APPENDIX F

Part II

Green Bay Harbor DMMP
Economic Evaluation of Alternative Plans

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Economic Evaluation of Alternative Plans

I. INTRODUCTION

The Green Bay Harbor Dredge Material Management Plan (DMMP) developed a number of plans that would allow dredging at Green Bay Harbor to continue for the next 20 years. Several alternatives were discussed in the main report that were not sufficient to meet the disposal needs of the next 20 years, these plans are discussed but their evaluation in this appendix is limited since they do not meet the 20 year requirement. This appendix documents the development of the plans that meet the 20 year requirement, their components and their costs. Average annual costs and average annual benefits are identified for each sufficient plan and used to develop benefit-cost ratios and net benefits. The project evaluation period for this DMMP is 2012 – 2031.

II. ALTERNATIVES/MEASURES

The Green Bay Harbor Dredge Material Management Plan (DMMP) reviewed a number of measures (17), including the "No Action" alternative, to develop plans that addressed the need to dispose of dredged material removed from the Harbor over the next 20 years. These 17 measures (referred to as "alternatives" in the main report) are listed in **Table F-II-1**. **Figure F-II-1** provides a depiction of a potential confined disposal facility (CDF) site location as associated with Alternatives 11, 12 and 17 (36 acre site). **Figure F-II-2** provides a depiction of the additional potential CDF site for Alternatives 12 and 17 (100 acre site). **Table F-II-2** provides the site, proposed acres, perimeter and design capacity for the various alternatives. Due to the late determination of site selection, there are no preliminary cost estimates for either the 36- or 100-acre site.

Table F-II-1 - Initial Measures Identified as Potential Components of Plans

MEASURES		Detailed Planning
1	No Action	YES
2	Construct One Island (West) with a Partial Barrier	YES
3	Construct One Island (West) with a Complete Barrier	YES
4	Construct Two Islands (West and Middle) with a Partial Barrier	YES
5	Construct Two Islands (West and Middle) with a Complete Barrier	YES
6	Construct Three Islands (West, Middle and East) with a Partial Barrier	YES
7	Construct Three Islands (West, Middle and East) with a Complete Barrier	YES
8	Construct One Island (East) with a Complete Barrier	YES
9	Open Water Placement	YES
10	Beach Nourishment	NO
11	Expand Brown County Bayport CDF - Adjacent Site	YES
12	Expand Brown County Bayport CDF & Holland Township Site	YES
13	Renard Island CDF - Barge	NO
14	Renard Island CDF - Causeway	NO
15	Construct Three Islands and Expand Brown County Bayport CDF - Adjacent	YES
16	Open Water Placement and Expand Brown County Bayport CDF	YES
17	Construct Two Islands and Expand Brown County Bayport CDF	YES

Green Bay Harbor DMMP, Green Bay, WI
Proposed Bayport Expansion, 36 Acre DMDF

Figure F-II-1

Green Bay Harbor DMMP, Green Bay, WI

Proposed Holland twp., Brown County, WI, 100 acre DMDF

Figure F-II-2

Table F-II-2 - Preliminary Disposal Site Characteristics									
Alternatives Impacted	**Proposed Site**	**Area (acres)**	**Perimeter (feet)**	**Preliminary Rough Construction Cost Estimate (millions)**	**Design Capacity (cy)**	**Design Capacity Inner Material (years)**	**Design Capacity Outer Material (years)**	**Environmental Habitat - Land (acres)**	**Environmental Habitat - Water (acres)**
11, 12, 15, 16, 17	Adjacent Land Site	36	5,193	$5.0	800,000	8.2		na	na
12, (17)	Holland Twp Land Site	100	8,400	$22.0	2,350,000		20.0	na	na
13, 14	Renard Island	Renard Island alternatives were removed from consideration since the project is being undertaken under different authority							
2	West Island - Partial Barrier	74	5,600	$9.9	630,000		5.4	74	420
3	West Island - Full Barrier	74	5,600	$13.5	630,000		5.4	74	1,423
4, 17	West & Middle Islands - Partial Barrier	166	8,000	$16.9	1,350,000		11.5	166	875
5	West & Middle Islands - Full Barrier	166	8,000	$19.2	1,350,000		11.5	166	1,331
6	West, Middle & East Islands - Incrementally Constructed Full Barrier	272	15,850	$34.5	2,350,000		20.0	272	1,225
7, 15	West, Middle & East Islands - Full Barrier	272	15,850	$34.2	2,350,000		20.0	272	1,225
8	East Island with Complete Barrier	106	12,000	$19.6	1,000,000		8.5	106	1,391

A. Preliminary Screening of Management Measures

Comparing Measures to Objectives – Complete descriptions of the 17 evaluated measures are presented in the main report. The No Action alternative, along with the 6 alternatives which meet the 20 year capacity requirements were evaluated in detail and descriptions are presented here

Those alternatives, along with the no action plan, which meet the 20 year capacity requirements were evaluated further and are presented here.

B. Measures Carried into Detailed Planning

Table F-II-3, Measures Carried into Detailed Planning		
1	No Action	YES
2	Construct One Island (West) with a Partial Barrier	*YES* *
3	Construct One Island (West) with a Complete Barrier	*YES* *
4	Construct Two Islands (West and Middle) with a Partial Barrier	*YES* *
5	Construct Two Islands (West and Middle) with a Complete Barrier	*YES* *
6	Construct Three Islands (West, Middle and East) with a Partial Barrier	*YES* *
7	Construct Three Islands (West, Middle and East) with a Complete Barrier	*YES* *
8	Construct One Island (East) with a Complete Barrier	*YES* *
9	Open Water Placement	*YES* *
10	Beach Nourishment	NO
11	Expand Brown County Bayport CDF - Adjacent Site	NO
12	Expand Brown County Bayport CDF - Holland Township Site	YES
13	Renard Island CDF - Barge	NO
14	Renard Island CDF - Causeway	NO
15	Construct Three Islands and Expand Brown County Bayport CDF - Adjacent	YES
16	Open Water Placement and Expand Brown County Bayport CDF	YES
17	Construct Two Islands and Expand Brown County Bayport CDF	YES

* These alternatives alone do not provide sufficient capacity, though each was evaluated for its suitability for combining with other disposal measures as in alternatives 15, 16 and 17.

The Green Bay Harbor DMMP identified thirteen measures resulting in five viable alternatives, including the "No Action" alternative, which would be evaluated in more detail. A description of these alternatives follows.

1. Alternative 1 - No Action. This alternative is essentially the Without Project Condition (WOPC). Under this measure, the Federal Government would do nothing to address the need for future long term placement of dredge material. 400,000 cy of material would still be removed from the existing cdf for placement on Renard Island. All Bayport CDFs are essentially filled after the 2015 dredging season, given their current configurations. Consequently, all federal action at Green Bay would cease after 2015.

Without dredging, the navigation channels would progressively shoal in and would result in reduced channel depths for commercial vessels and ultimately, a complete closure of the Harbor. Prior to the complete closure of the harbor to commercial traffic, reduced channel depths would result in the light loading of the commercial navigation vessels. Significant savings would be realized in the Federal budget as expenditures for operating and maintaining the Federal project at Green Bay Harbor would no longer be required. Consistent with USACE guidance (ER 1105-2-100) this measure will be carried forward into detailed planning and fully evaluated in the array of final plans.

2. **Alternatives 2 – 8 – Island Construction** – All of the Island construction options were evaluated further to determine the differences in terms of cost, capacity, and benefits. Since island construction alone does not provide sufficient capacity, island construction combined with other placement alternatives were evaluated in more detail and are designated as Alternatives 15 and 17 as described herein.

3. Alternative 9 – Open Water Placement. Dredge material would be placed in an open water disposal site approximately 51 miles from the outer channel of Green Bay Harbor, Lake Michigan. Dredge material from the outer Federal channel (Bay Mile 3 to 11) is classified as suitable for in-water placement. Since the inner material is not suitable for open water placement, this alternative does not meet the 20 year capacity requirement. Alternative 16 combines open water placement with a CDF for inner harbor material.

4. Alternative 12 - Expand Brown County Bayport CDF.

a. Inner Harbor Material: Bayport CDF will be expanded in 2023 to contain the dredge material from the Inner Channel to meet approximately 16 years of capacity. Brown County would then provide capacity for approximately 800,000 cy (for years 2024 – 2031) to meet the 20-year capacity requirement. The expansion would consist of constructing a 36 acre Dredge Material Disposal Facility (DMDF) adjacent to the existing Bayport CDF. The Corps would continue to pay a tipping fee for the Operation & Maintenance of the facility.

b. Outer Harbor Material: An additional Dredge Material Disposal Facility (DMDF) near Holland Township, Wisconsin, approximately 20 miles from the Bayport CDF would be constructed in year 2016 to provide additional capacity requirements for the outer harbor. The Corps would continue to pay a tipping fee for the Operation & Maintenance of the facility.

