APPENDIX B

LAKE WORTH INLET

Palm Beach Harbor

NAVIGATION STUDY FOR
LAKE WORTH INLET, FLORIDA

DRAFT INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B
DRAFT COST ENGINEERING AND RISK ANALYSIS APPENDIX

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

B. COST ESTIMATES 1
B1. GENERAL INFORMATION 1
B.1.1 Tentatively Selected Plan (TSP) 1
B.1.2 Construction Cost 2
B.1.3 Non-construction Cost 2
B.1.4 Plan Formulation Cost Estimates 3
B.1.5 Construction Schedule 3
B.1.6 Total Project Cost Summary 3
B2. PLAN FORMULATION COST ESTIMATES 3
B3. TENTATIVELY SELECTED PLAN (NED) COST ESTIMATE 3
B4. SCHEDULE 28
B5. RISK AND UNCERTAINTY ANALYSIS 30
B.5.1 Risk Analysis Methods 30
B.5.2 Risk Analysis Results 30
B6. TOTAL PROJECT COST SUMMARY 30
B.6.1 Total Project Cost Summary Spreadsheet 30
B7. COST DX TPCS CERTIFICATION 35

ATTACHMENT TO APPENDIX B
ATTACHMENT A: PROJECT COST AND SCHEDULE RISK ANALYSIS REPORT

B. COST ESTIMATES

B1. GENERAL INFORMATION

Corps of Engineers cost estimates for planning purposes are prepared in accordance with the following guidance:

- Engineer Technical Letter (ETL) 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 September 2008
- Engineer Regulation (ER) 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302, Civil Works Cost Engineering, 15 September 2008
- ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
- ER 1105-2-100, Planning Guidance Notebook, 22 April 2000, as amended
- Engineer Manual (EM) 1110-2-1304 (Tables Revised 31 March 2009), Civil Works Construction Cost Index System, 31 March 2000
- CECW-CP Memorandum for Distribution, Subject: Initiatives to Improve the Accuracy of Total Project Costs in Civil Works Feasibility Studies Requiring Congressional Authorization, 19 September 2007
- CECW-CE Memorandum for Distribution, Subject: Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs, 3 July 2007
- Cost and Schedule Risk Analysis Process, March 2008

The goal of the cost estimates for the Palm Beach County, Lake Worth Inlet Navigation Feasibility Study are to present a Total Project Cost (Construction and Non-Construction costs) for the recommended plan(s) at the current price level to be used for project justification/authorization and to escalate costs for budgeting purposes. In addition, the costing efforts are intended to produce a final product (cost estimate) that is reliable and accurate, and that supports the definition of the Government's and the Non-Federal sponsor's obligations.

The cost estimating effort for the study yields a series of alternative plan formulation cost estimates for decision making. The final set of plan formulation cost estimates used for plan selection rely on construction feature unit pricing and are prepared in Civil Works Work Breakdown Structure (CWWBS) format to the sub-feature level. The cost estimate supporting the National Economic Development (NED) plan (Tentatively Selected Plan/Locally Preferred Alternative Plan) is prepared in MCACES/MII format to the CWWBS sub-feature level. This estimate is supported by the preferred labor, equipment, materials and crew/production breakdown. A fully funded (escalated for inflation through project completion) cost estimate, the Baseline Cost Estimate or Total Project Cost Summary, has also been developed. A cost and schedule risk analysis was prepared that addresses project uncertainties and sets contingencies for the Tentatively Selected Plan's cost items. The final Cost and Schedule Risk Analysis Report produced by the Walla Walla District Cost Center of Expertise is attached to this appendix.

B.1.1 Tentatively Selected Plan (TSP)

The Tentatively Selected Plan (NED) was chosen by the Project Delivery Team (PDT) according to Cost Effectiveness/Incremental Cost Analysis procedures and resulted directly from the plan formulation described above. The Economics Appendix fully describes the

plan selection. The scope of work for the TSP is found in Appendix A, Engineering. The MCACES/MII cost estimate for the TSP (Section A3, below) is based on that scope and is formatted in the CWWBS. The notes provided in the body of the estimate detail the estimate parameters and assumptions. These include pricing at the Fiscal Year 2013 price level (1 October 2012-30 September 2013). For project justification purposes, the estimate costs are categorized under the appropriate CWWBS code and include both construction and non-construction costs.

The construction costs fall under the following feature codes:

- 06 Fish and Wildlife Facilities
- 10 Breakwaters and Seawalls
- 12 Navigation Ports and Harbors

The non-construction costs fall under the following feature codes:

- 01 Lands and Damages
- 02 Relocations
- 06 Fish and Wildlife Facilities
- 30 Planning, Engineering and Design
- 31 Construction Management

B.1.2 Construction Cost

Construction costs were developed in MCACES/MII and include all major project components categorized under the appropriate CWWBS to the sub-feature level. The Total Project Cost Summary (TPCS) on the TSP contains contingencies as noted in the estimate (below) and were determined as a result of the risk analysis. Additional information follows on the risk analysis.

B.1.3 Non-construction Cost

Non-construction costs typically include Lands and Damages (Real Estate), Planning Engineering & Design (PED) and Construction Management Costs (Supervision & Administration, S&A). These costs were provided by the PDT either as a lump sum cost or as a percentage of the total Construction Contract Cost. Lands and Damages are provided by Real Estate and are best described in the Real Estate Appendix, Appendix D. PED costs are for the preparation of contract plans and specifications (P&S) and include itemized costs that were provided by the PDT, as well as percentages for Engineering During Construction (EDC) and Planning During Construction (PDC) that were provided by the project manager. Construction Management costs are for the supervision and administration of a contract and include Project Management and Contract Admin costs. These costs were provided by the project manager and are included as a percentage of the total construction contract cost.

In addition to the typical non-construction costs, this project also includes a Relocations cost for the relocation of aids to navigation, as well as non-construction Fish and Wildlife Facilities costs for the post construction monitoring of constructed mitigation areas.

The main report details both cost allocation and cost apportionment for the Federal Government and the Non-Federal Sponsor. Also included in the main report are the Non-Federal Sponsor's obligations (items of local cooperation).

B.1.4 Plan Formulation Cost Estimates

For the plan formulation cost estimates, unit prices for dredging related work were developed in the Corps of Engineers Dredge Estimating Program (CEDEP) and then entered into MCACES/MII. Unit prices for the remaining major or variable construction elements were developed in MCACES/MII based on input from the PDT. Design details, information and assumptions were provided in the Engineering Appendix. Plan formulation alternatives and cost estimates did not include advanced maintenance or any associated advanced maintenance features. Jetty stabilization was included for any project depths deeper than 40 feet. An abbreviated risk analysis was done to establish the contingency for the plan formulation alternatives. Non-construction costs were included as percentages of the total construction contract cost for this level of comparison and screening.

Refer to Economics Section in the main report for final plan formulation cost tables.

B.1.5 Construction Schedule

A construction schedule was prepared utilizing input from the PDT and reflects all project construction components. The schedule considers not only durations of individual components of construction, but also the timing of construction contracts based on funding and multiple construction windows. The construction schedule was combined with the project schedule to create an overall schedule that was used for the generation of the Total Project Cost Summary (TPCS), as well as the schedule portion of the Cost and Schedule Risk Analysis (CSRA). The construction schedule will change as the project moves through the various project lifecycle phases. The overall project schedule is provided below.

B.1.6 Total Project Cost Summary

The cost estimate for the Tentatively Selected Plan is prepared with an identified price level date and inflation factors are used to adjust the pricing to the project schedule. This estimate is known as the Fully Funded Cost Estimate or Total Project Cost Summary. It includes all Federal and Non-Federal costs: Lands, Easements, Rights of Way and Relocations; construction features; Preconstruction Engineering and Design; Construction Management; Contingency; and Inflation.

B2. PLAN FORMULATION COST ESTIMATES

Refer to the Economics Section in the Main Report.

B3. TENTATIVELY SELECTED PLAN (NED) COST ESTIMATE

Refer to MII Printout on the next page.

LAKE WORTH INLET- REVISED TENTATIVELY SELECTED PLAN ESTIMATE

Title Page

Expansion and Deepening of the Existing Authorized Palm Beach Harbor/Lake Worth Inlet. Tentatively Selected Plan estimate revised to reflect ATR comments during review of the Draft Cost Appendix.

Estimated by	CESAJ-EN-TC
Designed by	CESAJ-EN-DW
Prepared by	CESAJ-EN-TC
Preparation Date	3/5/2013
Effective Date of Pricing	10/1/2012
Estimated Construction Time	973 Days

This report is not copyrighted, but the information contained herein is For Official Use Only.

Library Properties i

Project Notes ii

Project Cost Summary Report 1

Lake Worth Inlet Feasibility Study 1

39' Project Depth (737 Calendar Days) 1

Construction Costs 1

06 Fish and Wildlife Facilities (204 Calendar Days) 1

10 Breakwaters and Seawalls (97 Calendar Days) 1

12 Navigation Ports & Harbors (640 Calendar Days) 1

Non-Construction Costs 1

02 Relocations 1

06 Fish and Wildlife Facilities 1

30 Planning, Engineering and Design 1

31 Construction Management 1

Contract Cost Summary Report 2

Lake Worth Inlet Feasibility Study 2

39' Project Depth (737 Calendar Days) 2

Construction Costs 2

06 Fish and Wildlife Facilities (204 Calendar Days) 2

0603 Wildlife Facilities & Sanctuary 2

Contract 2 (204 Calendar Days) 2

10 Breakwaters and Seawalls (97 Calendar Days) 2

1000 Breakwaters & Seawalls 2

Contract 1 (97 Calendar Days) 2

12 Navigation Ports & Harbors (640 Calendar Days) 2

1202 Harbors 2

Contract 1 (51 Calendar Days) 2

Contract 2 (589 Calendar Days) 2

Non-Construction Costs 2

02 Relocations 2

0203 Cemetery, Utilities, & Structure 2

Contract 1 2

06 Fish and Wildlife Facilities 2

0603 Wildlife Facilities & Sanctuary 2

Contract 3 2

30 Planning, Engineering and Design 2

3023 Constructn Contracts(s) Documnts 3

Contract 1 3

Contract 2 3

31 Construction Management 3

3123 Construction Contracts 3

Contract 1 3

Contract 2 3

Project Direct Costs Report 4

Lake Worth Inlet Feasibility Study 4

39' Project Depth (737 Calendar Days) 4

Construction Costs 4

06 Fish and Wildlife Facilities (204 Calendar Days) 4

0603 Wildlife Facilities & Sanctuary 4

Contract 2 (204 Calendar Days) 4

10 Breakwaters and Seawalls (97 Calendar Days) 4

1000 Breakwaters & Seawalls 4

Contract 1 (97 Calendar Days) 4

12 Navigation Ports & Harbors (640 Calendar Days) 4

1202 Harbors 4

Contract 1 (51 Calendar Days) 4

Contract 2 (589 Calendar Days) 4

Non-Construction Costs 4

02 Relocations 4

0203 Cemetery, Utilities, & Structure 4

Contract 1 4

06 Fish and Wildlife Facilities 4

0603 Wildlife Facilities & Sanctuary 4

Contract 3 4

30 Planning, Engineering and Design 5

3023 Constructn Contracts(s) Documnts 5

Contract 1 5

Contract 2 5

31 Construction Management 5

3123 Construction Contracts 5

Contract 1 5

Contract 2 5

Designed by
CESAJ-EN-DW

Estimated by
CESAJ-EN-TC

Prepared by
Jennifer Tyler, CESAJ-EN-TC

Design Document	Draft EN Appendix and Supporting Plates
Document Date	10/18/2012
District	Jacksonville District
Contact	Jennifer Tyler, 904-232-2213
Budget Year	2013
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
CEDEP
OTHER
MISC

Timeline/Currency

Preparation Date	3/5/2013
Escalation Date	10/1/2012
Eff. Pricing Date	10/1/2012
Estimated Duration	973 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB10EB: MII English Cost Book 2010

Labor LFL2010: Labor_Florida_2010B_4.1

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP11R03: MII Equipment 2011 Region 03
Note: Gas and On-Road Diesel fuel prices were quotes obtained from the AAA Fuel Gauge Report website on 3/5/13. Diesel Off-Road fuel prices were estimated on 2/25/
Administ

03 SOUTHEAST

Sales Tax	8.35
Working Hours per Year	1,530
Labor Adjustment Factor	0.86
Cost of Money	1.38
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.087
Gas	3.914
Diesel Off-Road	3.585
Diesel On-Road	4.245

Shipping Rates

Over 0 CWT	15.58
Over 240 CWT	14.19
Over 300 CWT	12.14
Over 400 CWT	10.20
Over 500 CWT	6.13
Over 700 CWT	6.13
Over 800 CWT	9.25

Date Author Note

10/21/2012 J. Tyler
Planning Estimate for Navigation Feasibility Study, Including Profit and Excluding Contingency.

Project Name: Lake Worth Inlet Navigation Feasibility Study

EXPANSION AND DEEPENING OF EXISTING AUTHORIZED PROJECT

Tentatively Selected Plan (TSP): 39-Foot Project Depth

Scope of Work:
The recommended plan would include the addition of a new channel flare on the south side of the Entrance Channel, a widening of the Entrance Channel by either 40' or 60' to the north, widening of the Inner Harbor Cuts 1 and 2 to provide for a minimum channel width of 450', a 150' expansion of the Southern (Main) Turning Basin to the south, and an expansion of the Southern (Main) Turning Basin on the north side to remove a notch currently encroaching into the basin. The channel would be deepened to a project depth of 39 feet Mean Lower Low Water (MLLW) for the Inner Harbor and 41 feet MLLW for the Entrance Channel, plus applicable allowances and overdepths. An additional 2-foot of required overdepth and 1-foot of allowable overdepth are included in the estimated excavation quantities.

In addition to the project improvements described above that are necessary to facilitate the safe and efficient navigation of the design vessel, there are other features needed to support the project. These features include North Jetty stabilization, reconfiguration of the Advance Maintenance Zones, reconfiguration of the Settling Basin, Seagrass Mitigation Area construction, and Hardbottom Mitigation Area construction.

It is anticipated that all of the material to be excavated from the Entrance Channel from Station 18+00 up to Station 45+00 would be placed in the Beach Placement Area located south of the inlet, and the Nearshore Placement Area immediately offshore of the existing beach placement area. All material from the remainder of the project (Entrance Channel Station 45+00 to end, Cut-1, Cut-2, Southern Turning Basin, and reconfigured Settling Basins) would either be placed in the Palm Beach Ocean Dredged Material Disposal Site (ODMDS) or in the required mitigation sites for seagrass or hardbottom habitat.

