	PV Factor	PV of Total Cost
8	0	0.8207	$0
9	0	0.8007	$0
10	52,000	0.7812	$40,622
11	0	0.7621	$0
12	0	0.7436	$0
13	0	0.7254	$0
14	0	0.7077	$0
15	52,000	0.6905	$35,904
16	0	0.6736	$0
17	0	0.6572	$0
18	0	0.6412	$0
19	0	0.6255	$0
20	52,000	0.6103	$31,734
21	0	0.5954	$0
22	0	0.5809	$0
23	0	0.5667	$0
24	0	0.5529	$0
25	52,000	0.5394	$28,048
26	0	0.5262	$0
27	0	0.5134	$0
28	0	0.5009	$0
29	0	0.4887	$0
30	52,000	0.4767	$24,791
31	0	0.4651	$0
32	0	0.4538	$0
33	0	0.4427	$0
34	0	0.4319	$0
35	52,000	0.4214	$21,911
36	0	0.4111	$0
37	0	0.4011	$0
38	0	0.3913	$0
39	0	0.3817	$0
40	52,000	0.3724	$19,366
41	0	0.3633	$0
42	0	0.3545	$0
43	0	0.3458	$0
44	0	0.3374	$0
45	52,000	0.3292	$17,117
46	0	0.3211	$0
47	0	0.3133	$0
48	0	0.3057	$0
49	0	0.2982	$0

Evaluation Period	Dredging Cost	PV Factor	PV of Total Cost
50	52,000	0.2909	$15,129
Present Value of Costs With-Project:			**$280,584**
Capital Recovery Factor (CRF)			**0.0353**
Average Annual Cost = (PV of Total Costs) x (CRF)			**$10,000**

Costs avoided are considered benefits and are calculated by estimating the difference in costs incurred between the without-project and with-project conditions. Alternatives 2 and 3 provide identical benefits with annual benefits totaling $626,000. Table 6 summarizes total project benefits.

Table 6 Summary of Project Benefits

	FWOPC	FWPC	Benefits
Maintenance Dredging Costs Avoided	$636,000	$52,000	
Total Present Value	$18,038,430	$280,584	
Average Annual Value	$636,000	$10,000	$626,000

Average annual benefits are calculated using FY22 price level and discount rate of 2.25% over the 50-year period of analysis

In addition to reduced delay costs, there is a potential for increased use of the channel. As mentioned, commercial vessels with reported light loaded drafts over 10ft were excluded from the analysis because it is reasonable to assume those vessels would not repeatedly use the channel knowing the risks involved. When asked about their experience using the Inlet, 26 previously excluded respondents report a preference to offload in Ocean City but must do so elsewhere due to the shoaling problem.

PROJECT COSTS

Project construction costs are detailed in the Cost Engineering Appendix. Total annual costs for Alternatives 2 and 3 are summarized below in Table 7. All costs shown in the table are converted to annual terms using the Fiscal Year 2022 federal interest rate for water resources projects of 2.25 percent over a 50-year period of analysis. Two-year construction duration is assumed for interest during construction.

Table 7 Annualized Project Costs (in thousands)

Annualized Cost Calculation	Alternative 2	Alternative 3
Project Construction Cost	$7,912	$9,840
Interest During Construction	$360	$448
Total Investment Cost	$8,272	$10,287
Capital Recovery Factor (CRF) =	0.0335	0.0335
Average Annual Cost	$277	$345
Annual Operation & Maintenance Cost	$36	$36
Total Annual Cost	**$313**	**$381**

Costs are annualized over 50-year period of analysis using FY22 discount rate 2.25%

RECOMMENDED PLAN

A proposed project is considered economically justified if the benefits of the project exceed the costs. A project is considered economically justified if it has a benefit to cost ratio of 1.0 or greater. The alternative that maximizes net annual benefits is the alternative chosen for the National Economic Development (NED) plan. Table 8 presents net benefits and BCR of each alternative. Over a 50-year analysis period, Alternative 2 is the NED plan based on the highest net annual benefits of $312,000 and a 2.0 benefit to cost ratio. The NED plan will realign the authorized location of the federal channel to coincide with deeper water. Additionally, this alternative would include extending the existing breakwaters at the north end of Assateague Island with 300 feet of stone and constructing a 200-foot addition to the breakwater to the northwest.

Table 8 Evaluation of Alternatives (Benefit to Cost Ratio)

Alternative	Description	Annual Benefits	Annual Costs	Net Benefits	BCR
Alternative 1	No Action	-			
Alternative 2	Breakwater Extension	626,000	313,400	312,600	2.0
Alternative 3	Breakwaters Connected Extension	626,000	381,000	245,000	1.6

RISK AND UNCERTAINTY

There exists the risk of under predicting the requisite future dredging frequency. Current bathymetry shows that the current rate of shoaling is rapidly increasing from year to year. However, the realignment to deeper waters well below the authorized depth supports the current estimate. Table 9 shows the impact on net benefits if the maintenance cycle is increased as well as the volume. It is beneficial to undertake the project since increasing the maintenance cycle with-project projections show overall cost savings.

Table 9 Uncertainty in Fuel Costs Avoided

Benefits	Annual Benefits	Annual Costs	Net Benefits	BCR
Alternative 2				
2x Volume - Every 2 Years Cycle	$603,000	$329,231	$274,000	1.8
2x Volume - Annual Cycle	$532,000	$329,231	$203,000	1.6
Alternative 3				
2x Volume - Every 2 Years Cycle	$603,000	$400,651	$202,000	1.5
2x Volume - Annual Cycle	$532,000	$400,651	$131,000	1.3