5. Alternative 15 - Construct Three Islands and Expand Brown County Bayport CDF.

a. Inner Harbor Material: Inner material will continue to be placed in Bayport CDF. In 2023, Bayport CDF will be expanded to provide capacity for approximately 800,000 cy for 2024 – 2031. The expansion would consist of constructing a 36 acre DMDF adjacent to the existing Bayport CDF. The Corps will continue to pay a tipping fee for the Operation & Maintenance of the facility.

b. Outer Harbor Material: An in-water DMDF consisting of three islands, referred to as the West, Middle, and East Islands, would be constructed with a complete wave barrier extending 8,600 feet eastward along the northeast side of the three islands to protect the islands and the shallow water habitat behind it as shown in Figures 6 and 7 of the main report. Outer Harbor dredge material will be placed in the islands ultimately restoring approximately 1,225 acres of water habitat and 272 acres of terrestrial habitat for a total restoration of 1,497 acres as shown in the plan view in Appendix A, Attachment B, Alternative 7.

6. Alternative 16 –Open Water Placement and Expand Brown County Bayport CDF.

a. Inner Harbor Material: Inner material will continue to be placed in the Bayport CDF. In 2023, the CDF will be expanded to provide capacity for approximately 800,000 cy for the years 2024 – 2031. The expansion would consist of constructing a 36 acre DMDF adjacent to the existing Bayport CDF. The Corps will continue to pay a tipping fee for the Operation & Maintenance of the facility.

b. Outer Harbor Material: Outer Harbor dredge material would be placed in an open water disposal site approximately 51 miles from the outer channel of the Harbor. Outer Federal channel (Bay Mile 3 to 11) dredge material is classified as suitable for in-water placement.

7. Alternative 17 – Construct a Two Island (West and Middle) DMDF with a Partial Wave Barrier and an Access Road, Expand Bayport CDF Adjacent to the Existing CDF and Construct a New CDF Off-Site.

a. Inner Harbor Material: In 2023, Bayport CDF will be expanded to provide capacity for approximately 800,000 cy of inner harbor material for the years 2024 – 2031. The expansion would consist of constructing a 36 acre DMDF adjacent to the existing Bayport CDF. The Corps will continue to pay a tipping fee for the Operation & Maintenance of the facility.

b. Outer Harbor Material: An in-water DMDF consisting of two islands, referred to as the West and Middle Islands, would be constructed with a partial wave barrier extending 5,400 feet eastward along the northeast side of the two islands to protect the islands and the shallow water habitat behind them as shown in Figure 6 of the main report. The islands will provide outer material capacity from 2012 – 2022 ultimately restoring approximately 875 acres of water habitat and 166 acres of terrestrial habitat for a total restoration of 1,041 acres. The remaining outer harbor material will be placed in a 100-acre DMDF constructed at the Holland Township, Wisconsin site approximately 20 miles from the current Bayport CDF.

C. Dredging Schedule

Table F-II-4 presents the dredging schedule for the 20 year evaluation period. Capacity will be reached in the existing CDF after the 2015 dredging cycle.

Table F-II-4 - Green Bay Harbor Sediment Dredging Schedule 2012 - 2031				
Project Evaluation Period				**2012 - 2031**
Calendar Year	**Project Year**	**Outer Harbor (cy)**	**Inner Harbor (cy)**	**DISPOSAL**
2012	1	117,500	97,800	Existing Bayport CDF
2013	2	117,500	97,800	Existing Bayport CDF
2014	3	117,500	97,800	Existing Bayport CDF
2015	4	117,500	97,800	Existing Bayport CDF
2016	5	117,500	97,800	New
2017	6	117,500	97,800	Dredge
2018	7	117,500	97,800	Material
2019	8	117,500	97,800	Disposal
2020	9	117,500	97,800	Site
2021	10	117,500	97,800	
2022	11	117,500	97,800	
2023	12	117,500	97,800	16 years
2024	13	117,500	97,800	of
2025	14	117,500	97,800	Dredging
2026	15	117,500	97,800	
2027	16	117,500	97,800	
2028	17	117,500	97,800	3,444,800
2029	18	117,500	97,800	Cubic
2030	19	117,500	97,800	Yards
2031	20	117,500	97,800	Placed
Evaluation Period Disposal		2,350,000	1,956,000	
Total Annual Disposal			215,300	

III. PLANS DEVELOPED AND EVALUATED IN DETAIL – COMPONENTS, CHARACTERISTICS and COSTS

The measures evaluated resulted in five alternatives that would meet the 20 year capacity requirements. These alternatives are:

Alternative 1 – No Action
Alternative 12 – Expand Brown County Bayport CDF
Alternative 15 – Construct Three Islands and Expand Brown County Bayport CDF
Alternative 16 – Open Water Placement and Expand Brown County Bayport CDF
Alternative 17 – Construct a Two Island (West and Middle) DMDF and Expand Bayport CDF

These plans are presented in detail in the main report. All plan costs represent FY 2010 prices. **Table F-II-5** provides the various components of the five alternative plans and general plan characteristics such as cubic capacity, acres, average cubic yards removed per year, lifespan, CDF and island construction costs, and costs per cubic yard based on construction costs.

A. Alternative 1 - No Action

The No Action Plan implies that no short term or long term measure for management of dredged material from Green Bay Harbor will be undertaken during the Planning Evaluation period (2012-2031). Under the No Action plan, all expenditures associated with dredging would cease in project year one, 2012. Future sediments deposited in commercial navigation channels from shoaling over the twenty year evaluation period (2012-2031) would not be dredged and would result in reduced channel depths for commercial vessels.

Table F-II-5 - Green Bay DMMP Plan Components

a. Plan Components

Alternatives	Management Measures				
	No Action	New CDF 36 Acre Site - Adjacent	New CDF 100 Acre Site - Holland Twp	Island Creation	Open Water
1 - No Action	X				
12 - New CDF		X	X		
15 - 3 Islands, New CDF		X		X	
16 - Open Water, New CDF		X			X
17 - 2 Islands, New CDF		X	X	X	

Table F-II-5 - Green Bay DMMP Plan Components, continued
2010 dollars

b. General Alternative Characteristics

Alternative Characteristics	Alternative				
	1	**12**	**15**	**16**	**17**
Existing Cubic Yard Capacity (as of 2012)	756,000	756,000	756,000	756,000	756,000
Additional Capacity after Renard*	400,000	400,000	400,000	400,000	400,000
New Cubic Yards	na	3,150,000	3,150,000	800,000+	1,000,000^
Land Acres/cy	na	136/ 3,150,000	36/ 800,000	36/ 800,000	<136/ 1,800,000
Open Water Acres/cy	na	0	0	*na/ 2,244,800*	0
Island Creation Acres/cy	na	0	272/ 2,350,000	0	166/ 1,350,000
Total Construction Costs # (thousands)	na	$212,700	$122,141	$258,298	$176,573
Cubic yds Placed/yr	215,300	215,300	215,300	215,300	215,300
Costs/cy		$49.40	$28.37	$59.99	$41.01
Life Span	5.37	20.0	20.0	19.51	19.51
Island Construction Costs	na	na	$23,423,310		$11,097,568
Cubic yds Placed in Islands	na	na	2,350,000		1,350,000
Construction Costs/cy Islands	na	na	$9.97		$8.22

* 400,000 cy will be removed from the existing facility and used for Renard Island

\+ Open water capacity determined by quantity needed to reach exact 20 year capacity requirements

^ 100 acre Holland site capacity determined by quantity needed to reach exact 20 year capacity requirements

\# includes all estimated construction, non-construction, dredging and placement

B. Alternative 12 - Expand Brown County Bayport CDF

Alternative 12 involves the expansion of the current CDF to include the 36 acre adjacent site and the 100 acre site approximately 20 miles south of the harbor in Holland Township.

Implementation costs associated with Alternative 12 include: dredging, CDF management and new CDF construction costs. CDF management costs for Alternative 12 include management costs for the current site, the adjacent 36 acre site and the 100 acre site. Prior to the determination of a selected plan, management costs were not determined in detail. The initial estimates include management costs in the estimated dredging costs since CDF management is performed by the local port authority and is reimbursed through tipping fees. Thus, management costs, based on actual expenditures, are not presented separately from dredging costs and are included in the dredging costs presented for each of the alternatives. The initial cost estimate for alternative 12 is presented in **Table F-II-6**.

This analysis assumes that the existing Bayport CDF is used through the 2016 dredging cycle then the 36 acre site is used through the 2020 dredge cycle and finally, the 100 acre site is used for the remain project life through 2031.

C. Alternative 15 - Construct Three Islands and Expand Brown County Bayport CDF

Alternative 15 involves the expansion of the current CDF to include the 36 acre adjacent site for inner material combined with the creation of the three cat islands for outer material.

Implementation costs associated with Alternative 15 include: dredging, CDF management, new CDF construction costs and island construction costs. CDF management costs for Alternative 15 include management costs for the current site and the adjacent 36 acre site. Prior to the determination of a selected plan, management costs were not determined in detail. The initial estimates include management costs in the estimated dredging costs since CDF management is performed by the local port authority and is reimbursed through tipping fees. Thus, management costs, based on actual expenditures, are not presented separately from dredging costs and are included in the dredging costs presented for each of the alternatives. The initial cost estimate for alternative 15 is presented in **Table F-II-7**.

Dredge material from the outer harbor will be placed in the islands beginning with 2012, year one of the project. For inner harbor material, the existing Bayport CDF will be utilized until capacity is reached after the 2022 dredge cycle, then material will be placed in the 36 acre expansion site.