Area 1- Northern widening and deepening of the existing Entrance Channel from Station 18+00 to 30+00; Beach/Nearshore Disposal

Area 2- Deepening of the existing Entrance Channel from Station 18+00 to 30+00; Beach/Nearshore Disposal

Area 3- Southern widening and deepening of the existing Entrance Channel from Station 18+00 to 30+00; Beach/Nearshore Disposal

Area 4- Northern widening and deepening of the existing Entrance Channel from Station 30+00 to 43+00; Beach/Nearshore Disposal

Area 5- Deepening of the existing Entrance Channel from Station 30+00 to 43+00; Beach/Nearshore Disposal

Area 6- Southern widening and deepening of the existing Entrance Channel from Station 30+00 to 43+00; Beach/Nearshore Disposal

Area 7- Northern widening and deepening of the existing Entrance Channel from Station 43+00 to 45+00; Beach/Nearshore Disposal

Area 8- Deepening of the existing Entrance Channel from Station 43+00 to 45+00; Beach/Nearshore Disposal

Date Author Note

Area 9- Southern widening and deepening of the existing Entrance Channel from Station 43+00 to 45+00; Beach/Nearshore Disposal

Area 10- Northern widening and deepening of the existing Entrance Channel from Station 45+00 to 47+00; ODMDS Disposal

Area 11- Deepening of the existing Entrance Channel from Station 45+00 to 47+00; ODMDS Disposal

Area 12- Northern widening and deepening of the existing Entrance Channel from Station 47+00 to 60+00; ODMDS Disposal

Area 13- Deepening of the existing Entrance Channel from Station 47+00 to 60+00; ODMDS Disposal

Area 14- Northern widening and deepening of the existing Inner Channel from Station 60+00 to Main Turning Basin; ODMDS Disposal

Area 15- Deepening of the existing Inner Channel from Station 60+00 to Main Turning Basin; ODMDS Disposal

Area 16- Northern widening and deepening of the existing Main Turning Basin; ODMDS Disposal

Area 17- Deepening of the existing Main Turning Basin; ODMDS Disposal

Area 18- Southern widening and deepening of the existing Main Turning Basin; ODMDS Disposal

Advance Maintenance Areas:
AM-A: 8 ft from Sta 30+00 to Sta 39+00, full width of channel
AM-B: 4 ft from Sta 44+00 to Sta 47+00, full width of channel
AM-C: 8 ft from Sta 39+00 to Sta 40+50, 125 ft range
AM-D: 2 ft from Sta 39+00 to Sta 40+50, 40 ft range (widener only)
SB-1: 50 ft from Sta 34+00 to Sta 37+50
SB-2: 33 ft from Sta 37+50 to Sta 38+00
SB-3: 25 ft from Sta 38+00 to Sta 39+75

Construction Depths:
Sta 18+00 to Sta 60+00: 41 ft Required + 2 ft Required Overdepth + 1 ft Allowable Overdepth = 44 feet
Sta 60+00 to Southern Turning Basin: 39 ft Required + 2 ft Required Overdepth + 1 ft Allowable Overdepth = 42 feet.
Advance Maintenance Areas:
AM-A: 51 ft Required + 1 ft Allowable Overdepth
AM-B: 47 ft Required + 1 ft Allowable Overdepth
AM-C: 51 ft Required + 1 ft Allowable Overdepth
AM-D: 45 ft Required + 1 ft Allowable Overdepth
SB-1: 50 ft Required + 2 ft Allowable Overdepth
SB-2: 33 ft Required + 2 ft Allowable Overdepth
SB-3: 25 ft Required + 2 ft Allowable Overdepth

Date Author Note

Jetty Stabilization:
A jetty stabilization feature will be implemented approximately 330 feet from the centerline of the channel between STA 38+75 to 40+75. The jetty stabilization feature consists of a sheet pile wall placed at the jetty toe. This feature will prevent the jetty foundation from sliding into the dredged channel. The stabilization feature was designed at a cursory level in order to provide sufficient detail to have the feature priced.

Mitigation:
Mitigation must be provided for roughly 11.25 acres of seagrasses and 11.25 acres of hardbottoms. Turtle Cove is the selected Seagrass Mitigation site. Located approximately 26,400 ft or 5.0 miles from the inner harbor area, it requires 6,740 CY/AC for fill and 3,300 CY/AC for select fill. Singer Island Artificial Reef is the selected Hardbottom Mitigation site. Located approximately 12,600 ft or 2.4 miles from the berthing area, it requires 25,100 CY of material.

Material for seagrass mitigation (both fill and select fill) is assumed to be available within the inner harbor dredging limits and thus will come from within the project. The fill or base portion is used to bring the area up to approximately -6.5' MLLW and the select fill material is a 2' thick cap above the fill bringing the final elevation of the mitigation site to -4.5' MLLW. No planting is required.

Suitable materials for use in the fill portion of the site shall consist of material excavated from the project with less than 20% by weight of fines passing a #200 sieve for each barge load placed and free from trash and debris. Suitable materials for use in the select fill portion of the site shall consist of materials classified in accordance with ASTM D 2487 as SP (poorly graded sand), SW (well-graded sand), SP-SM (poorly graded sand with silt) and SW-SM (well-graded sand with silt) and free from rocks, trash and debris. The Contractor may stockpile suitable materials anywhere within the limits of the seagrass mitigation area prior to final placement as select fill. The Contractor may use material excavated from the project meeting this classification or he/she may obtain such material from offsite. If the select fill material is obtained from the areas to be dredged it shall be screened using a screen with 2"x2" openings prior to placement in the site and it shall contain less than 15% by weight of fines passing a #200 sieve for each barge load placed. If the contractor elects to obtain select fill from offsite it shall contain less than or equal to 5% by weight of fines passing a #200 sieve for each barge load placed.

Material for hardbottom mitigation (limestone) will be purchased from off-site and delivered to the Port of Palm Beach for transport and placement at the mitigation site.

Suitable materials for use in the reef mitigation areas shall consist of rock excavated from the project or native limestone quarried from nearby counties. Rock particles shall measure a minimum of 36-inches in length by 36-inches in width, the third dimension remains variable. The stone shall be free from components, minerals, cementing or bonding materials or structural defects that might contribute to spalling or breakdown from handling and placing.

Documents Used as the Basis for this Estimate
REFERENCES:

1. Plates provided by CESAJ-EN-DW
2. Draft EN Appendix
3. Draft Geotech Appendix
4. Excel file with volumes and areas provided by CESAJ-EN-DW
5. Various Emails

Major Project Features: 200 LF of Jetty Stabilization (Steel Sheetpile Wall) and 22.50 acres of Environmental Mitigation (Seagrasses- 11.25 acres and Hardbottoms- 11.25 acres)

Federal and non-Federal Cost Sharing Requirements:
Costs associated with dredging in the berthing areas will be non-federal costs.

Date Author Note

Volatile Cost Items:
Fuel

Risk Analysis:
Risk Analysis will be done by Glenn Matlock, Walla Walla District.

Construction Schedule (including date of mid-point of construction):
Contract 1 (Jetty Stabilization and Pipeline Dredging) = 122 Calendar Days
Jetty Stabilization = 97 Calendar Days (Includes 30-day Mob/Demob)
Pipeline Dredging = 54 Calendar Days (Includes 30-day Mob/Demob that overlaps Stabilization work)

15-day break between contracts due to Construction Window for Mechanical Dredging.

Contract 2 (Mechanical Dredging and Mitigation) = 552 Calendar Days
Mechanical Dredging = 552 Calendar Days (Includes three 30-day Mob/Demobs)
Running Concurrent with mechanical Dredging:
Seagrass Mitigation = 93 Calendar Days (Includes 30-day Mob/Demob)
Hardbottom Mitigation = 204 Calendar Days (Includes 30-day Mob/Demob)

Due to Construction Windows with complete periods of shutdown, the actual project duration is 1002 Calendar Days from NTP of first contract until completion of project (only 674 actual construction days).

Construction Windows:
Beach placement is restricted to October 1st-March 30th due to the Turtle Nesting Season. Mechanical Dredging is restricted to March 16th-November 14th due to manatee presence.

Escalation:
Escalation has been applied to the 5-year Post Construction Monitoring of the mitigation sites under Non-Construction costs.

General Assumptions:
1. Taxes: 7%
2. FOOH: 10% for Prime Dredging Contractors; 8% for Monitoring Contractor and all Subcontractors
3. HOOH: 6.5% for Prime Dredging Contractors; 4% for Monitoring Contractor and all Subcontractors
4. Profit: 10% for Prime Dredging Contractors; 8% for Monitoring Contractor and all Subcontractors
5. Bond: Used bond table
6. Price Level: FY13

7. Productivity/Overtime Usage:
Dredging is assumed to be a 24-hour a day, 7 days a week operation. The seawall construction for jetty stabilization is assumed to be 8-hours a day, 5 days a week. Mitigation work is assumed to be 12-hours a day, 7 days a week.

Date Author Note

8. Contingency:
No contingency currently applied. Estimate will be going through a Cost and Schedule Risk Analysis to determine the contingency.

Site Access: Dredging Areas can be accessed via the Lake Worth Inlet. Mitigation Areas are accessible via the Intracoastal Waterway (IWW) and the Lake Worth Lagoon. Beach access is through Palm Beach Island or from offshore within the designated nearshore placement area to avoid environmental impacts to hardbottoms offshore of the beach placement area.

Borrow Areas: N/A

Unusual Conditions (Soil, Water, Weather): The Singer Island Artificial Reef Area for Hardbottom Mitigation is located within the surf zone. Reduced production rates were used for this alternative to represent difficult working conditions. Also, the Turtle Cove Seagrass Mitigation site is located in shallow lagoon areas, so light loading of barges was a consideration in the estimate.

Work Plan Including Construction Processes:
Dredging with beach disposal will be accomplished using an offshore class 30-inch cutter suction pipeline dredge with direct placement on the beach placement area. This will include shore equipment to spread and grade the material on the beach, as well as push the material into the nearshore placement area.

Dredging with ODMDS disposal and disposal at one of the seagrass mitigation sites will be accomplished using two large hydraulic excavator dredges. For ODMDS disposal, the dredges will be loading large split-hulled scow barges with gravity placement into the ODMDS site. For seagrass mitigation construction, the dredges will be light loading (approx. 1,000 CY/load) large 3,000 CY scow barges with transport to the proposed mitigation site. Scow barges will be offloaded with a crane barge operation using a clamshell for placement in the fill area. It is assumed that the dredging operation will operate 24 hours/day, 7 days a week, whereas the mitigation construction will only occur 12 hours/day, 7 days.

Dredging costs were calculated using the Cost Engineering Dredge Estimating Program (CEDEP) in accordance with current Cost Engineering Regulation ER-1110-2-1302. Dredging transport costs for seagrass mitigation were calculated using CEDEP; transport costs were determined as being the delta between transport to the ODMDS and transport to the designated seagrass mitigation site. For transport to the mitigation site, light loading of scow barges was factored in due to lack of bathymetry and the possibility of access issues.

Dredge production used in CEDEP was based on previous CESAJ projects that used similar dredging equipment and working similar project conditions as this project. Production for the beach disposal segments (pipeline dredging) was based on past production for the 2005 Ocean Ridge and Delray Beach Segments of Palm Beach Co. SPP in which GLDD utilized the 30” Cutter Suction Dredge Illinois. Production for the ODMDS disposal segments (mechanical dredging) was based on past production from the 2003 Key West Harbor construction dredging event in which Bean-Stuyvesant utilized the Maricavor, an 11.5 CY excavator.

The character of the dredging materials is assumed to be predominately rock and sand based on information provided in the Geotech Appendix. According to the Geotech Appendix, no drilling and blasting of rock was considered to be required at this time. It will be assumed that the rock material is dredgeable without pretreatment for estimating purposes.

It is assumed that Limestone needed for construction of the hardbottom mitigation areas will need to be purchased. This material will be delivered to the Port of Palm Beach, loaded onto barges, offloaded onto a barge at the mitigation site and then placed using a crange barge operation with a clamshell for placement.

The jetty stabilization feature is assumed to be 200 LF of PZC-26 Hot Rolled Steel Sheet Piling. The estimated top elevation is to be at 3.5' and ground surface is roughly -31'. The embedment depth is assumed to be -60’. From -50’ to -60’ is rock and it is assumed pre-splitting will be required. It is anticipated that a crane with a pile hammer mounted on a barge will accomplish the placement of the sheet pile (no vibracore in order to avoid impacts to the jetty).

Unique Construction Techniques: --

Date Author Note

Construction Phasing and Sequencing:
The jetty stabilization feature must be in place prior to the start of dredging in the channel. Beach placement can only occur during Oct 1st-Mar 30th, so all pipeline dredging work must be accomplished during this timeframe. Mechanical dredging can only occur between Mar 16th-Nov 14th, so all mechanical dredging and it's components need to be accomplished during this timeframe or stop and start so that it fall within the available window. Seagrass Mitigation work needs to be done in conjunction with the mechanical dredging work since material will come from within the project. Material may need to be stockpiled somewhere until placement within the mitigation site. Hardbottom Mitigation may be completed during ether dredging operation since materials are being purchased from offsite.

Equipment and Labor Availability and Distance Traveled: --

Environmental Concerns During Construction:
Palm Beach Harbor is designated as a critical manatee habitat so strict measures may be enforced to ensure the safety of manatees during mechanical dredging operations.

Acquisition Plan: --

Sub-contracting Plan: It is anticipated that a big business dredging contractor will subcontract the jetty stabilization and hardbottom mitigation construction work. Turbidity monitoring for the sub-contracted work will be sub-contracted to an environmental contractor. Diving associated with placement of mitigation materials will also be sub-contracted to diving contractor.

Effective Dates for Labor, Equipment and Material Pricing:
Used 2010 Cost Book, 2010 Labor, 2011 Equipment.

Supporting Databases:
MII Labor, Equipment, and Cost Book libraries.

Expected Bid Competition:
Big business

Major Cost Quotes: Cost quotes for purchase of Limestone and Steel Sheetpile. Vendors are listed under Vendors tab in MII and quoted within the file.

11/8/2012 J. Tyler
Reduced Real Estate PED costs from $695K to $25K and removed $112,500 in Lands Costs per email directive from Stacey Roth, PD-PN, Lynn Zediak, RE-A and Tim Murphy, PM-WN due to change from beach disposal to nearshore disposal (below MHW).

12/9/2012 J. Tyler
The Cost Estimate was updated to reflect changes made in the EN Appendix. The Advanced Maintenance Areas were revised to include and/or combine additional areas within the Entrance Channel, as well as to revise the required and allowable depths in the Settling Basins. Both changes involved relabeling or changing notes regarding depths. Neither change affected quantities.