D. Alternative 16 - Open Water Placement and Expand Brown County Bayport CDF.

Alternative 16 involves the expansion of the current CDF to include the 36 acre adjacent site for inner material combined with open water disposal of the outer material.

Implementation costs associated with Alternative 16 include: dredging, CDF management and new CDF construction costs. CDF management costs for Alternative 16 include management costs for the current site and the adjacent 36 acre site. Prior to the determination of a selected plan, management costs were not determined in detail. The initial estimates include management costs in the estimated dredging costs since CDF management is performed by the local port authority and is reimbursed through tipping fees. Thus, management costs, based on actual expenditures, are not presented separately from dredging costs and are included in the dredging costs presented for each of the alternatives. The initial cost estimate for alternative 16 is presented in **Table F-II-8**.

Dredge material from the outer harbor will be placed in the open water site beginning with 2012, year one of the project. For inner harbor material, the existing Bayport CDF will be utilized until capacity is reached after the 2022 dredge cycle, then material will be placed in the 36 acre expansion site.

E. Alternative 17 – Construct a Two Island (West and Middle) DMDF with a Partial Wave Barrier and an Access Road, Expand Bayport CDF Adjacent to the Existing CDF and Construct a New CDF Off-Site.

Alternative 17 involves the expansion of the current CDF to include the 36 acre adjacent site for inner material combined with construction of two of the cat islands and some placement on the 100 acre site. Once it was determined that all of the dredge material could not be contained in the current site and the adjacent 36 acre site, this alternative became too costly.

Implementation costs associated with Alternative 17 include: dredging, CDF management, new CDF construction costs and island construction costs. CDF management costs for Alternative 17 include management costs for the current site, the adjacent 36 acre site and the 100 acre site. Prior to the determination of a selected plan, management costs were not determined in detail. The initial estimates include management costs in the estimated dredging costs since CDF management is performed by the local port authority and is reimbursed through tipping fees. Thus, management costs, based on actual expenditures, are not presented separately from dredging costs and are included in the dredging costs presented for each of the alternatives. The initial cost estimate for alternative 15 is presented in **Table F-II-9**.

Dredge material from the outer harbor will be placed in the islands beginning with 2012, year one of the project, until full after the 2022 dredge cycle. Outer harbor material will then be placed in the 100 acre site through the end of the project life in 2031. The existing Bayport CDF will be utilized for inner harbor material until capacity is reached after the 2022 dredge cycle, then material will be placed in the 36 acre expansion site.

Table F-II-6

GREEN BAY DMMP, GREEN BAY, WISCONSIN

PROPOSED ALTERNATIVE 12 - Expand Brown County Bayport CDF

BROWN COUNTY EXPANDED BAYPORT CDF (Scenario 2 - Inner & Outer) – 2010 dollars

S. No.	Item Feature/Description	Quantities	Unit	Unit Cost	Alternative 12
	CONSTRUCTION COST				
12	NAVIGATION PORTS & HARBORS				
1.0	Dredging	4300000	CY	$30.37	$130,591,000.00
2.0	Cat Island Disposal	1.00	LS	$0.00	
3.0	Bayport 36 Acre Site	1.00	LS	$5,055,426.00	$ 5,055,426.00
4.0	Bayport 100 Acre Site	1.00	LS	$21,900,709.00	$21,900,709.00
	SUB TOTAL				$157,547,135.00
	CONTINGENCY 23%				$36,235,841.05
	CONSTRUCTION COST				**$193,782,976.05**
	NON CONSTRUCTION COST				
	Engineering & Design (3% of Total Const. Cost)				$ 4,726,400.00
	Supervision & Inspection (8% of Total Const. Cost)				$12,603,800.00
	Engineering & Design During Construction EDDC (0.5% of Total Const. Cost)				$ 787,700.00
	Planning/Program Management				$ 100,000.00
	Engineering Tech. Review ATR				$ 30,000.00
	Solicitation/Contracting				$ 400,000.00
	Real Estate				$ 25,000.00
	LEERDS				$ 200,000.00
	Environmental Branch				$ 44,000.00
	TOTAL NON CONSTRUCTION COST				**$ 18,916,900.00**
	TOTAL CONSTRUCTION COST				**$212,699,876.05**

Table F-II-7

GREEN BAY DMMP, GREEN BAY, WISCONSIN

PROPOSED ALTERNATIVE 15 - Construct 3 Islands and Expand Brown Cty Bayport CDF

COMBINATION OF ALTERNATIVE 7 & ALTERNATIVE 11 – 2010 dollars

S. No.	Item Feature/Description	Quantities	Unit	Unit Cost	Alternative 15
	CONSTRUCTION COST				
12	NAVIGATION PORTS & HARBORS				
1.0	Dredging	4300000	CY	$14.87	$ 63,941,000.00
2.0	Cat Island Disposal (Three Islands)	1.00	LS	$23,423,310.00	$ 23,423,310.00
3.0	Bayport 36 Acre Site	1.00	LS	$5,055,426.00	$ 5,055,426.00
4.0	Bayport 100 Acre Site	1.00	LS	$0.00	$ -
	SUB TOTAL				$ 92,419,736.00
	CONTINGENCY 20%				$ 8,483,947.20
	CONSTRUCTION COST				**$ 110,903,683.20**
	NON CONSTRUCTION COST				
	Engineering & Design (3% of Total Const. Cost)				$ 2,772,600.00
	Supervision & Inspection (8% of Total Const. Cost)				$ 7,393,600.00
	Engineering & Design During Construction EDDC (0.5% of Total Const. Cost)				$ 462,100.00
	Planning/Program Management				$ 100,000.00
	Engineering Tech. Review ATR				$ 30,000.00
	Solicitation/Contracting				$ 400,000.00
	Real Estate				$ 25,000.00
	LEERDS				$ 10,000.00
	Environmental Branch				$ 44,000.00
	TOTAL NON CONSTRUCTION COST				**$ 11,237,300.00**
	TOTAL CONSTRUCTION COST				**$ 122,140,983.20**

Table F-II-8

GREEN BAY DMMP, GREEN BAY, WISCONSIN

PROPOSED ALTERNATIVE 16 - Open Water Placement & Expand Brown Cty Bayport CDF

COMBINATION OF ALTERNATIVE 9 & ALTERNATIVE 11– 2010 dollars

S. No.	Item Feature/Description	Quantities	Unit	Unit Cost	Alternative 16
	CONSTRUCTION COST				
12	NAVIGATION PORTS & HARBORS				
1.0	Dredging	4300000	CY	$44.14	$189,802,000.00
2.0	Cat Island Disposal (Three Islands)	1.00	LS	$0.00	$ -
3.0	Bayport 36 Acre Site	1.00	LS	$5,055,426.00	$ 5,055,426.00
4.0	Bayport 100 Acre Site	1.00	LS	$0.00	$ -
	SUB TOTAL				$194,857,426.00
	CONTINGENCY 21%				$ 40,920,059.46
	CONSTRUCTION COST				**$235,777,485.46**
	NON CONSTRUCTION COST				
	Engineering & Design (3% of Total Const. Cost)				$ 5,845,700.00
	Supervision & Inspection (8% of Total Const. Cost)				$ 15,588,600.00
	Engineering & Design During Construction EDDC (0.25% of Total Const. Cost)				$ 487,100.00
	Planning/Program Management				$ 100,000.00
	Engineering Tech. Review ATR				$ 30,000.00
	Solicitation/Contracting				$ 400,000.00
	Real Estate				$ 25,000.00
	LEERDS				$ -
	Environmental Branch				$ 44,000.00
	TOTAL NON CONSTRUCTION COST				**$ 22,520,400.00**
	TOTAL CONSTRUCTION COST				**$258,297,885.46**

Table F-II-9

GREEN BAY DMMP, GREEN BAY, WISCONSIN
PROPOSED ALTERNATIVE 17 -
COMBINATION OF ALTERNATIVE 4 & ALTERNATIVE 11– 2010 dollars

S. No.	Item Feature/Description	Quantities	Unit	Unit Cost	Alternative 17
	CONSTRUCTION COST				
12	NAVIGATION PORTS & HARBORS				
1.0	Dredging	4300000	CY	$21.94	$ 94,342,000.00
2.0	Cat Island Disposal (Two Islands)	1.00	LS	$11,097,568.00	$ 11,097,568.00
3.0	Bayport 36 Acre Site	1.00	LS	$5,055,426.00	$ 5,055,426.00
4.0	Bayport 100 Acre Site	1.00	LS	$18,505,959.00	$ 18,505,959.00
	SUB TOTAL				$ 129,000,953.00
	CONTINGENCY 25%				$ 32,250,238.25
	CONSTRUCTION COST				**$ 161,251,191.25**
	NON CONSTRUCTION COST				
	Engineering & Design (3% of Total Const. Cost)				$ 3,870,000.00
	Supervision & Inspection (8% of Total Const. Cost)				$ 10,320,100.00
	Engineering & Design During Construction EDDC (0.25% of Total Const. Cost)				$ 322,500.00
	Planning/Program Management				$ 100,000.00
	Engineering Tech. Review ATR				$ 30,000.00
	Solicitation/Contracting				$ 400,000.00
	Real Estate				$ 25,000.00
	LEERDS				$ 210,000.00
	Environmental Branch				$ 44,000.00
	TOTAL NON CONSTRUCTION COST				**$ 15,321,600.00**
	TOTAL CONSTRUCTION COST				**$ 176,572,791.25**

F. Alternative Plan Dredging Costs

1. Introduction

Dredging costs per dredging event were calculated for each alternative. There are a number of pieces of information that need to be known before dredging costs can be calculated. These include frequency of dredging, cubic yards removed per cycle, the quality of the sediments and location of disposal sites (CDF / Island / Open Water). Once this information is known, fixed and variable costs for dredging associated with the various plans can be calculated.

2. Dredging Frequency, Cubic Yards Removed Per Dredging Event, Sediment Quality

The need for maintenance dredging arises from the buildup of shoal material in the navigation channel which leads to the restriction of the flow of commercial navigation. The need to dredge portions of the Outer and Inner harbor depends upon the continued operation of the various docks that receive the major bulk commodities that use Green Bay Harbor: coal, limestone, cement and concrete, sodium chloride, and pig iron and on the particular location of the greatest shoaling. Dredging sites are chosen based on greatest need.

Since the expansion of the Bayport Confined Disposal Facility (CDF) by Brown County in 2001, the current procedure has been to dredge the Harbor and dispose of all the dredged material in the Bayport CDF. Periodic testing is performed to determine the contamination levels of all dredged material. The dredge material from the inner channels and from the mouth of the Fox River, or mile zero to 3 miles out in the outer Bay channel, is considered contaminated material. Throughout this analysis, this material will be referred to as inner harbor material. Dredge material from miles 3 to 11 in the outer Bay channel is normally considered clean material and is referred to in this analysis as outer harbor material. Both materials are transported to Hurlbut Slip and placed on trucks, after which, they are transported to the CDF and dumped.

According to Detroit District Operations Office, prior-to-dredge and after-dredge surveys reveal that the Green Bay Harbor entrance channel shoals up to 3 feet annually in certain locations. The sides of the channel most often shoal heavier than the center but trouble spots of high shoaling occasionally occur in the channel center. Further, shoaling tends to occur heavily at the corners where the channel changes direction, often interfering with a vessel's turning capability. For budgetary reasons over the last decade, the Harbor has not been dredged to authorized depth for the entire width of the channels. For example, the outer channel has an authorized width of 500 feet, but is currently dredged to approximately 100 feet, a width that allows one-way traffic only. The accumulated sediments that are restricting the channel widths remain unaddressed and are referred to as backlog dredging needs.

Conversations with personnel at the Harbor reveal that because the channels have been dredged to authorized depth, albeit at restricted width, vessels carrying domestic cargo, called Lakers, do not routinely light load at the Harbor. When Detroit District ceased dredging the entire authorized width of the entrance channel in 1998, the undredged portions of the channel shoaled to block vessel traffic roughly 5-7 years thereafter. The exact time frame is unspecified because vessels naturally limited themselves to using the dredged portion of the channel. It was not until the outgoing salties began experiencing problems at the Harbor, circa 2003, that the extent of vessel

accessibility loss became evident. Salties, ocean-going vessels that transport international cargo, have ceased using Green Bay because of the restricted channel widths. As a potential alternative harbor, Menominee has rail and truck connections via the roughly 55 miles to the Green Bay area. However, Menominee has less than 3% of the storage capacity for coal than does Green Bay and less than 50% of the storage capacity for general cargo and corresponding stevedoring services. In addition, Green Bay has significant storage capacity for liquid cargo and stone, sand and dry bulk cargos where Menominee's capacity for these commodities is severely limited or non-existent.

Annual dredge quantities for Green Bay Harbor are expected to be 215,300 cy. The last few years, Green Bay Harbor was funded at a rate consistent with dredging the estimated 215,300 cubic yards estimated (228,000 cy in FY08, and over 200,000 cy in FY09). Also, the funding constraint that frequently kept the cubic yards down in the 150kcy range over the last 10 years was the cost of disposal into the Bayport Disposal facility operated by Brown County. If the Cat Islands are built, the cost of dredging will decrease by approximately $7 to $10 per cubic yard. This equates to much more dredging than was done in the past. Therefore, the estimated 215,300 cubic yards is an accurate assessment of the amount of dredging that should be completed in the future.

3. Dredging Costs per Dredging Event by Disposal Location

Quantities dredged in the past were limited by funds and by the prohibitive cost per cubic yard. The expected annual quantity per year is 215,300 CY as presented in the main report. **Table F-II-10** presents the quantities of material to be placed for each of the twenty project years.

Table F-II-11 summarizes the dredging costs per cubic yard by CDF site. Dredging costs per cubic yard for the 100 acre Holland Township site are greater than those for the adjacent 36 acre site due to the need to transport the material.

Table F-II-10
Green Bay Harbor Sediment Dredging Schedule-2009- 2028
Project Evaluation Period 2012 – 2031

Calendar Year	Project Year	Inner Harbor Material Placed	Outer Harbor Material Placed	Total Cubic yds Placed
2012	1	97,800	117,500	215,300
2013	2	97,800	117,500	215,300
2014	3	97,800	117,500	215,300
2015	4	97,800	117,500	215,300
2016	5	97,800	117,500	215,300
2017	6	97,800	117,500	215,300
2018	7	97,800	117,500	215,300
2019	8	97,800	117,500	215,300
2020	9	97,800	117,500	215,300
2021	10	97,800	117,500	215,300
2022	11	97,800	117,500	215,300
2023	12	97,800	117,500	215,300
2024	13	97,800	117,500	215,300
2025	14	97,800	117,500	215,300
2026	15	97,800	117,500	215,300
2027	16	97,800	117,500	215,300
2028	17	97,800	117,500	215,300
2029	18	97,800	117,500	215,300
2030	19	97,800	117,500	215,300
2031	20	97,800	117,500	215,300
Evaluation Period Disposal		1,956,000	2,350,000	4,306,000

Table F-II-11 Dredging Component Cost [1]								
Alternatives	**Disposal Site**	**Cost per cy to Dredge Sediment**	**Cost per cy Hydraulic Off-Loading**	**Cost per cy Trucking**	**Cost per cy Tipping Fee**	**Total Cost per cy to Remove and Place Dredge Sediment**	**Total yds Placed**	**Total Cost to Remove and Place Dredge Sediment**
12, 15, 16, 17	Existing	$6.12	$0.00	$4.60	$5.74	$16.46	1,156,000	$19,027,800
12, 15, 16, 17	36 Acre Site	$6.12	$0.00	$4.60	$5.74	$16.46	800,000	$13,168,000
12	100 Acre Site	not determined	$0.00	not determined		$41.98	2,350,000	$98,647,100
17	100 Acre Site		$0.00			$41.98	1,000,000	$41,977,500
15	3 Islands	$8.69	$3.53	$0.00	$0.00	$12.22	2,350,000	$28,717,000
16	Open Water	not determined		$0.00	$0.00	$67.10*	2,350,000	$157,685,000
17	2 Islands	$8.69	$3.53	$0.00	$0.00	$12.22	1,350,000	$16,497,000

[1] Appendix C – page C-103

These dredging costs per cubic yard by disposal site were then used with cubic yards removed per year, to develop variable dredging costs per dredging event by disposal location. Added to these variable costs were fixed costs consisting of mobilization and demobilization costs, Engineering and Design (E&D) and Supervision and Administration (S&A). **Table F-II-12** provides a summary of dredging costs per cycle by cubic yards removed by disposal location.

The cost of dredging at any one time is a function of the dredging event's variable and fixed costs. The variable costs of dredging are the product of an estimated cost per cubic yard of dredging by disposal site **(Table F-II-11)**, times the number of cubic yards removed that year **(Table F-II-10)**. Fixed costs consist of the mobilization/demobilization cost for the dredge, and the cost the District incurs in engineering, administering and supervising the entire dredging project each time the harbor is dredged. For Green Bay Harbor, the mobilization/demobilization cost is $155,833. Other fixed costs per dredging event (Engineering and Design, Supervision and Administration)) are set at $17,142[1] plus 11 percent of variable costs.

[1] $155,833 x 0.11 = $17,142.

4. Time Steam of Annual Dredging Costs by Alternative

The cyclical dredging costs presented in **Table F-II-12**, in conjunction with the dredging schedule presented in **Table F-II-10**, were used to develop a time stream of dredging costs associated with each of the plans being evaluated in detail over the project evaluation period: 2012-2031. **Table F-II-13** presents the annual and total dredging costs associated with each plan being evaluated. Dredging costs were used as inputs in calculating average annual implementation costs associated with each plan. Dredging costs are just one of many components that make up implementation costs associated with each alternative.