Advance Maintenance Areas:

Date Author Note

AM-A: 8 ft from Sta 30+00 to Sta 39+00, full width of channel
AM-B: 4 ft from Sta 39+00 to Sta 40+50, 275 ft range
Sta 40+50 to Sta 47+00, 400 ft range
AM-C: 8 ft from Sta 39+00 to Sta 40+50, 165 ft range
AM-D: **Combined with AM-C and removed from plan**
SB-1: 51 ft from Sta 34+00 to Sta 37+50
SB-2: 34 ft from Sta 37+50 to Sta 38+00
SB-3: 26 ft from Sta 38+00 to Sta 39+75

Construction Depths:
Sta 18+00 to Sta 60+00: 41 ft Required + 2 ft Required Overdepth + 1 ft Allowable Overdepth = 44 feet
Sta 60+00 to Southern Turning Basin: 39 ft Required + 2 ft Required Overdepth + 1 ft Allowable Overdepth = 42 feet.
Advance Maintenance Areas:
AM-A: 51 ft Required + 1 ft Allowable Overdepth
AM-B: 47 ft Required + 1 ft Allowable Overdepth
AM-C: 51 ft Required + 1 ft Allowable Overdepth
AM-D: **Combined with AM-C and removed from plan**
SB-1: 51 ft Required + 1 ft Allowable Overdepth
SB-2: 34 ft Required + 1 ft Allowable Overdepth
SB-3: 26 ft Required + 1 ft Allowable Overdepth

2/11/2013 J. Tyler
Per PDT decision that the NED plan is nearshore placement and not beach and nearshore placement due to RE costs associated with the beach placement of material above MHW, the following reflects the current scope of work: It is anticipated that all of the material to be excavated from the Entrance Channel from Station 18+00 up to Station 45+00 would be placed in the Nearshore Placement Area immediately offshore of the existing beach placement area (below MHW).

Notes within the estimate were revised to reflect the change as well.

There is no change to the estimated costs at this time.

3/7/2013 J. Tyler
Planning Estimate for Navigation Feasibility Study, Including Profit and Excluding Contingency.

Project Name: Lake Worth Inlet Navigation Feasibility Study

EXPANSION AND DEEPENING OF EXISTING AUTHORIZED PROJECT

Tentatively Selected Plan (TSP): 39-Foot Project Depth; ATR Revisions

Scope of Work:
The recommended plan would include the addition of a new channel flare on the south side of the Entrance Channel, a widening of the Entrance Channel by either 40’ or 60’ to the north,

Date Author Note

widening of the Inner Harbor Cuts 1 and 2 to provide for a minimum channel width of 450', a 150' expansion of the Southern (Main) Turning Basin to the south, and an expansion of the Southern (Main) Turning Basin on the north side to remove a notch currently encroaching into the basin. The channel would be deepened to a project depth of 39 feet Mean Lower Low Water (MLLW) for the Inner Harbor and 41 feet MLLW for the Entrance Channel, plus applicable allowances and overdepths. An additional 2-foot of required overdepth and 1-foot of allowable overdepth are included in the estimated excavation quantities.

In addition to the project improvements described above that are necessary to facilitate the safe and efficient navigation of the design vessel, there are other features needed to support the project. These features include North Jetty stabilization, reconfiguration of the Advance Maintenance Zones, reconfiguration of the Settling Basin, Seagrass Mitigation Area construction, and Hardbottom Mitigation Area construction.

It is anticipated that all of the material to be excavated from the Entrance Channel from Station 18+00 up to Station 45+00 would be placed in the Nearshore Placement Area immediately offshore of the existing beach placement area. All material from the remainder of the project (Entrance Channel Station 45+00 to end, Cut-1, Cut-2, Southern Turning Basin, and reconfigured Settling Basins) would either be placed in the Palm Beach Ocean Dredged Material Disposal Site (ODMDS) or in the required mitigation sites for seagrass or hardbottom habitat.

Area 1- Northern widening and deepening of the existing Entrance Channel from Station 18+00 to 30+00; Beach/Nearshore Disposal

Area 2- Deepening of the existing Entrance Channel from Station 18+00 to 30+00; Beach/Nearshore Disposal

Area 3- Southern widening and deepening of the existing Entrance Channel from Station 18+00 to 30+00; Beach/Nearshore Disposal

Area 4- Northern widening and deepening of the existing Entrance Channel from Station 30+00 to 43+00; Beach/Nearshore Disposal

Area 5- Deepening of the existing Entrance Channel from Station 30+00 to 43+00; Beach/Nearshore Disposal

Area 6- Southern widening and deepening of the existing Entrance Channel from Station 30+00 to 43+00; Beach/Nearshore Disposal

Area 7- Northern widening and deepening of the existing Entrance Channel from Station 43+00 to 45+00; Beach/Nearshore Disposal

Area 8- Deepening of the existing Entrance Channel from Station 43+00 to 45+00; Beach/Nearshore Disposal

Area 9- Southern widening and deepening of the existing Entrance Channel from Station 43+00 to 45+00; Beach/Nearshore Disposal

Area 10- Northern widening and deepening of the existing Entrance Channel from Station 45+00 to 47+00; ODMDS Disposal

Area 11- Deepening of the existing Entrance Channel from Station 45+00 to 47+00; ODMDS Disposal

Area 12- Northern widening and deepening of the existing Entrance Channel from Station 47+00 to 60+00; ODMDS Disposal

Area 13- Deepening of the existing Entrance Channel from Station 47+00 to 60+00; ODMDS Disposal

Area 14- Northern widening and deepening of the existing Inner Channel from Station 60+00 to Main Turning Basin; ODMDS Disposal

Date Author Note

Area 15- Deepening of the existing Inner Channel from Station 60+00 to Main Turning Basin; ODMDS Disposal

Area 16- Northern widening and deepening of the existing Main Turning Basin; ODMDS Disposal

Area 17- Deepening of the existing Main Turning Basin; ODMDS Disposal

Area 18- Southern widening and deepening of the existing Main Turning Basin; ODMDS Disposal

Advance Maintenance Areas:
AM-A: 8 ft from Sta 30+00 to Sta 39+00, full width of channel
AM-B: 4 ft from Sta 39+00 to Sta 40+50, 275 ft range
Sta 40+50 to Sta 47+00, 400 ft range
AM-C: 8 ft from Sta 39+00 to Sta 40+50, 165 ft range
SB-1: 51 ft from Sta 34+00 to Sta 37+50
SB-2: 34 ft from Sta 37+50 to Sta 38+00
SB-3: 26 ft from Sta 38+00 to Sta 39+75

Construction Depths:
Sta 18+00 to Sta 60+00: 41 ft Required + 2 ft Required Overdepth + 1 ft Allowable Overdepth = 44 feet
Sta 60+00 to Southern Turning Basin: 39 ft Required + 2 ft Required Overdepth + 1 ft Allowable Overdepth = 42 feet.
Advance Maintenance Areas:
AM-A: 51 ft Required + 1 ft Allowable Overdepth
AM-B: 47 ft Required + 1 ft Allowable Overdepth
AM-C: 51 ft Required + 1 ft Allowable Overdepth
SB-1: 50 ft Required + 2 ft Allowable Overdepth
SB-2: 33 ft Required + 2 ft Allowable Overdepth
SB-3: 25 ft Required + 2 ft Allowable Overdepth

Jetty Stabilization:
A jetty stabilization feature will be implemented approximately 330 feet from the centerline of the channel between STA 38+75 to 40+75. The jetty stabilization feature consists of a sheet pile wall placed at the jetty toe. This feature will prevent the jetty foundation from sliding into the dredged channel. The stabilization feature was designed at a cursory level in order to provide sufficient detail to have the feature priced.

Mitigation:
Mitigation must be provided for roughly 11.25 acres of seagrasses and 11.25 acres of hardbottoms. Turtle Cove is the selected Seagrass Mitigation site. Located approximately 26,400 ft or 5.0 miles from the inner harbor area, it requires 6,740 CY/AC for fill and 3,300 CY/AC for select fill. Singer Island Artificial Reef is the selected Hardbottom Mitigation site. Located approximately 12,600 ft or 2.4 miles from the berthing area, it requires 25,100 CY of material.

Material for seagrass mitigation (both fill and select fill) is assumed to be available within the inner harbor dredging limits and thus will come from within the project. The fill or base portion is used to bring the area up to approximately -6.5' MLLW and the select fill material is a 2' thick cap above the fill bringing the final elevation of the mitigation site to -4.5' MLLW. No planting

Date Author Note

is required.

Suitable materials for use in the fill portion of the site shall consist of material excavated from the project with less than 20% by weight of fines passing a #200 sieve for each barge load placed and free from trash and debris. Suitable materials for use in the select fill portion of the site shall consist of materials classified in accordance with ASTM D 2487 as SP (poorly graded sand), SW (well-graded sand), SP-SM (poorly graded sand with silt) and SW-SM (well-graded sand with silt) and free from rocks, trash and debris. The Contractor may stockpile suitable materials anywhere within the limits of the seagrass mitigation area prior to final placement as select fill. The Contractor may use material excavated from the project meeting this classification or he/she may obtain such material from offsite. If the select fill material is obtained from the areas to be dredged it shall be screened using a screen with 2"x2" openings prior to placement in the site and it shall contain less than 15% by weight of fines passing a #200 sieve for each barge load placed. If the contractor elects to obtain select fill from offsite it shall contain less than or equal to 5% by weight of fines passing a #200 sieve for each barge load placed.

Material for hardbottom mitigation (limestone) will be purchased from off-site and delivered to the Port of Palm Beach for transport and placement at the mitigation site.

Suitable materials for use in the reef mitigation areas shall consist of rock excavated from the project or native limestone quarried from nearby counties. Rock particles shall measure a minimum of 36-inches in length by 36-inches in width, the third dimension remains variable. The stone shall be free from components, minerals, cementing or bonding materials or structural defects that might contribute to spalling or breakdown from handling and placing.

Documents Used as the Basis for this Estimate
REFERENCES:

1. Plates provided by CESAJ-EN-DW
2. Draft EN Appendix
3. Draft Geotech Appendix
4. Excel file with volumes and areas provided by CESAJ-EN-DW
5. Various Emails

Major Project Features: 200 LF of Jetty Stabilization (Steel Sheetpile Wall) and 22.50 acres of Environmental Mitigation (Seagrasses- 11.25 acres and Hardbottoms- 11.25 acres)

Federal and non-Federal Cost Sharing Requirements:
All costs for this project are cost shared at 75% Federal and 25% Non-Federal.

Volatile Cost Items:
Fuel, Steel and Limestone

Risk Analysis:
A Cost and Schedule Risk Analysis was completed by Glenn Matlock, Walla Walla District.

Construction Schedule (including date of mid-point of construction):
Contract 1 (Jetty Stabilization and Pipeline Dredging) = 118 Calendar Days
Jetty Stabilization = 97 Calendar Days (Includes 30-day Mob/Demob)
Pipeline Dredging = 51 Calendar Days (Includes 30-day Mob/Demob that overlaps Stabilization work)

15-day break between contracts due to Construction Window for Mechanical Dredging.

Date Author Note

Contract 2 (Mechanical Dredging and Mitigation) = 589 Calendar Days
Mechanical Dredging = 589 Calendar Days (Includes three 30-day Mob/Demobs)
Running Concurrent with mechanical Dredging:
Seagrass Mitigation = 93 Calendar Days (Includes 30-day Mob/Demob)
Hardbottom Mitigation = 204 Calendar Days (Includes 30-day Mob/Demob)

Due to Construction Windows with complete periods of shutdown, the actual project duration is 973 Calendar Days from NTP of first contract until completion of project (only 737 actual construction days).

Construction Windows:
Beach placement is restricted to October 1st-March 30th due to the Turtle Nesting Season. Mechanical Dredging is restricted to March 16th-November 14th due to manatee presence.

Escalation:
No escalation is included.

General Assumptions:
1. Taxes: 6%
2. FOOH: 10% for Prime Dredging Contractors; 8% for Monitoring Contractor and all Subcontractors
3. HOOH: 6.5% for Prime Dredging Contractors; 4% for Monitoring Contractor and all Subcontractors
4. Profit: 10% for Prime Dredging Contractors; 8% for Monitoring Contractor and all Subcontractors
5. Bond: 1%
6. Price Level: FY13

7. Productivity/Overtime Usage:
Dredging is assumed to be a 24-hour a day, 7 days a week operation. The seawall construction for jetty stabilization is assumed to be 8-hours a day, 5 days a week. Mitigation work is assumed to be 12-hours a day, 7 days a week.

8. Contingency:
A 30% contingency is applied as determined by a Cost and Schedule Risk Analysis conducted by NWW.

Site Access: Dredging Areas can be accessed via the Lake Worth Inlet. Mitigation Areas are accessible via the Intracoastal Waterway (IWW) and the Lake Worth Lagoon. Beach access is through Palm Beach Island or from offshore within the designated nearshore placement area to avoid environmental impacts to hardbottoms offshore of the beach placement area.

Borrow Areas: N/A

Unusual Conditions (Soil, Water, Weather): The Singer Island Artificial Reef Area for Hardbottom Mitigation is located within the surf zone. Reduced production rates were used for this alternative to represent difficult working conditions. Also, the Turtle Cove Seagrass Mitigation site is located in shallow lagoon areas, so light loading of barges was a consideration in the estimate.

Work Plan Including Construction Processes:

Date Author Note

Dredging with beach disposal will be accomplished using an offshore class 30-inch cutter suction pipeline dredge with direct placement on the beach placement area. This will include shore equipment to spread and grade the material on the beach, as well as push the material into the nearshore placement area.

Dredging with ODMDS disposal and disposal at one of the seagrass mitigation sites will be accomplished using two large hydraulic excavator dredges. For ODMDS disposal, the dredges will be loading large split-hulled scow barges with gravity placement into the ODMDS site. For seagrass mitigation construction, the dredges will be light loading (approx. 1,000 CY/load) large 3,000 CY scow barges with transport to the proposed mitigation site. Scow barges will be offloaded with a crane barge operation using a clamshell for placement in the fill area. It is assumed that the dredging operation will operate 24 hours/day, 7 days a week, whereas the mitigation construction will only occur 12 hours/day, 7 days.

Dredging costs were calculated using the Cost Engineering Dredge Estimating Program (CEDEP) in accordance with current Cost Engineering Regulation ER-1110-2-1302. Dredging transport costs for seagrass mitigation were calculated using CEDEP; transport costs were determined as being the delta between transport to the ODMDS and transport to the designated seagrass mitigation site. For transport to the mitigation site, light loading of scow barges was factored in due to lack of bathymetry and the possibility of access issues.

Dredge production used in CEDEP was based on previous CESAJ projects that used similar dredging equipment and working similar project conditions as this project. Production for the beach disposal segments (pipeline dredging) was based on past production for the 2005 Ocean Ridge and Delray Beach Segments of Palm Beach Co. SPP in which GLDD utilized the 30” Cutter Suction Dredge Illinois. Production for the ODMDS disposal segments (mechanical dredging) was based on past production from the 2003 Key West Harbor construction dredging event in which Bean-Stuyvesant utilized the Maricavor, an 11.5 CY excavator.

The character of the dredging materials is assumed to be predominately rock and sand based on information provided in the Geotech Appendix. According to the Geotech Appendix, no drilling and blasting of rock was considered to be required at this time. It will be assumed that the rock material is dredgeable without pretreatment for estimating purposes.