Table F-II-12 Summary of Dredging Costs per Cycle, by Placement Location
2010 dollars

		Current Bayport CDF Inner Material	Current Bayport CDF Outer Material	36 Acre Site Inner Material	36 Acre Site Outer Material	100 Acre Site Outer Material
Cubic Yards Placed		1,156,000	1,156,000	800,000	800,000	2,350,000
Variable Dredging Costs						
	Variable Cost per Cubic Yard	$16.46	$16.46	$16.46	$16.46	$41.98
	Cubic Yards Dredged	97,800	117,500	97,800	117,500	117,500
	Variable Dredging Costs	$1,609,788	$1,934,050	$1,609,788	$1,934,050	$4,932,355
Fixed Dredging Costs						
	Mobilization & Demobilization	$155,833	$155,833	$155,833	$155,833	$155,833
	E&D and S&A	$194,219	$229,888	$194,219	$229,888	$559,701
	Fixed Dredging Costs	$350,052	$385,721	$350,052	$385,721	$715,534
Total Dredging Costs per Dredging Event		$1,959,840	$2,319,771	$1,959,840	$1,959,840	$5,647,889

Table F-II-12 Summary of Dredging Costs per Cycle, by Placement Location, Continued 2010 dollars					
		100 Acre Site Outer Material	Open Water Outer Material	3 Islands	2 Islands
Cubic Yards Placed		1,000,000	2,350,000	2,350,000	1,350,000
Variable Dredging Costs					
	Variable Cost per Cubic Yard	$41.98	$67.10	$12.22	$12.22
	Cubic Yards Dredged	117,500	117,500	117,500	117,500
	Variable Dredging Costs	$4,932,355	$7,884,250	$1,435,850	$1,435,850
Fixed Dredging Costs					
	Mobilization & Demobilization	$155,833	$155,833	$155,833	$155,833
	E&D and S&A	$559,701	$884,410	$175,086	$175,086
	Fixed Dredging Costs	$715,534	$1,040,243	$330,919	$330,919
Total Dredging Costs per Dredging Event		$5,647,889	$8,924,493	$1,766,769	$1,766,769

IV. DEVELOPMENT OF PLAN AVERAGE ANNUAL COSTS

Section III described the alternative plans that would be evaluated in detail, and identified the year when various major expenditures would take place over the 20 year planning evaluation period. These major expenditures included dredging costs, new disposal site implementation costs (real estate, land costs, CDF engineering and design, plans and specs, construction costs, etc) and habitat restoration.

Plan costs were developed for each year of the 20 year project evaluation period for each plan under with project conditions. These expenditure time streams are provided in **Table F-II-14** for each of the alternative Plans evaluated.

These time streams of costs were then brought back to their present worth values using the Federal discount rate of 4.375 percent. The Plan Evaluation Period for this analysis is 20 years, starting in 2012 and ending in 2031. **Table F-II-15** provides a summary of this procedure. The present worth values in **Table F-II-15** represent an estimate of Project First Costs for the various plans. Project First Costs include Engineering and Design, Supervision and Administration and Land costs by Plan. Total investment costs were converted to an average annual basis using the water resources Federal discount rate of 4.375 percent, and a 20 year project life. Annual maintenance costs, covered in the tipping fees, were derived from existing expenses and through consultation with the local sponsor, who provides the annual maintenance. Annual maintenance costs were added to average annualized investment costs to arrive at plan average annual costs **(Table F-II-16)**.

Table F-II-13 – Time Stream of Dredging Costs per Year by Plan

Project Evaluation Year	Alternative 1	Alternative 12	Alternative 15	Alternative 16	Alternative 17
annual	$ -	$6,529,550	$3,197,050	$9,490,100	$4,717,100
Total		$130,591,000	$63,941,000	$189,802,000	$94,342,000

Table F-II-14 - Time Stream of Plan Costs

Alternative Plan 1- No Action

Evaluation Period	Calendar Year	Dredging Costs	Real Estate	LEERDs	Environ'l Studies	Solicitation and Contracting	Engineering Tech. Review ATR	Planning/ Project Mgt	36 Acre Site Const'n	100 Acre Site Const'n	Const'n Contingency	Engineering & Design	Supervision & Inspection	Engineering & Design During Const'n	Costs in 2010 dollars
0	2011	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1	2012	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2	2013	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3	2014	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4	2015	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5	2016	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
6	2017	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
7	2018	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	2019	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9	2020	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	2021	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11	2022	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	2023	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
13	2024	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
14	2025	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
15	2026	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
16	2027	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
17	2028	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
18	2029	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
19	2030	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
20	2031	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Table F-II-14 - Time Stream of Plan Costs - Continued

Alternative Plan 12 - Expand Brown County Bayport CDF

Evaluation Period	Calendar Year	Dredging Costs	Real Estate	LEERDs	Environ'l Studies	Solicitation and Contracting	Engineering Tech. Review ATR	Planning/ Project Mgt	2016 36 Acre Site Const'n	2020 100 Acre Site Const'n	Const'n Contingency	Engineering & Design	Engineering Supervision & Inspection	Engineering & Design During Const'n	Costs in 2010 dollars
0	2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	2012	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
2	2013	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
3	2014	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
4	2015	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
5	2016	$6,529,550				$200,000	$15,000	$50,000	$5,055,426		$2,664,544	$347,549	$926,798	$57,925	$15,846,793
6	2017	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
7	2018	$6,529,550	$25,000	$200,000		$200,000	$15,000	$50,000		$21,900,709	$6,538,960	$852,908	$2,274,421	$142,151	$38,728,698
8	2019	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
9	2020	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
10	2021	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
11	2022	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
12	2023	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
13	2024	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
14	2025	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
15	2026	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
16	2027	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
17	2028	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
18	2029	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
19	2030	$6,529,550									$1,501,797	$195,887	$522,364	$32,648	$8,782,245
20	2031	$6,529,550			$4,400						$1,501,797	$195,887	$522,364	$32,648	$8,786,645
		$130,591,000	$25,000	$200,000	$44,000	$400,000	$30,000	$100,000	$5,055,426	$21,900,709	$36,235,841	$4,726,400	$12,603,800	$787,700	$212,699,876
% of Total		61.40%	0.01%	0.09%	0.02%	0.19%	0.01%	0.05%	2.38%	10.30%	17.04%	2.22%	5.93%	0.37%	100.00%

See Appendix C – page C-13

Table F-II-14 - Time Stream of Plan Costs - Continued

Alternative Plan 15 - Construct Three Islands and Expand Brown County Bayport CDF

Evaluation Period	Calendar Year	Dredging Costs	Real Estate	LEERDs	Environ'l Studies	Solicitation and Contracting	Engineering Tech. Review ATR	Planning/ Project Mgt	2022 36 Acre Site Const'n	2012 3 Islands Const'n	Const'n Contingency	Engineering & Design	Supervision & Inspection	Engineering & Design During Const'n	Costs in 2010 dollars
0	2011	-	$25,000	$10,000		$200,000	$15,000	$50,000		$23,423,310	$4,684,662	$702,699	$1,873,865	$117,117	$31,101,653
1	2012	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
2	2013	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
3	2014	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
4	2015	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
5	2016	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
6	2017	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
7	2018	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
8	2019	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
9	2020	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
10	2021	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
11	2022	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
12	2023	$3,197,050			$4,400	$200,000	$15,000	$50,000	$5,055,426		$1,650,495	$247,574	$660,198	$41,262	$11,121,406
13	2024	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
14	2025	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
15	2026	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
16	2027	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
17	2028	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
18	2029	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
19	2030	$3,197,050									$639,410	$95,912	$255,764	$15,985	$4,204,121
20	2031	$3,197,050			$4,400						$639,410	$95,912	$255,764	$15,985	$4,208,521
		$63,941,000	$25,000	$10,000	$44,000	$400,000	$30,000	$100,000	$5,055,426	$23,423,310	$18,483,947	$2,772,600	$7,393,600	$462,100	$122,140,983
% of Total		52.35%	0.02%	0.01%	0.04%	0.33%	0.02%	0.08%	4.14%	19.18%	15.13%	2.27%	6.05%	0.38%	100.00%

See Appendix C – page C-14

Table F-II-14 - Time Stream of Plan Costs - Continued

Alternative Plan 16 - Open Water Placement and Expand Brown County Bayport CDF

Evaluation Period	Calendar Year	Dredging Costs	Real Estate	LEERDs	Environ'l Studies	Solicitation and Contracting	Engineering Tech. Review ATR	Planning/ Project Mgt	2022 36 Acre Site Const'n	Const'n Contingency	Engineering & Design	Supervision & Inspection	Engineering & Design During Const'n	Costs in 2010 dollars
0	2011	-	-	-	-	-	-	-	-	-	-	-	-	-
1	2012	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
2	2013	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
3	2014	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
4	2015	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
5	2016	$9,490,100			$11,000					$1,992,921	$284,703	$759,208	$23,725	$12,561,657
6	2017	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
7	2018	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
8	2019	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
9	2020	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
10	2021	$9,490,100			$11,000					$1,992,921	$284,703	$759,208	$23,725	$12,561,657
11	2022	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
12	2023	$9,490,100	$25,000			$400,000	$30,000	$100,000	$5,055,426	$3,054,560	$436,366	$1,163,642	$36,364	$19,791,458
13	2024	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
14	2025	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
15	2026	$9,490,100			$11,000					$1,992,921	$284,703	$759,208	$23,725	$12,561,657
16	2027	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
17	2028	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
18	2029	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
19	2030	$9,490,100								$1,992,921	$284,703	$759,208	$23,725	$12,550,657
20	2031	$9,490,100			$11,000					$1,992,921	$284,703	$759,208	$23,725	$12,561,657
		$189,802,000	$25,000	$0	$44,000	$400,000	$30,000	$100,000	$5,055,426	$40,920,059	$5,845,700	$15,588,600	$487,100	$258,297,885
% of Total		73.48%	0.01%	0.00%	0.02%	0.15%	0.01%	0.04%	1.96%	15.84%	2.26%	6.04%	0.19%	100.00%