It is assumed that Limestone needed for construction of the hardbottom mitigation areas will need to be purchased. This material will be delivered to the Port of Palm Beach, loaded onto barges, offloaded onto a barge at the mitigation site and then placed using a crange barge operation with a clamshell for placement.

The jetty stabilization feature is assumed to be 200 LF of PZC-26 Hot Rolled Steel Sheet Piling. The estimated top elevation is to be at 3.5' and ground surface is roughly -31'. The embedment depth is assumed to be -60’. From -50’ to -60’ is rock and it is assumed pre-splitting will be required. It is anticipated that a crane with a pile hammer mounted on a barge will accomplish the placement of the sheet pile (no vibracore in order to avoid impacts to the jetty).

Unique Construction Techniques: --

Construction Phasing and Sequencing:
The jetty stabilization feature must be in place prior to the start of dredging in the channel. Beach placement can only occur during Oct 1st-Mar 30th, so all pipeline dredging work must be accomplished during this timeframe. Mechanical dredging can only occur between Mar 16th-Nov 14th, so all mechanical dredging and it’s components need to be accomplished during this timeframe or stop and start so that it fall within the available window. Seagrass Mitigation work needs to be done in conjunction with the mechanical dredging work since material will come from within the project. Material may need to be stockpiled somewhere until placement within the mitigation site. Hardbottom Mitigation may be completed during either dredging operation since materials are being purchased from offsite.

Equipment and Labor Availability and Distance Traveled: --

Environmental Concerns During Construction:
Palm Beach Harbor is designated as a critical manatee habitat so strict measures may be enforced to ensure the safety of manatees during mechanical dredging operations.

Date Author Note

Acquisition Plan: --

Sub-contracting Plan: It is anticipated that a big business dredging contractor will subcontract the jetty stabilization and hardbottom mitigation construction work. Turbidity monitoring for the sub-contracted work will be sub-contracted to an environmental contractor. Diving associated with placement of mitigation materials will also be sub-contracted to diving contractor.

Effective Dates for Labor, Equipment and Material Pricing:
Used 2010 Cost Book, 2013 Labor, 2011 Equipment.

Supporting Databases:
MII Labor, Equipment, and Cost Book libraries.

Expected Bid Competition:
Big business

Major Cost Quotes: Cost quotes for purchase of Limestone and Steel Sheetpile. Vendors are listed under Vendors tab in MII and quoted within the file.

Description	Quantity	UOM	ContractCost	Escalation	Contingency	ProjectCost
Project Cost Summary Report			**70,091,763**	**0**	**0**	**70,091,763**
Lake Worth Inlet Feasibility Study	**1.00**	**LS**	**70,091,763**	**0**	**0**	**70,091,763**
39' Project Depth (737 Calendar Days)	**1.00**	**LS**	**70,091,763**	**0**	**0**	**70,091,763**
Construction Costs	**1.00**	**LS**	**61,478,559**	**0**	**0**	**61,478,559**
06 Fish and Wildlife Facilities (204 Calendar Days)	**1.00**	**LS**	**10,366,567**	**0**	**0**	**10,366,567**
10 Breakwaters and Seawalls (97 Calendar Days)	**1.00**	**LS**	**2,082,352**	**0**	**0**	**2,082,352**
12 Navigation Ports & Harbors (640 Calendar Days)	**1.00**	**LS**	**49,029,639**	**0**	**0**	**49,029,639**
Non-Construction Costs	**1.00**	**LS**	**8,613,204**	**0**	**0**	**8,613,204**
02 Relocations	**1.00**	**LS**	**20,000**	**0**	**0**	**20,000**
06 Fish and Wildlife Facilities	**1.00**	**LS**	**1,030,904**	**0**	**0**	**1,030,904**
30 Planning, Engineering and Design	**1.00**	**LS**	**2,641,100**	**0**	**0**	**2,641,100**
31 Construction Management	**1.00**	**LS**	**4,921,200**	**0**	**0**	**4,921,200**

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost
Contract Cost Summary Report				54,411,298	2,476,094	56,887,392	13,204,371	70,091,763
Lake Worth Inlet Feasibility Study	1.00	LS		54,411,298	2,476,094	56,887,392	13,204,371	70,091,763
39' Project Depth (737 Calendar Days)	1.00	LS		54,411,298	2,476,094	56,887,392	13,204,371	70,091,763
Construction Costs	1.00	LS		45,987,572	2,476,094	48,463,666	13,014,893	61,478,559
06 Fish and Wildlife Facilities (204 Calendar Days)	1.00	LS	Hardbottom Mitigation Subcontractor	7,001,564	1,846,545	8,848,109	1,518,458	10,366,567
0603 Wildlife Facilities & Sanctuary	1.00	LS	Hardbottom Mitigation Subcontractor	7,001,564	1,846,545	8,848,109	1,518,458	10,366,567
Contract 2 (204 Calendar Days)	1.00	LS	Hardbottom Mitigation Subcontractor	7,001,564	1,846,545	8,848,109	1,518,458	10,366,567
10 Breakwaters and Seawalls (97 Calendar Days)	1.00	LS	Sheetpile Subcontractor	1,442,742	334,594	1,777,337	305,016	2,082,352
1000 Breakwaters & Seawalls	1.00	LS	Sheetpile Subcontractor	1,442,742	334,594	1,777,337	305,016	2,082,352
Contract 1 (97 Calendar Days)	1.00	LS	Sheetpile Subcontractor	1,442,742	334,594	1,777,337	305,016	2,082,352
12 Navigation Ports & Harbors (640 Calendar Days)	1.00	LS		37,543,266	294,954	37,838,220	11,191,419	49,029,639
1202 Harbors	1.00	LS		37,543,266	294,954	37,838,220	11,191,419	49,029,639
Contract 1 (51 Calendar Days)	1.00	LS	Prime Dredging Contractor- Contract 1	3,444,506	0	3,444,506	1,038,644	4,483,151
Contract 2 (589 Calendar Days)	1.00	LS	Prime Dredging Contractor- Contract 2	34,098,760	294,954	34,393,714	10,152,774	44,546,488
Non-Construction Costs	1.00	LS		8,423,726	0	8,423,726	189,478	8,613,204
02 Relocations	1.00	LS	Government: Non-Construction	20,000	0	20,000	0	20,000
0203 Cemetery, Utilities, & Structure	1.00	LS	Government: Non-Construction	20,000	0	20,000	0	20,000
Contract 1	1.00	LS	Government: Non-Construction	20,000	0	20,000	0	20,000
06 Fish and Wildlife Facilities	1.00	LS	Prime Contractor- Monitoring	841,426	0	841,426	189,478	1,030,904
0603 Wildlife Facilities & Sanctuary	1.00	LS	Prime Contractor- Monitoring	841,426	0	841,426	189,478	1,030,904
Contract 3	1.00	LS	Prime Contractor- Monitoring	841,426	0	841,426	189,478	1,030,904
30 Planning, Engineering and Design	1.00	LS	Government:	2,641,100	0	2,641,100	0	2,641,100

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost
			Non-Construction Government:					
3023 Constructn Contracts(s) Documnts	1.00	LS	Non-Construction Government:	2,641,100	0	2,641,100	0	2,641,100
Contract 1	1.00	LS	Non-Construction Government:	1,961,400	0	1,961,400	0	1,961,400
Contract 2	1.00	LS	Non-Construction Government:	679,700	0	679,700	0	679,700
31 Construction Management	1.00	LS	Non-Construction Government:	4,921,200	0	4,921,200	0	4,921,200
3123 Construction Contracts	1.00	LS	Non-Construction Government:	4,921,200	0	4,921,200	0	4,921,200
Contract 1	1.00	LS	Non-Construction Government:	526,400	0	526,400	0	526,400
Contract 2	1.00	LS	Non-Construction	4,394,800	0	4,394,800	0	4,394,800

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost
Project Direct Costs Report				**2,133,108**	**3,225,380**	**3,141,275**	**434,285**	**45,477,251**	**54,411,298**
Lake Worth Inlet Feasibility Study	**1.00**	**LS**		**2,133,108**	**3,225,380**	**3,141,275**	**434,285**	**45,477,251**	**54,411,298**
39' Project Depth (737 Calendar Days)	**1.00**	**LS**		**2,133,108**	**3,225,380**	**3,141,275**	**434,285**	**45,477,251**	**54,411,298**
Construction Costs	**1.00**	**LS**		**1,701,138**	**3,225,380**	**3,141,275**	**434,285**	**37,485,495**	**45,987,572**
06 Fish and Wildlife Facilities (204 Calendar Days)	**1.00**	**LS**	**Hardbottom Mitigation Subcontractor**	**1,443,227**	**1,876,790**	**2,386,455**	**139,195**	**1,155,896**	**7,001,564**
0603 Wildlife Facilities & Sanctuary	**1.00**	**LS**	**Hardbottom Mitigation Subcontractor**	**1,443,227**	**1,876,790**	**2,386,455**	**139,195**	**1,155,896**	**7,001,564**
Contract 2 (204 Calendar Days)	**1.00**	**LS**	**Hardbottom Mitigation Subcontractor**	**1,443,227**	**1,876,790**	**2,386,455**	**139,195**	**1,155,896**	**7,001,564**
10 Breakwaters and Seawalls (97 Calendar Days)	**1.00**	**LS**	**Sheetpile Subcontractor**	**123,687**	**503,201**	**622,527**	**16,700**	**176,627**	**1,442,742**
1000 Breakwaters & Seawalls	**1.00**	**LS**	**Sheetpile Subcontractor**	**123,687**	**503,201**	**622,527**	**16,700**	**176,627**	**1,442,742**
Contract 1 (97 Calendar Days)	**1.00**	**LS**	**Sheetpile Subcontractor**	**123,687**	**503,201**	**622,527**	**16,700**	**176,627**	**1,442,742**
12 Navigation Ports & Harbors (640 Calendar Days)	**1.00**	**LS**		**134,223**	**845,388**	**132,292**	**278,390**	**36,152,973**	**37,543,266**
1202 Harbors	**1.00**	**LS**		**134,223**	**845,388**	**132,292**	**278,390**	**36,152,973**	**37,543,266**
Contract 1 (51 Calendar Days)	**1.00**	**LS**	**Prime Dredging Contractor-Contract 1**	**10,263**	**266,459**	**0**	**0**	**3,167,784**	**3,444,506**
Contract 2 (589 Calendar Days)	**1.00**	**LS**	**Prime Dredging Contractor-Contract 2**	**123,960**	**578,929**	**132,292**	**278,390**	**32,985,189**	**34,098,760**
Non-Construction Costs	**1.00**	**LS**		**431,970**	**0**	**0**	**0**	**7,991,756**	**8,423,726**
02 Relocations	**1.00**	**LS**	**Government: Non-Construction**	**0**	**0**	**0**	**0**	**20,000**	**20,000**
0203 Cemetery, Utilities, & Structure	**1.00**	**LS**	**Government: Non-Construction**	**0**	**0**	**0**	**0**	**20,000**	**20,000**
Contract 1	**1.00**	**LS**	**Government: Non-Construction**	**0**	**0**	**0**	**0**	**20,000**	**20,000**
06 Fish and Wildlife Facilities	**1.00**	**LS**	**Prime Contractor-Monitoring**	**431,970**	**0**	**0**	**0**	**409,456**	**841,426**
0603 Wildlife Facilities & Sanctuary	**1.00**	**LS**	**Prime Contractor-Monitoring**	**431,970**	**0**	**0**	**0**	**409,456**	**841,426**
Contract 3	**1.00**	**LS**	**Prime Contractor-Monitoring**	**431,970**	**0**	**0**	**0**	**409,456**	**841,426**

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost
30 Planning, Engineering and Design	1.00	LS	Government: Non-Construction	0	0	0	0	2,641,100	2,641,100
3023 Constructn Contracts(s) Documnts	1.00	LS	Government: Non-Construction	0	0	0	0	2,641,100	2,641,100
Contract 1	1.00	LS	Government: Non-Construction	0	0	0	0	1,961,400	1,961,400
Contract 2	1.00	LS	Government: Non-Construction	0	0	0	0	679,700	679,700
31 Construction Management	1.00	LS	Government: Non-Construction	0	0	0	0	4,921,200	4,921,200
3123 Construction Contracts	1.00	LS	Government: Non-Construction	0	0	0	0	4,921,200	4,921,200
Contract 1	1.00	LS	Government: Non-Construction	0	0	0	0	526,400	526,400
Contract 2	1.00	LS	Government: Non-Construction	0	0	0	0	4,394,800	4,394,800

B4. SCHEDULE

Refer to the Schedule on the next page.

B6. SCHEDULE

ID	Activity	Duration	Start	Finish
1	**SAN MARTIN HILTOP DEVELOPMENT PROJECT**	**4677 days**	**Fri 2/28/13**	**Sun 5/26/25**
2	**SELECTED PLAN**	**4677 days**	**Fri 2/28/13**	**Sun 5/26/25**
3	**DEIR PROJECT DESIGN**	**4677 days**	**Fri 2/28/13**	**Sun 5/26/25**
4	**PLANNED PHASE**	**4600 days**	**Fri 2/28/13**	**Fri 11/27/26**
5	Prepare Draft Report	135 days	Fri 2/28/13	Sat 10/26/13
6	Submit Draft Report to SJAI	15 days	Tue 10/29/13	Mon 11/18/13
7	Submit Final Report to SJAI	0 days	Tue 11/19/13	Mon 11/19/13 FP+100 days
8	Director Engineer Transmitted Letter	15 days	Mon 11/18/13	Mon 12/2/13
9	Circulate Engineers Report	27 days	Tue 12/3/13	Wed 12/31/13 FP+45 days
10	JPA(s) Hrs. Transmitted to Congress	115 days	Mon 12/31/13	Fri 11/27/14 FP+120 days
11	WRDA Authorization	0 days	Fri 11/27/14	Fri 11/27/14 FP
12	**PRE-PHASE**	**718 days**	**Sat 8/1/14**	**Mon 2/27/17**
13	**Contract 1**	**570 days**	**Sat 8/1/14**	**Thu 1/26/16**
14	PS/E Development	334 days	Sat 8/1/14	Fri 6/26/15 FP-0.5*L days
15	NOD (CEQA Permit)	30 days	Fri 6/26/15	Tue 8/25/15
16	PS/E Complete	75 days	Tue 8/25/15	Sun 9/27/15
17	PPL	75 days	Tue 9/29/15	Sun 9/27/15
18	Advertise	30 days	Tue 9/29/15	Tue 10/27/15
19	Bid Opening	0 days	Tue 9/1/15	Tue 9/1/15
20	Award	30 days	Tue 9/1/15	Thu 10/1/15
21	**Contract 2**	**350 days**	**Fri 10/30/15**	**Mon 2/27/17**
22	PS/E Development	137 days	Fri 10/30/15	Tue 5/24/16
23	NOD (CEQA Permit)	30 days	Tue 5/24/16	Sat 6/23/16
24	PS/E Complete	75 days	Sat 6/23/16	Thu 10/27/16
25	PPL	75 days	Sat 10/29/16	Thu 12/27/16
26	Advertise	30 days	Thu 12/27/16	Sat 1/28/17
27	Bid Opening	0 days	Sat 1/28/17	Sat 1/28/17
28	Award	30 days	Sat 1/28/17	Mon 2/27/17
29	**CONSTRUCTION PHASE**	**970 days**	**Thu 10/1/20**	**Thu 5/26/24**
30	**Contract 1**	**730 days**	**Thu 10/1/20**	**Thu 1/26/22**
31	**10 MOBILIZATION AND SEQUE**	**77 days**	**Thu 10/1/20**	**Wed 1/13/21**
32	MOB AND CATCHUP	70 days	Thu 10/1/20	Sat 12/12/20
33	Submittals	77 days	Sat 10/31/20	Wed 1/13/21
34	**12 NAVIGATION PORTS AND PA**	**51 days**	**Tue 12/29/20**	**Thu 1/28/21**
35	MOB AND CATCHUP	30 days	Sat 12/29/20	Thu 1/7/21 SF+28 days
36	**PIPELINE EMBEDDING**	**21 days**	**Thu 1/7/21**	**Thu 1/28/21**
37	Segment A	5 days	Thu 1/7/21	Sat 1/12/21 SF
38	Segment B	17 days	Sat 1/16/21	Thu 1/28/21
39	**Contract 2**	**240 days**	**Mon 2/28/22**	**Thu 2/28/23**
40	**13 NAVIGATION PORTS AND PA**	**210 days**	**Mon 2/28/22**	**Thu 9/28/22**
41	INSTALL MOB AND CATCHUP	30 days	Mon 2/28/22	Wed 3/30/22 SF
42	PIPELINE CONSTRUCTION	30 days	Tue 3/31/22	Thu 5/5/22
43	PIPELINE AND CATCHUP	30 days	Wed 3/14/22	Fri 5/6/22
44	MOB AND CATCHUP, SETTLE	30 days	Mon 3/28/22	Wed 5/25/22
45	**MECHANICAL TIMESHARE**	**180 days**	**Wed 5/25/22**	**Thu 9/28/22**
46	Segment C	30 days	Wed 5/25/22	Sat 6/25/22 SF
47	Segment D	105 days	Tue 6/28/22	Sat 10/15/22 SF
48	Segment E	150 days	Thu 7/21/22	Wed 12/21/22 SF
49	Segment F	52 days	Wed 8/24/22	Mon 10/24/22 SF
50	Setting Basins	75 days	Fri 9/23/22	Thu 12/22/22 SF
51	**JURISDICTIO GENERAL TI**	**51 days**	**Wed 3/16/22**	**Wed 5/18/22**
52	Seagrass Mitigation	57 days	Wed 3/16/22	Wed 5/18/22 SF
53	**50 FINISHING MOLD PLANTS**	**250 days**	**Tue 2/14/23**	**Mon 2/26/24**
54	MOB AND CATCHUP	30 days	Tue 2/14/23	Thu 3/16/23
55	**HABITAT AND PERMANE TE**	**170 days**	**Thu 3/16/23**	**Wed 9/6/23**
56	Vegetation Mitigation	170 days	Thu 3/16/23	Wed 9/6/23 SF
57	**MONITORING**	**1825 days**	**Thu 5/26/22**	**Tue 5/26/26**
58	**Contract 1**	**1825 days**	**Thu 5/26/22**	**Tue 5/26/26**
59	**50 FINISHING MOLD PLANTS**	**1825 days**	**Thu 5/26/22**	**Tue 5/26/26**
60	Post Construction Monitoring	1825 days	Thu 5/26/22	Tue 5/26/26 SF

Project: LAT_SanMartinPlant-Schedule1
Date: Mon 3/25/13

Critical | Critical Split | Critical Progress | Task | Split | Task Progress | Baseline | Baseline Split | Baseline Milestone | Milestone | Summary Progress | Summary | Project Summary | External Tasks | External Milestone | Deadline

B5. RISK AND UNCERTAINTY ANALYSIS

A Cost and Schedule Risk Analysis was conducted according to the procedures outlined in the manual entitled, "Cost and Schedule Risk Analysis Process" dated March 2008.

B.5.1 Risk Analysis Methods

The entire PDT participated in a cost and schedule risk analysis brainstorming session to identify risks associated with the Tentatively Selected Plan. The risks were listed in the risk register and evaluated by the PDT. Assumptions were made as to the likelihood and impact of each risk item, as well as the probability of occurrence and magnitude of the impact if it were to occur. A risk model was then developed in Crystal Ball in order to develop a contingency to apply to the project cost and schedule. After the model was run, the results were reviewed and all parameters were re-evaluated by the PDT as a sanity check of assumptions and inputs. Adjustments were made to the analysis accordingly and the final contingency was established. The contingency was applied to the recommended plan estimate in the Total Project Cost Summary in order to obtain the Fully Funded Cost.

B.5.2 Risk Analysis Results

Refer to the Project Cost and Schedule Risk Analysis Report provided by Walla Walla Mandatory Cost Center of Expertise as an attachment to this appendix.

B6. TOTAL PROJECT COST SUMMARY

The Total Project Cost Summary (TPCS) addresses inflation through project completion (accomplished by escalation to mid-point of construction per ER 1110-2-1302, Appendix C, Page C-2). It is based on the scope of the Tentatively Selected Plan and the official project schedule. The TPCS includes Federal and Non-Federal costs for Lands and Damages, all construction features, PED, S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the CWWBS and uses Civil Works Construction Cost Indexing System (CWCCIS) factors for escalation (EM 1110-2-1304) of construction costs and Office of Management and Budget (EC 11-2-18X, 20 Feb 2008) factors for escalation of PED and S&A costs.

The Total Project Cost Summary was prepared using the MCACES/MII cost estimate on the Tentatively Selected Plan, as well as the contingency set by the risk analysis and the official project schedule.

B.6.1 Total Project Cost Summary Spreadsheet

Refer to the Total Project Cost Summary Spreadsheet on the next page.

PROJECT: Lake Worth Inlet Feasibility Study
LOCATION: Palm Beach, FL

DISTRICT: SAJ- Jacksonville District
POC: CHIEF, COST ENGINEERING, Tracy Leeser

PREPARED: 3/7/2013

This Estimate reflects the scope and schedule in report; Lake Worth Inlet Feasibility Study Draft Report

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
							Program Year (Budget EC):		2015					
							Effective Price Level Date:		1 OCT 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: 1-Oct-12 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
06	FISH & WILDLIFE FACILITIES	$10,367	$3,110	30%	$13,477	3.4%	$10,723	$3,217	$13,940	$0		$11,015	$3,304	$14,319
10	BREAKWATER & SEAWALLS	$2,082	$625	30%	$2,707	3.4%	$2,154	$646	$2,800	$0		$2,193	$658	$2,850
12	NAVIGATION PORTS & HARBORS	$49,030	$14,709	30%	$63,739	3.4%	$50,714	$15,214	$65,929	$0		$52,926	$15,878	$68,803
		$0	$0 -		$0	-	$0	$0	$0	$0		$0	$0	$0
		$0	$0 -		$0	-	$0	$0	$0	$0		$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$61,479	$18,444		$79,922	3.4%	$63,591	$19,077	$82,668	$0		$66,133	$19,840	$85,973
01	LANDS AND DAMAGES	$0	$0 -		$0	-	$0	$0	$0	$0		$0	$0	$0
02	RELOCATIONS	$20	$6	30%	$26	5.8%	$21	$6	$28	$0		$22	$7	$29
06	FISH & WILDLIFE FACILITIES	$1,031	$309	30%	$1,340	2.7%	$1,059	$318	$1,377	$0		$1,137	$341	$1,478
30	PLANNING, ENGINEERING & DESIGN	$2,641	$792	30%	$3,433	6.9%	$2,823	$847	$3,669	$0		$2,856	$857	$3,713
31	CONSTRUCTION MANAGEMENT	$4,921	$1,476	30%	$6,398	6.9%	$5,259	$1,578	$6,837	$0		$5,742	$1,723	$7,465
	PROJECT COST TOTALS:	$70,092	$21,028	30%	$91,119		$72,753	$21,826	**$94,579**	$0		$75,891	$22,767	$98,659

Mandatory by Regulation CHIEF, COST ENGINEERING, Tracy Leeser

Mandatory by Regulation PROJECT MANAGER, Tim Murphy

Mandatory by Regulation CHIEF, REAL ESTATE, Aubrey Ormerod

CHIEF, PLANNING, Eric Bush

CHIEF, ENGINEERING, Loreen Borochaner

CHIEF, OPERATIONS, Jim Jeffords

CHIEF, CONSTRUCTION, Steven Duba

CHIEF, CONTRACTING, Carlos Clarke

CHIEF, PM-PB, Dan Haubner

CHIEF, DPM, David Hobbie

ESTIMATED FEDERAL COST:	**75%**	**$73,994**
ESTIMATED NON-FEDERAL COST:	**25%**	**$24,665**
ESTIMATED TOTAL PROJECT COST:		**$98,659**

O&M OUTSIDE OF TOTAL PROJECT COST:

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Lake Worth Inlet Feasibility Study
LOCATION: Palm Beach, FL
This Estimate reflects the scope and schedule in report; Lake Worth Inlet Feasibility Study Draft Report

DISTRICT: SAJ- Jacksonville District
POC: CHIEF, COST ENGINEERING, Tracy Leeser
PREPARED: 3/7/2013

Estimate Prepared: 5-Mar-13
Effective Price Level: 1-Oct-12

Program Year (Budget EC): 2015
Effective Price Level Date: 1 OCT 14

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
06	FISH & WILDLIFE FACILITIES	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
10	BREAKWATER & SEAWALLS	$2,082	$625	30%	$2,707	3.4%	$2,154	$646	$2,800	2016Q1	1.8%	$2,193	$658	$2,850
12	NAVIGATION PORTS & HARBORS	$4,483	$1,345	30%	$5,828	3.4%	$4,637	$1,391	$6,028	2016Q2	2.3%	$4,742	$1,423	$6,165
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$6,566	$1,970	30%	**$8,535**		$6,791	$2,037	$8,828			$6,935	$2,080	$9,015
02	RELOCATIONS	$20	$6	30%	$26	5.8%	$21	$6	$28	2018Q3	4.1%	$22	$7	$29
06	FISH & WILDLIFE FACILITIES	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
01	LANDS AND DAMAGES	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.0%	Project Management	$100	$30	30%	$130	6.9%	$107	$32	$139	2015Q1	0.0%	$107	$32	$139
0.0%	Planning & Environmental Compliance	$807	$242	30%	$1,049	6.9%	$862	$259	$1,121	2015Q1	0.0%	$862	$259	$1,121
0.0%	Engineering & Design	$877	$263	30%	$1,140	6.9%	$937	$281	$1,218	2015Q1	0.0%	$937	$281	$1,218
0.0%	Engineering Tech Review ITR & VE	$86	$26	30%	$112	6.9%	$92	$28	$119	2015Q1	0.0%	$92	$28	$119
0.0%	Contracting & Reprographics	$40	$12	30%	$52	6.9%	$43	$13	$56	2015Q1	0.0%	$43	$13	$56
0.0%	Engineering During Construction	$13	$4	30%	$17	6.9%	$14	$4	$18	2016Q1	3.9%	$15	$4	$19
0.0%	Planning During Construction	$13	$4	30%	$17	6.9%	$14	$4	$18	2016Q1	3.9%	$15	$4	$19
0.0%	Real Estate	$25	$8	30%	$33	6.9%	$27	$8	$35	2015Q1	0.0%	$27	$8	$35
31	CONSTRUCTION MANAGEMENT													
0.0%	Construction Management	$500	$150	30%	$650	6.9%	$534	$160	$695	2016Q1	3.9%	$555	$167	$722
0.0%	Contract Admin	$13	$4	30%	$17	6.9%	$14	$4	$18	2016Q1	3.9%	$15	$4	$19
0.0%	Project Management	$13	$4	30%	$17	6.9%	$14	$4	$18	2016Q1	3.9%	$15	$4	$19
	CONTRACT COST TOTALS:	$9,073	$2,722		**$11,795**		$9,471	$2,841	$12,312			$9,639	$2,892	**$12,530**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Lake Worth Inlet Feasibility Study
LOCATION: Palm Beach, FL
This Estimate reflects the scope and schedule in report; Lake Worth Inlet Feasibility Study Draft Report

DISTRICT: SAJ- Jacksonville District
POC: CHIEF, COST ENGINEERING, Tracy Leeser
PREPARED: 3/7/2013

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			5-Mar-13	Program Year (Budget EC):			2015					
		Effective Price Level:			1-Oct-12	Effective Price Level Date:			1 OCT 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST	CNTG	CNTG	TOTAL	ESC	COST	CNTG	TOTAL	Mid-Point Date	INFLATED	COST	CNTG	FULL
A	B	($K) C	($K) D	(%) E	($K) F	(%) G	($K) H	($K) I	($K) J	P	(%) L	($K) M	($K) N	($K) O
	PHASE 2 or CONTRACT 2													
06	FISH & WILDLIFE FACILITIES	$10,367	$3,110	30%	$13,477	3.4%	$10,723	$3,217	$13,940	2016Q3	2.7%	$11,015	$3,304	$14,319
10	BREAKWATER & SEAWALLS	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	NAVIGATION PORTS & HARBORS	$44,546	$13,364	30%	$57,910	3.4%	$46,077	$13,823	$59,900	2017Q3	4.6%	$48,184	$14,455	$62,639
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$54,913	$16,474	30%	**$71,387**		$56,800	$17,040	$73,840			$59,198	$17,759	$76,958
02	RELOCATIONS	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
01	LANDS AND DAMAGES	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.0%	Project Management	$100	$30	30%	$130	6.9%	$107	$32	$139	2015Q3	1.9%	$109	$33	$142
0.0%	Planning & Environmental Compliance	$41	$12	30%	$53	6.9%	$43	$13	$56	2015Q3	1.9%	$44	$13	$57
0.0%	Engineering & Design	$279	$84	30%	$363	6.9%	$299	$90	$388	2015Q3	1.9%	$304	$91	$396
0.0%	Engineering Tech Review ITR & VE	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Contracting & Reprographics	$40	$12	30%	$52	6.9%	$43	$13	$56	2015Q3	1.9%	$44	$13	$57
0.0%	Engineering During Construction	$110	$33	30%	$143	6.9%	$117	$35	$153	2017Q3	9.8%	$129	$39	$168
0.0%	Planning During Construction	$110	$33	30%	$143	6.9%	$117	$35	$153	2017Q3	9.8%	$129	$39	$168
0.0%	Real Estate	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
0.0%	Construction Management	$4,175	$1,253	30%	$5,428	6.9%	$4,462	$1,339	$5,800	2017Q3	9.8%	$4,900	$1,470	$6,370
0.0%	Contract Admin	$110	$33	30%	$143	6.9%	$117	$35	$153	2017Q3	9.8%	$129	$39	$168
0.0%	Project Management	$110	$33	30%	$143	6.9%	$117	$35	$153	2017Q3	9.8%	$129	$39	$168
	CONTRACT COST TOTALS:	$59,988	$17,996		**$77,984**		$62,223	$18,667	$80,890			$65,115	$19,535	**$84,650**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Lake Worth Inlet Feasibility Study
LOCATION: Palm Beach, FL
This Estimate reflects the scope and schedule in report; Lake Worth Inlet Feasibility Study Draft Report

DISTRICT: SAJ- Jacksonville District
POC: CHIEF, COST ENGINEERING, Tracy Leeser
PREPARED: 3/7/2013

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			5-Mar-13	Program Year (Budget EC):			2015					
		Effective Price Level:			1-Oct-12	Effective Price Level Date:			1 OCT 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 3 or CONTRACT 3													
06	FISH & WILDLIFE FACILITIES	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
10	BREAKWATER & SEAWALLS	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
12	NAVIGATION PORTS & HARBORS	$0	$0	30%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
		$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$0	$0	0%	**$0**		$0	$0	$0			$0	$0	$0
02	RELOCATIONS	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$1,031	$309	30%	$1,340	2.7%	$1,059	$318	$1,377	2021Q3	7.4%	$1,137	$341	$1,478
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.0%	Project Management	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Planning & Environmental Compliance	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Engineering & Design	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Engineering Tech Review ITR & VE	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Contracting & Reprographics	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Engineering During Construction	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Planning During Construction	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Project Operations													
31	CONSTRUCTION MANAGEMENT													
0.0%	Construction Management	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Operation:	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Management	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$1,031	$309		**$1,340**		$1,059	$318	$1,377			$1,137	$341	**$1,478**

B7. COST DX TPCS CERTIFICATION

The Tentatively Selected Plan estimate as well as the Cost and Schedule Risk Analysis and Total Project Cost Summary will undergo Cost Review and Certification by the Walla Walla Mandatory Center of Expertise following the final ATR, prior to submittal of the Final Report.