See Appendix C – page C-15

Table F-II-14 - Time Stream of Plan Costs - Continued

Alternative Plan 17 - Two Islands, 36 Acre Expansion, partial 100 Acre Expansion

Evaluation Period	Calendar Year	Dredging Costs	Real Estate	LEERDs	Environ'l Studies	Solicitation and Contracting	Engineering Tech. Review ATR	Planning/ Project Mgt	2022 36 Acre Site Const'n	2022 100 Acre Site Const'n	2012 2 Islands Const'n	Const'n Contingency	Engineering & Design	Supervision & Inspection	Engineering & Design During Const'n	Costs in 2010 dollars
0	2011			$10,000		$200,000	$15,000	$50,000			$11,097,568	$2,774,392	$332,927	$887,805	$27,744	$15,395,436
1	2012	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
2	2013	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
3	2014	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
4	2015	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
5	2016	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
6	2017	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
7	2018	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
8	2019	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
9	2020	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
10	2021	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
11	2022	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
12	2023	$4,717,100	$25,000	$200,000	$4,400	$200,000	$15,000	$50,000	$5,055,426	$18,505,959		$7,069,621	$848,355	$2,262,279	$70,696	$39,023,836
13	2024	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
14	2025	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
15	2026	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
16	2027	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
17	2028	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
18	2029	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
19	2030	$4,717,100										$1,179,275	$141,513	$377,368	$11,793	$6,427,049
20	2031	$4,717,100			$4,400							$1,179,275	$141,513	$377,368	$11,793	$6,431,449
		$94,342,000	$25,000	$210,000	$44,000	$400,000	$30,000	$100,000	$5,055,426	$18,505,959	$11,097,568	$32,250,238	$3,870,000	$10,320,100	$322,500	$176,572,791
% of Total		53.43%	0.01%	0.12%	0.02%	0.23%	0.02%	0.06%	2.86%	10.48%	6.28%	18.26%	2.19%	5.84%	0.18%	100.00%

See Appendix C – page C-16

Table F-II-15 - Present Worth of Alternative Costs - Alternatives 12, 15, 16, 17										
		Alternative Costs in Current Dollars					Alternative Costs in Present Worth Dollars			
Evaluation Period	Calendar Year	Alt. 12	Alt. 15	Alt. 16	Alt. 17	Present Worth Factor	Alt. 12	Alt. 15	Alt. 16	Alt. 17
0	2011	-	$31,101,653	-	$15,395,436	1.0000000	-	$31,101,653	-	$15,395,436
1	2012	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.9580838	$8,414,127	$4,027,900	$12,024,582	$6,157,651
2	2013	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.9179246	$8,065,478	$3,863,105	$11,520,557	$5,903,585
3	2014	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.8794487	$7,723,534	$3,697,309	$11,037,660	$5,652,260
4	2015	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.8425856	$7,403,501	$3,546,039	$10,575,003	$5,419,046
5	2016	$15,846,793	$4,204,121	$12,561,657	$6,427,049	0.8072677	$12,792,603	$3,393,851	$10,140,620	$5,188,349
6	2017	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.7734301	$6,795,856	$3,254,997	$9,707,056	$4,974,276
7	2018	$38,728,698	$4,204,121	$12,550,657	$6,427,049	0.7410109	$28,698,387	$3,115,299	$9,300,173	$4,762,513
8	2019	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.7099505	$6,238,083	$2,987,842	$8,910,346	$4,566,010
9	2020	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.6801921	$5,973,614	$2,859,610	$8,536,858	$4,371,628
10	2021	$8,786,645	$4,208,521	$12,561,657	$6,431,449	0.6516811	$5,726,090	$2,742,613	$8,186,194	$4,191,253
11	2022	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.6243651	$5,483,327	$2,624,906	$7,836,192	$4,012,825
12	2023	$8,786,645	$11,121,406	$19,791,458	$39,023,836	0.5981941	$5,256,119	$6,652,760	$11,839,134	$23,343,829
13	2024	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.5731201	$5,033,281	$2,409,466	$7,193,034	$3,683,471
14	2025	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.5490971	$4,824,721	$2,310,887	$6,891,530	$3,531,490
15	2026	$8,782,245	$4,204,121	$12,561,657	$6,427,049	0.5260811	$4,620,173	$2,211,708	$6,608,450	$3,381,149
16	2027	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.5040298	$4,428,730	$2,121,220	$6,325,905	$3,241,642
17	2028	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.4829028	$4,240,970	$2,030,182	$6,060,747	$3,103,640
18	2029	$8,786,645	$4,208,521	$12,550,657	$6,431,449	0.4626613	$4,065,241	$1,947,120	$5,806,704	$2,975,583
19	2030	$8,782,245	$4,204,121	$12,550,657	$6,427,049	0.4432683	$3,892,891	$1,863,554	$5,563,309	$2,848,907
20	2031	$8,786,645	$4,208,521	$12,561,657	$6,431,449	0.4246882	$3,731,585	$1,787,309	$5,334,788	$2,731,361
		$212,699,897	$122,140,983	$258,297,885	$176,572,791		$143,408,310	$90,549,328	$169,398,843	$119,435,904

Table F-II-16 - Alternative Average Annual Costs					
	Alternative				
	1	12	15	16	17
	No Action	36 & 100 acre CDF's	3 Islands & CDF	Open Water & CDF	2 Islands & CDF's
Total Implementation Costs					
100 acre site construction	-	$21,900,709	-	-	$18,505,959
36 acre site construction	-	$5,055,426	$5,055,426	$5,055,426	$5,055,426
Island construction	-	-	$23,423,310	-	$11,097,568
Construction Contingency	-	$36,235,841	$18,483,947	$40,920,059	$32,250,238
Engineering & Design	-	$4,726,400	$2,772,600	$5,845,700	$3,870,000
E&D during Construction	-	$787,700	$462,100	$487,100	$322,500
Supervision & Inspection	-	$12,603,800	$7,393,600	$15,588,600	$10,320,100
LEERD's	-	$200,000	$10,000	$0	$210,000
Dredging Costs	-	$130,591,000	$63,941,000	$189,802,000	$94,342,000
All Other Project Costs	-	$599,000	$599,000	$599,000	$599,000
Total Implementation Costs	-	$212,699,876	$122,140,983	$258,297,885	$176,572,791
Present Value of Implementation Costs	-	$143,408,310	$90,549,328	$169,398,843	$119,435,904
Alternative Average Annual Costs					
Investment Costs					
First Costs-Present Value	-	$143,408,310	$90,549,328	$169,398,843	$119,435,904
Interest During Construction (1)	-	$1,652,063	$1,280,893	$309,832	$2,332,201
Investment Costs	-	$145,060,373	$91,830,221	$169,708,676	$121,768,105
Average Annual Costs					
Investment Costs	-	$145,060,373	$91,830,221	$169,708,676	$121,768,105
Capital Recovery Factor (2)	-	0.07605	0.07605	0.07605	0.07605
Average Annual Costs	-	$11,031,221	$6,983,296	$12,905,619	$9,259,944
Annual tipping fees (3)	-	$1,235,822	$561,372	$561,372	$864,875
Total Average Annual Costs	**-**	**$12,267,043**	**$7,544,668**	**$13,466,991**	**$10,124,818**

V. DEVELOPMENT OF PLAN AVERAGE ANNUAL BENEFITS

Benefits for this evaluation are the commercial navigation transportation cost increases avoided, by continuing to maintain the channels at the harbor. Maintained channel depths at Green Bay Harbor are 26 feet LWD in the outer harbor and 24 feet LWD in the Inner Harbor. The difference in vessel transportation costs associated with maintaining current harbor depths (With Project Condition-WP) and vessel transportation costs associated with discontinuing harbor dredging (Without Project Condition-WOP), over a 20 year period, are the benefits associated with continuing to maintain the harbor.

The increase in vessel transportation costs under the WOP condition is a function of the harbors shoaling rate. If Green Bay harbor dredging were to cease, the federal navigation channel would fill in rather quickly with sediment. The infilling would take only a few years in certain areas, particularly those that intersect zones of high sediment transport. Conversely, there might be some parts of the channel that would take considerably longer to completely fill. Regardless of these areas of low deposition, the channel would be unusable once any part of it fills in, which, based on a 3 foot per year shoaling rate, is likely to take only a few years. The equilibrium depth of the harbor would vary along the 11 miles of federal channel in Green Bay since the depth of the bay varies. Assuming no dredging, depth would approach that of the bay on either side of the present channel with a limiting depth of 5 feet. Thus, the equilibrium limiting depth of the channel is assumed to be 5 feet. The shoaling rate impacts the rate of increase in vessel transportation costs under the Without Project condition, when harbor channels are allowed to shoal in.