ATTACHMENT A
PROJECT COST AND SCHEDULE RISK ANALYSIS REPORT

US Army Corps
of Engineers®

Lake Worth Inlet Navigation
Pilot Feasibility Study
Tentatively Selected Plan
Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Jacksonville District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

December 12, 2012

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

MAIN REPORT 1

1.0 PURPOSE 1

2.0 BACKGROUND 1

3.0 REPORT SCOPE 1

3.1 Project Scope 2

3.2 USACE Risk Analysis Process 2

4.0 METHODOLOGY / PROCESS 3

4.1 Identify and Assess Risk Factors 4

4.2 Quantify Risk Factor Impacts 5

4.3 Analyze Cost Estimate and Schedule Contingency 6

5.0 PROJECT ASSUMPTIONS 6

6.0 RESULTS 7

6.1 Risk Register 7

6.2 Cost Contingency and Sensitivity Analysis 8

6.2.1 Sensitivity Analysis 9

6.2.2 Sensitivity Analysis Results 9

7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS 13

7.1 Major Findings/Observations 13

7.2 Recommendations 17

LIST OF TABLES

Table ES-1. Contingency Analysis ES-1

Table ES-2. Cost Summary ES-2

Table 1. Project Cost Contingency Summary 8

Table 2. Schedule Duration Contingency Summary 10

Table 3. Project Cost Comparison Summary (Uncertainty Analysis) 14

LIST OF FIGURES

Figure 1. Cost Sensitivity Analysis 11

Figure 2. Schedule Sensitivity Analysis 12

Figure 4. Project Cost Summary (Uncertainty Analysis) 15

Figure 5. Project Duration Summary (Uncertainty Analysis) 16

LIST OF APPENDICES

Risk Register ..... APPENDIX A

EXECUTIVE SUMMARY

Under the auspices of the U.S. Army Corps of Engineers (USACE), Jacksonville District, this report presents a recommendation for the total project cost and schedule contingencies for the Lake Worth Inlet Navigation Pilot Feasibility Study. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost.

Specific to the Lake Worth project, the base case project cost for the Tentatively Selected Plan is estimated at approximately $72 Million. Based on the results of the analysis, the Cost Engineering Mandatory Center of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $22 Million, or 30%. This contingency includes $16.5 Million (23%) for the initial construction and $5.3 Million (7%) for the four subsequent nourishment activities.

Walla Walla Cost MCX performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following tables ES-1, ES-2, and ES-3 portray the development of contingencies (30% overall). The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Base Cost Estimate	**$71,922,819**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$65,750,489	-8.58%
50%	$83,527,428	16.13%
80%	**$93,746,921**	**30.34%**
95%	$104,167,897	44.83%

The following table ES-2 portrays the full costs of the recommended alternative based on the anticipated contracts. The costs are intended to address the congressional request of estimates to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-2. Cost Summary

LAKE WORTH FEATURE ACCOUNTS		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
02	RELOCATIONS	20	6	26
06	FISH AND WILDLIFE FACILITIES	11,883	3,606	15,488
10	BREAKWATERS AND SEAWALLS	2,087	633	2,720
12	NAVIGATION PORTS AND HARBORS	50,233	15,243	66,476
30	PLANNING, ENGINEERING, AND DESIGN	2,648	803	3,451
31	CONSTRUCTION MANAGEMENT	5,052	1,533	6,586
	TOTAL PROJECT COSTS	**71,923**	**21,824**	**93,747**

Notes: 1) Costs include the recommended contingency of 30%.
2) Costs exclude O&M and Life Cycle Cost estimates.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis are PR-1 (Market Conditions/Bidding Climate) and PR-2 (Limited Competition), which together contribute nearly 69 percent of the statistical cost variance.

> Market Conditions/Bidding Climate captures the risk that market forces contribute to either a decrease or increase in the ultimate contract costs, either due to commodity price volatility or supply and demand forces on the bidding environment. Limited Competition captures the risk of limiting the pool of contractors available to perform the work, impacting the ultimate contract costs.

The key schedule risk drivers identified through sensitivity analysis are CON-4 (Construction Schedule Accuracy), RE-3 (ODMDS Capacity), and CON-1 (Variation in Estimated Quantity), which together contribute over 46 percent of the statistical schedule variance.

> Construction Schedule Accuracy captures the risk that the construction schedule may not be completely accurate, as compared to the actual construction schedule, changing the overall project schedule. ODMDS Capacity captures the risk that there may be restrictions on the disposal site for dredge material or that another site may be required, delaying the overall project schedule. Variation in Estimated Quantity captures the risk that overruns or underruns could impact the schedule.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Jacksonville District, this report presents a recommendation for the total project cost and schedule contingencies for the Lake Worth Inlet Navigation Pilot Study Project.

2.0 BACKGROUND

The Lake Worth Inlet Navigation Pilot Study consists of widening and deepening (to a depth of 39-feet) in the navigation channel that serves the Port of Palm Beach. The ROM cost for the project is approximately $85 Million. The project sponsor is the Port of Palm Beach. The work includes mitigation features for potential impacts to sea grass and the creation of hard bottoms. The majority of the disposal will be using the ODMDS, while some will be disposed to create the mitigation features and renourish beaches. The project will also include jetty stabilization (using sheet piles) if the channel is deepened to 39-feet or greater. The work will likely be complete in 2-3 phases due to funding increment limitations. It is likely that the contracts will be acquired using a best value-tradeoff RFP procurement to secure performance. The current construction schedule is approximately 15 months in duration. The PDT estimates that one year of feasibility remains, followed by 12-18 months of PED. The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project.

As a part of this effort, Jacksonville District requested that the USACE Cost Engineering Mandatory Center of Expertise for Civil Works (Cost Engineering MCX) provide an agency technical review (ATR) of the cost estimate and schedule for Recommended Project Plan. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all

project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the base case Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Jacksonville District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Walla Walla Cost Engineering MCX performed the Cost and Schedule Risk Analysis, relying on local Jacksonville District staff to provide information gathering. The Walla Walla Cost Engineering MCX facilitated an on-site risk identification meeting on September 11, 2012 with the Jacksonville District PDT to produce a risk register that served as the framework for the risk analysis. Participants in risk identification meeting included the following:

Name	Organization	Title
Dan Abecassis	USACE - SAJ	PD-D, Economist
Steve Bratos	USACE - SAJ	EN-WC, Hydrodynamics Modeler
Stephen Conger	USACE - SAJ	EN-DW, Levee Design
Angela Dunn	USACE - SAJ	PD-ES, NEPA
Al Fletcher	USACE - SAJ	PM-WN, Operations manager
Pat Griffin	USACE - SAJ	PD-ES, NEPA
Mike Hensch	USACE - SAJ	PM-WN, Operations manager
Russ Jones	USACE - SAJ	PD-EQ, Water Quality
Max Millstein	USACE - SAJ	PD-D, Economist
Mike Neves	USACE - SAJ	EN-GS, Soils
Barbara Nist	USACE - SAJ	EN-GG, Geotechnical
Cynthia Perez	USACE - SAJ	PM-WN, Project Manager
Philip Sylvestor	USACE - SAJ	PM-WF, Ship Simulation
Jennifer Tyler	USACE - SAJ	EN-TC, Cost Estimating
Lynn Zediak	USACE - SAJ	RE-A, Real Estate Acquisition
Joelle Verhagen	USACE - SAJ	PD-EC, ODMDS Manager
Ian Mcclary	USACE - SAJ	CT, Contracting
Glenn Matlock	USACE - NWW	Chief, Cost MCX, Risk Facilitator
Stacey Roth	USACE - SAJ	PD-PN, Planning
Sheldon Shuff	USACE - SAJ	OC, Office of Council

The first cost risk model was completed November 26, 2012. However, scope and estimate updates since then, as well as a PDT sanity check review, necessitated a rerun of the original model. The final results were completed and reported to Jacksonville on November 30, 2012.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or

economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

A formal PDT meeting was held with the Jacksonville District office for the purposes of identifying and assessing risk factors. The meeting included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, environmental compliance, and real estate

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and

discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Lake Worth project.

a. The Jacksonville District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files electronically. The MII and CWE files transmitted and downloaded on November 30, 2012 was the basis for the final cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay. Specific to the Lake Worth project, the schedule was analyzed only for impacts due to residual fixed costs.

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for the State of Florida is 0.93, meaning that the average inflation for

the project area is assumed to be 7% lower than the national average for inflation. Therefore, it is assumed that the project inflations experienced are similar (or better) to OMB inflation factors for future construction. Thus, the risk analyses accounted for no escalation over and above the national average.

e. Per the data in the estimate, the Overhead percentage for the Prime Contractor is 10%, and 7% for the Subcontractors. Thus, the assumed residual fixed cost rate for this project is 8.5%. For the P80 schedule, this comprises approximately 24% of the total contingency and 7.4% of the base cost estimate. This is due to the accrual of residual fixed costs associated with delay associated with the implementation schedule.

f. The Cost MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list”.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the

identified risks and their assessment in terms of probability and impact.

- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $21.8 Million at the P80 confidence level (30% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 16% and 84% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Total Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$83,527,428	$11,604,609	16.13%
80% Confidence Level			
Project Cost	$93,746,921	$21,824,102	30.34%
100% Confidence Level			
Project Cost	$132,111,209	$60,188,390	83.68%

Notes:
1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of “unknown unknowns”) makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 30 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	34	19
80% Confidence Level		
Project Duration	34	30
100% Confidence Level		
Project Duration	34	73

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of “unknown unknowns”) makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

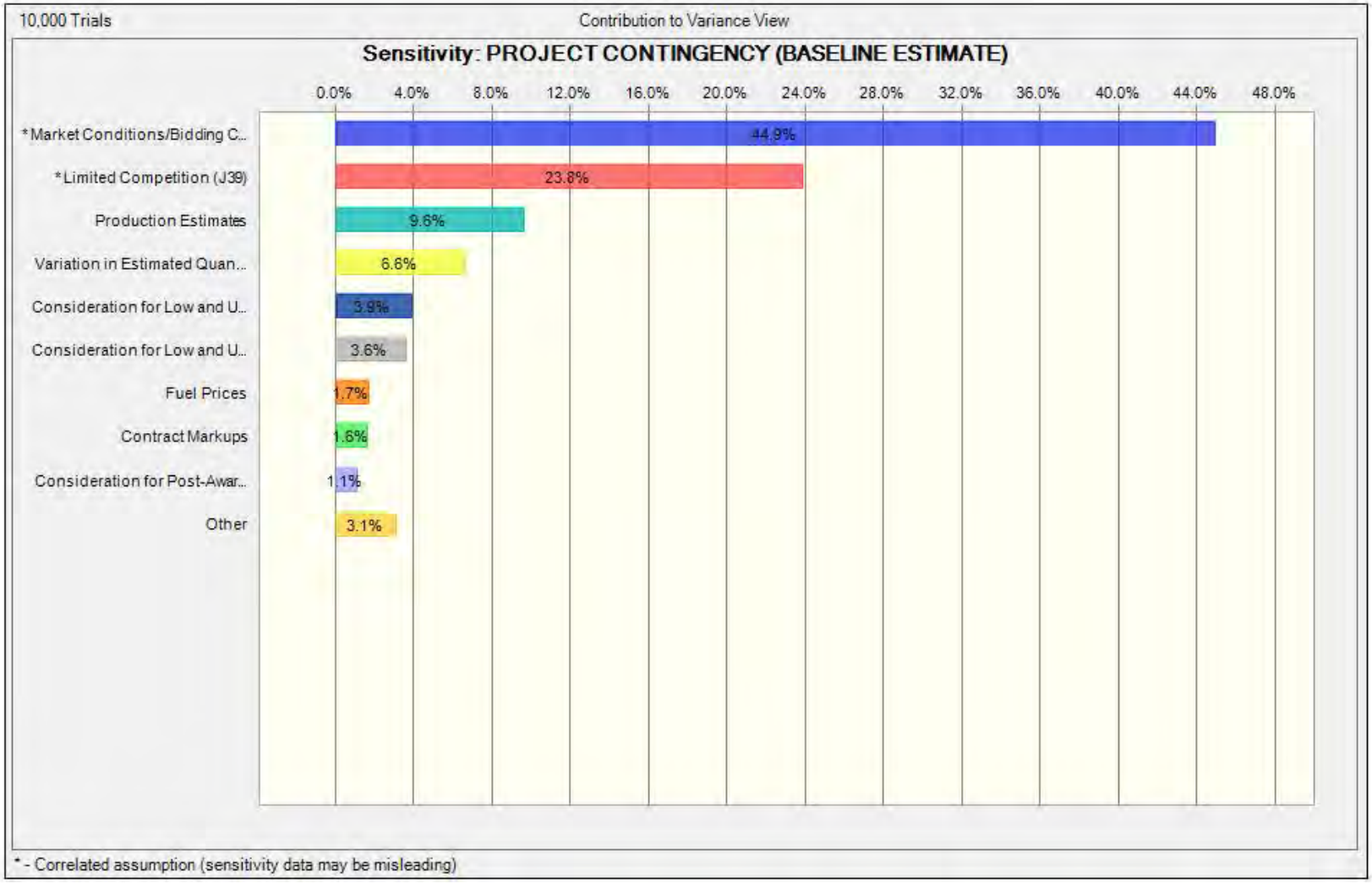
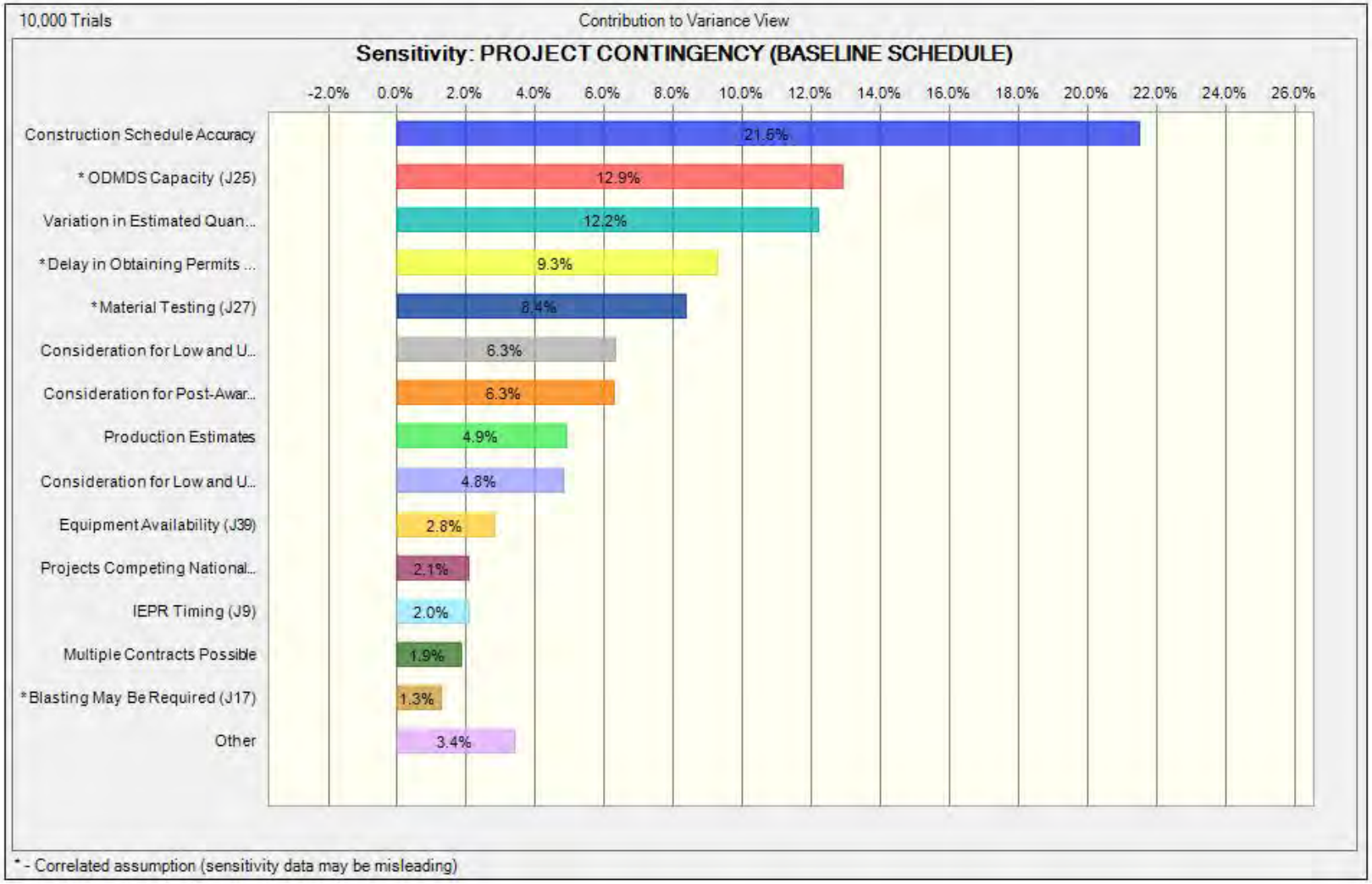


Figure 2. Schedule Sensitivity Analysis - Initial



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis are Risks PR-1 (Market Conditions/Bidding Climate) and PR-2 (Limited Competition), which together contribute nearly 69 percent of the statistical cost variance.

2. The key schedule risk drivers identified through sensitivity analysis are Risks CON-4 (Construction Schedule Accuracy), RE-3 (ODMDS Capacity), and CON-1 (Variation in Estimated Quantity), which together contribute over 46 percent of the statistical schedule variance.

3. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full life cycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3. Project Cost Comparison Summary (Uncertainty Analysis)

Confidence Level	Project Cost ($)	Contingency ($)	Contingency (%)
P0	**$44,937,192**	**($26,985,627)**	**-37.52%**
P5	**$65,750,489**	**($6,172,330)**	**-8.58%**
P10	**$69,462,070**	**($2,460,749)**	**-3.42%**
P15	**$71,921,378**	**$(1,441)**	**0.00%**
P20	**$74,040,629**	**$2,117,810**	**2.94%**
P25	**$75,940,431**	**$4,017,612**	**5.59%**
P30	**$77,530,976**	**$5,608,157**	**7.80%**
P35	**$79,117,936**	**$7,195,117**	**10.00%**
P40	**$80,650,767**	**$8,727,948**	**12.14%**
P45	**$82,082,008**	**$10,159,189**	**14.13%**
P50	**$83,527,428**	**$11,604,609**	**16.13%**
P55	**$85,056,641**	**$13,133,822**	**18.26%**
P60	**$86,529,673**	**$14,606,854**	**20.31%**
P65	**$88,132,005**	**$16,209,186**	**22.54%**
P70	**$89,717,642**	**$17,794,824**	**24.74%**
P75	**$91,610,142**	**$19,687,323**	**27.37%**
P80	**$93,746,921**	**$21,824,102**	**30.34%**
P85	**$96,221,729**	**$24,298,910**	**33.78%**
P90	**$99,382,841**	**$27,460,023**	**38.18%**
P95	**$104,167,897**	**$32,245,078**	**44.83%**
P100	**$132,111,209**	**$60,188,390**	**83.68%**

Figure 3. Project Cost Summary (Uncertainty Analysis)

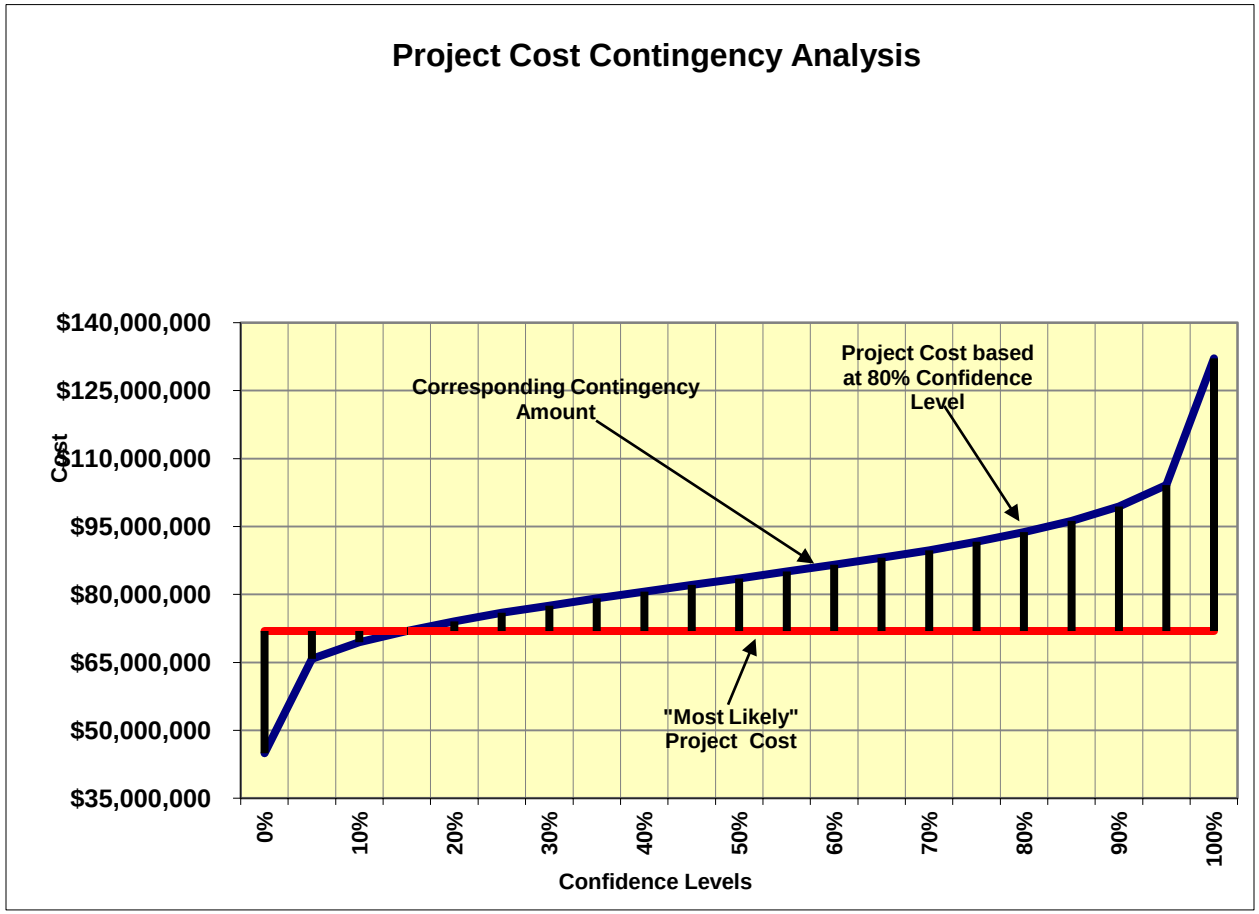
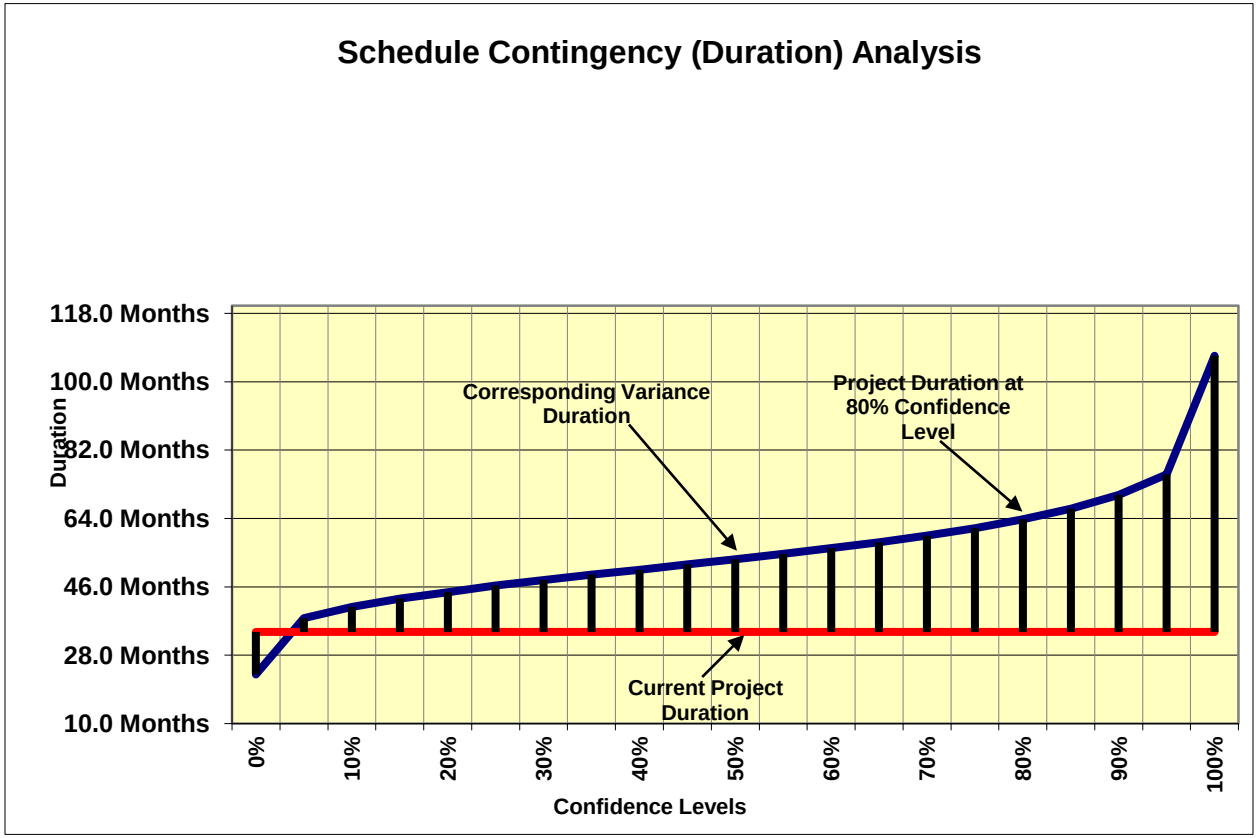


Figure 4. Project Duration Summary (Uncertainty Analysis)



7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis are Risks PR-1 (Market Conditions/Bidding Climate) and PR-2 (Limited Competition), which together contribute nearly 69 percent of the statistical cost variance.

a) Market Conditions/Bidding Climate: There is inherent risk that the ultimate bidding climate at the time of award of future contracts will be unfavorable to the price, as compared to the current working estimates of contract price. The PDT should continue to perform market research and analysis of trends within the construction industry. Ultimately, this uncertainty cannot be mitigated until more information is available. This should be communicated to management, and an adequate amount of contingency should be reserved to capture this risk.

b) Limited Competition: Project leadership should take proactive measures to obtain decisions regarding acquisition strategy, as well as communication to management regarding the impact of those decisions on cost performance. Project leadership should develop the acquisition strategy to maximize competition and cost control, and so that current working estimates can capture the probable costs.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis are Risks CON-4 (Construction Schedule Accuracy), RE-3 (ODMDS Capacity), and CON-1 (Variation in Estimated Quantity), which together contribute over 46 percent of the statistical schedule variance.

a) Construction Schedule Accuracy: Project leadership should invest in the development of a detailed construction schedule, taking into consideration any resource, milestone, or operational restriction constraints. Realism should be built into the schedule to account for risk to ensure that the current working budgetary estimates are based on the most likely scenarios. Project leadership should also take proactive measures with respect to the schedule and the timeline, controlling any changes as they arise. Changes to the anticipated timeline with respect to schedule should be controlled and reported to management for expeditious schedule recovery efforts.

b) ODMDS Capacity: Project leadership should proactively coordinate and communicate with District management and the other involved project partners and sponsors. Additionally, the PDT should actively research and report any changes to the characterization of the ODMDS capacity, operational restrictions, or other regulatory requirements. Ultimately, an amount and duration for this issue should be included and protected within the contingency and/or management reserve.

c) Variation in Estimated Quantity: Although there has been a thorough development of quantities, inherently the PDT has some uncertainty regarding the computation of quantities. This makes the ultimate costs of the project vulnerable to overruns of estimated quantities. The PDT should conduct investigations and surveys to obtain data to lower the uncertainty with respect to quantity computation.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

SAJ Lake Worth Inlet Navigation Pilot Study

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Project Scope Narrative: The Lake Worth Inlet Navigation Pilot Study consists of widening and deepening (to a depth of 39-feet) in the navigation channel that serves the Port of Palm Beach. The ROM cost for the project is approximately $85 Million. The project sponsor is the Port of Palm Beach. The work includes mitigation features for potential impacts to sea grass and the creation of hard bottoms. The majority of the disposal will using the ODMDS, while some will be disposed to create the mitigation features and renourish beaches. The project will also include Jetty stabilization (using sheet piles) if the channel is deepened to 39-feet or greater. The work will likely be complete in 2-3 phases due to funding increment limitations. It is likely that the contracts will be acquired using a best value-tradeoff RFP procurement to secure performance. The current construction schedule is approximately 15 months in duration. The PDT estimate that one year of feasibility remains, followed by 12-18 months of PED.