Transportation cost associated with not maintaining the harbor is the transportation cost time stream that develops due to discontinued dredging and the harbors annual shoaling rate. A transportation cost time stream was developed for a 20-year evaluation period based on the shoaling rate and the annual transportation costs by maintained channel depth provided in Part I of Appendix F. Part I of this appendix contains an economic evaluation entitled “Green Bay Harbor Economic Viability Analysis.” **Table F-I-3** of this Green Bay Harbor viability analysis provides the average annual vessel transportation costs associated with the WP Condition (continued maintenance of the harbors authorized channels of 26 feet in the outer Harbor and 24 feet in the Inner Harbor). These average annual transportation costs are $63,141,958.

Green Bay Harbor channels were allowed to decrease to 16.0/14.0 feet LWD, based on the limiting 3 foot per year shoaling rate. Channels were allowed to shoal up 10 feet and then remain at that depth for the remainder of the 20 year evaluation period. Although the Green Bay Harbor equilibrium channel depth was assumed to be 5 feet, modeling efforts stopped at 16.0/14.0 since damages were assumed maximized at that point and data limitations prevented modeling beyond that level. Transportation cost time streams were developed for a 20 year evaluation period based on these shoaling rates. **Table F-I-4** provides a summary of the transportation cost time streams given the shoaling rate and assuming a 20-year project life.

Thus, if dredging at Green Bay Harbor were to cease, the channels would gradually fill in and additional transportation costs would be incurred. **Table F-I-6** of Appendix F, “Green Bay Harbor

Economic Viability Analysis", summarizes these WOP transportation costs, given the shoaling rate. WOP condition average annual transportation costs are $87,656,900.

Alternative plan benefits are the difference between WOP and WP condition transportation costs **(Table F-II-17)**. The annual benefits associated with maintaining harbor depths are $24,514,942. Greater detail on the calculation of WOP and WP condition average annual vessel transportation costs can be found in Appendix F: Part I, "Green Bay Harbor Economic Viability Analysis".

Table F-II-17 - Green Bay Harbor Average Annual Transportation Cost Savings Associated with Maintaining a 26/24 Foot Channel Depth
Shoaling Rate - 3.0 ft/yr

Commodity	WOP Condition Average Annual Transportation Costs	WP Condition Average Annual Transportation Costs	Average Annual Transportation Benefits
Cement & Concrete	$9,814,500	$4,575,166	$5,239,334
Coal	$62,127,600	$48,252,556	$13,875,044
Sodium Chloride	$6,356,000	$3,438,752	$2,917,248
Limestone	$7,256,000	$5,035,636	$2,220,364
Pig Iron	$2,102,800	$1,839,848	$262,952
Total	$87,656,900	$63,141,958	$24,514,942

VI. PLAN BENEFIT-COST RATIOS

Table F-II-18 provides Benefit Cost Ratios by alternative plan. The benefit cost ratio is the ratio developed by dividing plan average annual benefits **(Table F-II-17)** by plan average annual costs **(Table F-II-16).**

Table F-II-18 shows benefit-cost ratios ranging from 1.82 to 3.25 prior to any risk adjustment of the costs. Alternative 1, the No Action Plan, has no net benefits and no net costs, but does not provide any facilities to place sediments. This alterative does not meet the major goal of providing sediment storage facilities for a 20 year evaluation period. Alternative 15 has the lowest average annual costs. Thus, Alternative 15 is the Base Plan. Alternative 15 also has the greatest net benefits and is therefore, also the NED Plan.

Table F-II-18 - Benefit-Cost Ratios by Plan					
Benefit-Cost Ratios - 20-Year Project Evaluation Period - 4.375% Annual Interest Rate					
	Alternative				
	1	12	15	16	17
	No	36 & 100	3 Islands	Open Water	2 Islands
	Action	acre CDF's	& CDF	& CDF	& CDF's
Annual Benefits					
Without Project Transportation Costs	$87,656,900	$87,656,900	$87,656,900	$87,656,900	$87,656,900
With Project Transportation Costs	$87,656,900	$63,141,958	$63,141,958	$63,141,958	$63,141,958
Average Annual Plan Benefits	$0	$24,514,942	$24,514,942	$24,514,942	$24,514,942
Annual Costs					
W/Project Harbor Maintenance Costs	$ -	$12,267,043	$7,544,668	$13,466,991	$10,124,818
W/O Project Harbor Maintenance Costs	$ -	$ -	$ -	$ -	$ -
Plan Costs	$ -	$12,267,043	$7,544,668	$13,466,991	$10,124,818
Benefit-Cost Ratios					
Average Annual Benefits	$ -	$24,514,942	$24,514,942	$24,514,942	$24,514,942
Average Annual Costs		$12,267,043	$7,544,668	$13,466,991	$10,124,818
Benefit-Cost Ratio	0.00	2.00	3.25	1.82	2.42
Annual Net Benefits	$ -	$12,247,899	$16,970,274	$11,047,951	$14,390,124

VII. THE SELECTED PLAN

Once Alternative 15 was determined to be the Base Plan, the Walla Walla District Cost-Risk Analysis Team prepared a detailed cost-risk analysis and provided revised contingencies which were then incorporated into the Total Project Cost Summary as presented in Appendix C – The Cost Engineering Appendix to this report. The revised cost is presented here, including the dredging costs, in Table **F-II-19**. A time stream of these costs is presented in **Table F-II-20** with present worth values presented in **Table F-II-21**. Revised average annual costs are presented in **Table F-II-22**. **Table F-II-23** presents the revised Benefit-Cost Ratio utilizing the refined cost estimate.

Table F-II-19 – Revised Alternative 15 Costs		
FY2010		
Construction Costs	$28,477,000	
Construction Contingency	$5,695,000	
Total Construction (1)		$34,171,000
Lands & Damages (2)		$11,000
Planning, Engineering & Design (2)		$1,507,000
Project Management	$66,000	
Planning & Environmental Compliance	$54,000	
Engineering & Design	$1,025,000	
Engineering Technical Review - ATR & VE	$34,000	
Contracting & Reprographics	$90,000	
Engineering During Construction	$172,000	
Planning During Construction	$66,000	
Construction Management (2)		$2,734,000
Construction Management	$2,734,000	
SUBTOTAL (1)		$38,424,000
Dredging		$74,592,864
Dredging (3)	$63,941,000	
Dredging Contingency	$10,651,864	
Total First Costs		$113,016,864
Interest During Construction (IDC) (4)		$17,748,683
TOTAL COSTS		**$130,765,547**
(1) Cost Appendix p. C-17		
(2) Includes contingency		
(3) Cost Appendix p. C-14		
(4) IDC calculated on risk adjusted construction cost of $28,108,000 for 3 Islands,		
$5,147,000 for 36 acre site and $918,000 for capping using current interest rate of 4.375%		
& corresponding construction periods as presented in Section 6.2 of the Cost Appendix		

Table F-II-20 - Time Stream of Plan Costs - Post Risk Adjusted Cost Estimate

Alternative 15 - Construct Three Islands and Expand Brown County Bayport CDF

Evaluation Period	Calendar Year	Dredging Costs (1)	Lands & Damages	PED	Construction Management	2023 36 Acre Site Construction	2011-2013 Three Islands Construction	Construction Contingency (2)	Costs in FY2010 dollars
0	2011		$11,000	$150,410	$299,867		$3,123,067	$609,050	$4,193,393
1	2012	$3,197,050		$470,000	$899,600		$9,369,200	$2,406,593	$16,342,443
2	2013	$3,197,050		$470,000	$899,600		$9,369,200	$2,406,593	$16,342,443
3	2014	$3,197,050		$82,250	$157,430		$1,639,610	$860,543	$5,936,883
4	2015	$3,197,050						$532,593	$3,729,643
5	2016	$3,197,050						$532,593	$3,729,643
6	2017	$3,197,050						$532,593	$3,729,643
7	2018	$3,197,050						$532,593	$3,729,643
8	2019	$3,197,050						$532,593	$3,729,643
9	2020	$3,197,050						$532,593	$3,729,643
10	2021	$3,197,050						$532,593	$3,729,643
11	2022	$3,197,050						$532,593	$3,729,643
12	2023	$3,197,050		$272,000	$412,000	$4,289,000		$1,390,593	$9,560,643
13	2024	$3,197,050						$532,593	$3,729,643
14	2025	$3,197,050						$532,593	$3,729,643
15	2026	$3,197,050						$532,593	$3,729,643
16	2027	$3,197,050						$532,593	$3,729,643
17	2028	$3,197,050						$532,593	$3,729,643
18	2029	$3,197,050						$532,593	$3,729,643
19	2030	$3,197,050						$532,593	$3,729,643
20	2031	$3,197,050		$78,000	$73,000	$765,000		$685,593	$4,798,643
Total		$63,941,000	$11,000	$1,522,660	$2,741,497	$5,054,000	$23,501,077	$16,347,864	$113,119,097
% of Total		56.53%	0.01%	1.35%	2.42%	4.47%	20.78%	14.45%	100.00%

(1) Cost appendix p. C-14

(2) Construction contingency of $5,695,000 + dredging contingency $10,651,864 = $16,346,864

Table F-II-21 - Present Worth of Alternative 15 Risk Adjusted Costs

Evaluation Period	Calendar Year	Costs Alt. 15	Present Worth Factor	Present Worth Alt. 15
0	2011	$4,193,393	1.0000000	$4,193,393
1	2012	$16,342,443	0.9580838	$15,657,431
2	2013	$16,342,443	0.9179246	$15,001,131
3	2014	$5,936,883	0.8794487	$5,221,184
4	2015	$3,729,643	0.8425856	$3,142,544
5	2016	$3,729,643	0.8072677	$3,010,820
6	2017	$3,729,643	0.7734301	$2,884,618
7	2018	$3,729,643	0.7410109	$2,763,706
8	2019	$3,729,643	0.7099505	$2,647,862
9	2020	$3,729,643	0.6801921	$2,536,874
10	2021	$3,729,643	0.6516811	$2,430,538
11	2022	$3,729,643	0.6243651	$2,328,659
12	2023	$9,560,643	0.5981941	$5,719,121
13	2024	$3,729,643	0.5731201	$2,137,534
14	2025	$3,729,643	0.5490971	$2,047,936
15	2026	$3,729,643	0.5260811	$1,962,095
16	2027	$3,729,643	0.5040298	$1,879,851
17	2028	$3,729,643	0.4829028	$1,801,055
18	2029	$3,729,643	0.4626613	$1,725,562
19	2030	$3,729,643	0.4432683	$1,653,233
20	2031	$4,798,643	0.4246882	$2,037,927
		$113,119,097		$82,783,074

Table F-II-22 - Alternative 15 Average Annual Costs	
Alternative 15 - 3 Islands and CDF	
Total Implementation Costs	
Dredging Costs	$63,941,000
100 acre site construction	$0
36 acre site construction (1)	$4,289,000
Island construction (2)	$23,423,000
Capping construction (3)	$765,000
Lands & Damages	$11,000
Engineering & Design	$1,025,000
E&D during Construction	$172,000
Construction Management	$2,734,000
All Other Project Costs	$310,000
Subtotal	$96,670,000
Construction Contingencies	$16,346,864
Total Implementation Costs	**$113,016,864**
Average Annual Costs	
Investment Costs	
First Costs-Present Value	$82,783,074
Interest During Construction (1)	$17,748,683
Investment Costs	$100,531,757
Average Annual Costs	
Investment Costs	$100,531,757
Capital Recovery Factor (2)	0.07605
Average Annual Costs	$7,645,010
Annual tipping fees (3)	$561,372
Total Average Annual Costs	**$8,206,382**
(1) IDC calculated on risk adjusted construction costs using current interest rate of 4.375% and corresponding construction periods	
(2) Capital Recover Factor based no 20 year project life and 4.375% annual interest rate	
(3) Annual tipping fees are paid rather than annual maintenance since the local port authority provides all maintenance. Tipping fee estimate is based on actual expenditures and calculated as $5.74 per cy x number of cy placed in CDF annually.	

VIII. SUMMARY

Utilizing the risk adjusted cost estimate, alternative 15, Three Islands Creation and Bayport CDF Expansion to the Adjacent 36-Acre Site, has the lowest average annual costs ($8,206,382) and is thus, the Base Plan. Alternative 15 also has the greatest net benefits ($16,308,560) and is therefore, the NED Plan with a Benefit-Cost ratio of 3.0.

Table F-II-23 - Benefit-Cost Ratio for Selected Plan	
20-Year Project Evaluation Period - 4.375% Annual Interest Rate	
ALTERNATIVE 15 - THREE ISLANDS AND CDF	
Benefits	
Without Project Transportation Costs	$87,656,900
With Project Transportation Costs	$63,141,958
Plan Benefits	$24,514,942
Costs	
With Project Harbor Maintenance Costs	$8,206,382
Without Project Harbor Maintenance Costs	$ -
Plan Costs	$8,206,382
Benefit-Cost Ratios	
Annual Benefits	$24,514,942
Annual Costs	$8,206,382
Benefit-Cost Ratio	3.0
Annual Net Benefits	$16,308,560

IX. RISK/UNCERTAINTY ASSESSMENT

Project benefits are calculated on the basis of 'the most probable' with-project and without-project conditions. However, risk and uncertainty should be addressed in the analysis of NED benefits and costs. Since the cost appendix addresses the risks associated with the costs of Alternative 15, Three Islands and 36 acre Expanded Bayport CDF for the Green Bay DMMP, this section addresses the sensitivity of the benefit-cost ratio to changes in the interest rate or the benefits of the project.

A. Annual Net Benefits and Benefit-Cost Ratio Sensitivity to Changes in Transportation Cost Savings

A sensitivity analysis was performed to examine how changes in transportation cost savings benefits would impact net benefits and the benefit-cost ratio. The transportation cost savings, as developed in Part I of this Economic Assessment, are displayed here in **Table F-II-24**.

Table F-II-24 - Green Bay Harbor Average Annual Harbor Transportation Cost Savings Associated with Maintaining a 26/24 foot Project Depth
(FY 2010 Prices)

Commodity	**Average Annual Transportation Benefits**
Cement and Concrete	$5,239,334
Coal	$13,875,044
Sodium Chloride	$2,917,248
Limestone	$2,220,364
Pig Iron	$262,952
TOTALS	**$24,514,942**

This analysis reviews the impacts of a 10% plus or minus change in average annual transportation cost savings on the benefit-cost ratio and annual net benefits. The results of this assessment are presented in **Table F-II-25** below.

Table F-II-25 – Annual Net Benefit and BCR Sensitivity to Changes in Average Annual Harbor Transportation Cost Savings (FY 2010 Prices)			
		+10%	**-%10**
Average Annual Transportation Cost Savings	$24,514,942	$26,966,436	$22,063,448
Total Average Annual Costs	$8,206,382	$8,206,382	$8,206,382
Benefit-Cost Ratio	3.0	3.3	2.7
Annual Net Benefits	$16,308,560	$18,760,054	$13,857,065

Thus, with a decrease in average annual transportation cost savings, annual net benefits would fall from $16,308,560 to $13,857,065 and the benefit-cost ratio would decrease from 3.0 to 2.7. Conversely, if annual transportation cost savings were underestimated and actual savings were 10% greater than presented in the report, annual net benefits would increase to $18,760,054 and the benefit-cost ratio would increase to 3.3. Further, the average annual transportation cost savings could decrease by as much as 35% and still retain a benefit-cost ratio greater than 1.0.

B. Annual Net Benefits and Benefit-Cost Ratio Sensitivity to Changes in Interest Rates

A sensitivity analysis was performed to examine how changes in interest rates would affect project benefits and would thereby, impact the benefit-cost ratio.

This analysis reviews the impacts of a .25 plus or minus change in interest rates on the benefit-cost ratio and annual net benefits. Since by law, the discount rate utilized in Corps studies cannot move up or down by more than a quarter percentage point into a new fiscal year, this would provide the results if the project were reevaluated at the following year discount rate. The results of this assessment are presented in **Table F-II-26** below.

F-II-26 - Impacts of a plus or minus .25% Change in the Interest Rate			
Interest Rate	4.375%	4.125%	4.625%
Average Annual Transportation Cost Savings	$24,514,942	$26,563,542	$22,532,742
Total Average Annual Costs	$8,206,382	$8,206,382	$8,206,382
Benefit-Cost Ratio	2.99	3.24	2.75
Annual Net Benefits	$16,308,560	$18,357,160	$14,326,360

Thus, with a decrease in the interest rate of 0.25, from 4.375% to 4.125%, annual net benefits would increase from $16,308,560 to $18,357,160 and the benefit-cost ratio would increase from 2.99 to 3.24. Conversely, if the interest rate was to increase by 0.25 to 4.625%, annual net benefits would decrease to $14,326,360 and the benefit-cost ratio would decrease to 2.75.

Since the impacts of these incremental changes were negligible, the sensitivity analysis further evaluated changes of +/- a full percentage in the interest rate. The results of which are presented in **Table F-II-27.**

F-II-27 - Impacts of a plus or minus 1% Change in the Interest Rate			
Interest Rate	4.375%	5.375%	3.375%
Average Annual Transportation Cost Savings	$24,514,942	$16,959,942	$33,136,142
Total Average Annual Costs	$8,206,382	$8,206,382	$8,206,382
Benefit-Cost Ratio	2.99	2.07	4.04
Annual Net Benefits	$16,308,560	$8,753,560	$24,929,760

Thus, with a decrease in the interest rate of 1.0 percent, from 4.375% to 3.375%, annual net benefits would increase from $16,308,560 to $24,929,760 and the benefit-cost ratio would increase from 2.99 to 4.04. Conversely, if the interest rate was to increase by 1.0 to 5.375%, annual net benefits would decrease to $8,753,560 and the benefit-cost ratio would decrease to 2.07.

C. Summary of the Risk/Sensitivity Assessment

Thus, in summary, the justification of Green Bay Harbor DMMP is not sensitive to a 10% increase/decrease in total annual benefits or a 1% increase/decrease in the interest rate. Further, any change, up or down in the interest rate in the next fiscal year, a .25% maximum, would not impact project justification.