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule			Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*		
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)											
PROJECT & PROGRAM MGMT											
PPM-1	IEPR Timing	If the IEPR takes longer than 4 months, then the authorization may be delayed up to one fiscal year.	This has impact to the preconstruction schedule. This is a program milestone.	Unlikely	Negligible	LOW	Unlikely	Crisis	HIGH	Project Manager	Project Schedule
PPM-2	Division/HQUSACE Approvals	If SAD/HQ does not approve report for public release as DP 2, then it could have a significant impact on the schedule.	This has impact to the preconstruction schedule. This is a program milestone.	Unlikely	Negligible	LOW	Unlikely	Significant	MODERATE	Project Manager	Project Schedule
PPM-3	Economic Modeling Accuracy	Although highly unlikely, if the economic benefit/modeling was determined to be inaccurate through the ATR or IEPR process, it could significantly impact the project.	It is not likely that the whole project will not be economically justified. However, there is the possibility that the NED scope could change (i.e. the navigation depth), presenting a significant change to the cost and schedule. *This could be a show-stopping risk. Model only for impact to configuration different from current proposed plan.	Unlikely	Critical	MODERATE	Unlikely	Marginal	LOW	Project Manager	Project Cost
PPM-4	Projects Competing for Resources	There is typically a great deal of competition for the same resources.	This has a delay impact to the preconstruction schedule (feasibility and PED)	Very Unlikely	Negligible	LOW	Likely	Marginal	MODERATE	Project Manager	Project Schedule
PPM-5	Projects Competing Nationally for Funding	Typically, several projects nationally are competing for funding. However, since this is a Pilot project, it has better chances of obtaining funds.	This could have an impact to cost and schedule. Cost impacts would most likely be captured by the schedule. There is also risk of obtaining reduced increments (less than optimal funding).	Very Unlikely	Negligible	LOW	Likely	Significant	HIGH	Project Manager	Project Schedule
PPM-6	ATR Impacts	There may be some expected delay due to the ATR review process.	Since this is a pilot project, it should receive some priority. The PDT does not feel that this will likely substantially impact the overall schedule.	Very Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Project Manager	Project Schedule
PPM-7	Need to Develop PPA with the Port	A new PPA must still be executed with the Port of Palm Beach. This may take some time.	This could impact the schedule.	Very Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Project Manager	Project Schedule
CONTRACT ACQUISITION RISKS											
CA-1	RFP - Tradeoff Procurement	The PDT is contemplating using a tradeoff (best value) type of contract procurement. This could impact the costs, either positively or negatively.	Could vary the ultimate contract costs and impact the schedule.	Unlikely	Marginal	LOW	Unlikely	Negligible	LOW	Contracting	Contract Cost & Project Schedule
CA-2	Multiple Contracts Possible	There could be more than one contract due to the funding limitations. Also, there could be one main contract with options.	If funding limitations drive the strategy to multiple contracts, it could impact the costs and schedule. There could be up to 3 separate contracts. The risk would impact the contractor mobilizations, markups, and potential efficiencies.	Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE	Contracting	Contract Cost & Project Schedule
CA-3	Contractor Protests	There is inherent risk of protests from the industry. The PDT feels that the acquisition plan minimizes the protest risk.	This could have impact on the schedule.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW	Contracting	Project Schedule

	TECHNICAL RISKS										
TL-1	Require Additional Borings	Although the design is quite well developed, the borings are not complete. The borings cannot begin until the initiation of PED. It will take at least 8 months from the development of the boring scope to receipt of the results/report.	This will be a delay to the current schedule. This was not in the PM's schedule. It will be added to the schedule and reflected in the estimates.	Unlikely	Negligible	LOW	Likely	Marginal	MODERATE	Geotechnical/Civil Design	Project Schedule
TL-2	Blasting May Be Required	The PDT is fairly confident that blasting will not be required. There is no blasting in the current estimate. They could be blasting required in up to 20% of the present project footprint.	This could have a major impact to the costs. It may impact the work that can take place in the work windows (no blasting in winter due to manatees); could impact the schedule because we would need permits	Unlikely	Critical	MODERATE	Unlikely	Significant	MODERATE	Geotechnical/Civil Design	Contract Cost
TL-3	Change in Subsurface Conditions	Less or more stiff material (rock) could have an impact on the ultimate quantities. It could also impact the overall footprint (prism). It could also impact the required mitigation.	This could have a significant impact on the costs. This is not at all likely for the deepening, but more likely for the widening. Overall, still unlikely.	Unlikely	Critical	MODERATE	Unlikely	Marginal	LOW	Geotechnical/Civil Design	Contract Cost
TL-4	Modeling for Advanced Maintenance Conservative	The PDT has identified that the assumptions made for the advanced maintenance dredging activities are extremely conservative. This could present opportunity for savings with respect to the advance maintenance dredging.	This could be an *opportunity* for cost savings.	Likely	Significant	HIGH	Very Unlikely	Negligible	LOW	Technical Lead	Contract Cost
TL-5	Sea Level Rise	If the PDT underestimates the effects of a sea level rise, it could have an impact on the project configuration.	This is seen as a low risk.	Very Unlikely	Significant	LOW	Very Unlikely	Significant	LOW	Technical Lead	Project Cost & Schedule
TL-6	Uncertainty with a Design Feature (Peanut Island)	There may be a competitor for the activity planned for Peanut Island that may impact the currently planned design for this feature.	Likely would require some reconfiguration, but could probably be handled with no net effect to construction costs. However, it may produce a marginal delay.	Likely	Negligible	LOW	Likely	Marginal	MODERATE	Technical Lead	Project Schedule
TL-7	Port May Construct Additional Berths (Slip 3)	There may be a sponsor driven scope change that would cause a reformulation of feasibility and design activities.	Momentum for the Port's contemplated activity at Slip 3 is growing. This would have a ripple effect on the entire project scope.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	Technical Lead	Project Cost & Schedule
TL-8	Jetty Slope Stability	If blasting is required, then there is some concern regarding the jetty slope stability.	Current information suggests that it is not very likely to blast in proximity to the jetty (failure). However, there is a chance of blasting which could affect the jetty. This is highly correlated to the blasting risk, itself.	Unlikely	Critical	MODERATE	Unlikely	Critical	MODERATE	Technical Lead	Project Cost & Schedule
TL-9	Jetty Stabilization Design	A cursory level design based on loosely defined assumptions was the basis for determining the need for jetty stabilization and to what extent.	Could have a significant impact to project cost if the location and amount of sheetpile has been underestimated; it could also be a cost savings if it is determined by a detailed design investigation during PED that jetty stabilization is not needed.	Likely	Significant	HIGH	Very Unlikely	Negligible	LOW		Project Cost
TL-10	Complications with the ATR of the Ship Simulation	The ATR of the Ship Simulation process has been protracted. It is likely that it will be resolved. However, it could delay the project.	It is unlikely that this will produce significant delays.	Very Unlikely	Negligible	LOW	Unlikely	Marginal	LOW	Technical Lead	Project Schedule
	LANDS AND DAMAGES RISKS										
LD-1	Extension of the Beach Disposal Template	The PDT is seriously contemplating extension of the beach disposal template from the current template configuration.	The issue is the potential addition of an additional 2,000 feet of extension. This would mean additional land acquisition. There is also the potential risk of condemnations, which could significantly delay the project. There is the chance of obtaining with funds other than this project.	Likely	Significant	HIGH	Likely	Significant	HIGH	Real Estate	Project Cost & Schedule
	REGULATORY AND ENVIRONMENTAL										
RE-1	Salinity Intrusion	Saline water could introduce brackish water into the bay.	This is seen as a low risk.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Environmental	Contract Cost & Project Schedule
RE-2	Delay in Obtaining Permits	There may be some delay in obtaining a permit from FDEP due to geotechnical uncertainties for any of the beach placements (since the geotechnical data is not complete).	Currently, the data suggests rock in the settling basin. However, presence of sand would require disposal to beaches.	Very Unlikely	Negligible	LOW	Likely	Marginal	MODERATE	Environmental	Project Schedule
RE-3	ODMDS Capacity	There is a current restriction on the volume per annum to be placed in the ODMDS. If there is no expansion to the current ODMDS, then there would not be capacity to accept the material from this project.	The current ODMDS has the technical capacity for the material, but there is a restriction which impacts the volume required for this project. Issue is whether or not the material would migrate outside the boundaries of the site.	Unlikely	Significant	MODERATE	Unlikely	Critical	MODERATE	Technical Lead	Project Cost & Schedule
RE-4	Uncertainty with the Level/Amount of Mitigation	The mitigation modeling that has already been accomplished is not fully complete. There are 2 models that need to be completed. At this time, the ultimate level and mount of mitigation is not certain. NMFS may require different amounts and levels that are currently contemplated, as reflected in the cost estimate.	This could have an impact on the costs.	Unlikely	Significant	MODERATE	Very Unlikely	Negligible	LOW	Environmental	Project Cost
RE-5	Availability of Sites for Mitigation Features	There are a number of sites. However, if they are taken or occupied by other entities, it could withhold the most cost effective sites from the project.	This could impact the costs.	Unlikely	Marginal	LOW	Very Unlikely	Negligible	LOW	Technical Lead	Contract Cost
RE-6	Success of the Mitigation Features	There is a track record of success with these measures. There will be a 5-year monitoring requirement to determine effectiveness. If issues arise, rework may be necessary.	This could impact the costs.	Unlikely	Significant	MODERATE	Very Unlikely	Negligible	LOW	Technical Lead	Project Cost
RE-7	Environmental Work Windows	There are restrictions on dredging and excavation due to manatees. There is a large critical habitat for manatees (Lake Worth Inner Channel). There is currently a restriction on the O&M permit that does not allow mechanical dredging.	There is not a set work window for the manatees. The PDT is attempting to use mechanical dredging in the new work taking place under this project. There is a possibility that a concession to be made to restrict to no night time dredging.	Likely	Critical	HIGH	Likely	Significant	HIGH	Technical Lead	Project Cost & Schedule
RE-8	Material Testing	Many projects these days are completely dependent on ocean disposal but need to pass testing to ensure it is suitable material before we can take the material offshore. Material testing normally happens during PED a year or so before construction as the suitability is only good for a 3 year period.	Material testing is mandatory. If it does not pass, it would need another placement area.	Very Unlikely	Significant	LOW	Very Unlikely	Crisis	HIGH	Technical Lead	Project Cost & Schedule

	CONSTRUCTION RISKS										
CON-1	Variation in Estimated Quantities	There may be some uncertainty in the quantities due to potential scope changes.	This could impact the contract costs. If quantities are off by 15%, could be almost 9.5% increase in project cost.; if quantities are off, could increase or decrease construction duration.	Likely	Significant	HIGH	Unlikely	Significant	MODERATE	Technical Lead	Contract Cost
CON-2	Noise Pollution/Control	The local communities may restrict the noise levels permitted, particularly during nights and weekends.	While this may be a nuisance issue, it will not likely impact the cost or schedule.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW	Construction	Contract Cost
CON-3	Haul Route Construction/Loading Restriction	There is a limitation on the construction on the inlet channels that may cause the contractor to use smaller and more lightly loaded barges.	This could impact contractor productivity, and therefore contract costs.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW	Technical Lead	Contract Cost
CON-4	Construction Schedule Accuracy	There are many factors not considered in the current construction schedule, including the work windows, severe weather, permit delays, restrictions, etc.	This could impact both cost and schedule.	Likely	Marginal	MODERATE	Likely	Significant	HIGH	Cost Engineering	Contract Cost & Project Schedule
CON-5	Air Quality	The contractor will have to comply with clean air restrictions.	This could impact contractor productivity, and therefore contract costs.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW	Construction	Contract Cost
CON-MOD	Consideration for Post-Award Construction Claims and Modifications	There is inherent risk of construction modifications and claims that arise after contract award due to issues such as weather, schedules dictated by O&M cycles, differing site conditions, user directed changes or omissions, inaccurate surveys, and variations in estimated quantities (minor).	Post-award construction contract modifications and claims could impact the ultimate contract costs and delay the overall schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Construction	Project Cost & Schedule
	ESTIMATE AND SCHEDULE RISKS										
EST-1	Production Estimates	Possibility of production estimates not accurately depicting production we will actually see on job	If production estimates are off, unit costs could be innaccurate and construction duration could be shorter or longer	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	Cost Engineering	Project Cost & Schedule
EST-2	Contract Markups	We have used average large dredging contractor markups for many years but the actual markups bid for the contracts could vary from this.		Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW	Cost Engineering	Project Cost & Schedule
	ECONOMICS RISKS										
INT-1	Consideration for Low and Unknown Internal Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	N/A	Project Cost & Schedule
	Programmatic Risks	(External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)									
PR-1	Market Conditions/Bidding Climate	There is inherent variability and volatility in the dredging industry that could impact the ultimate contract costs.	This could have significant impact on the costs.	Very Likely	Significant	HIGH	Very Unlikely	Negligible	LOW	Cost Engineering	Contract Cost
PR-2	Limited Competition	There may be too few bidders, limiting competition and driving prices up.	The Government is configuring the project with a barge mounted excavator in order to not limited competition.	Unlikely	Significant	MODERATE	Very Unlikely	Negligible	LOW	Cost Engineering	Contract Cost
PR-3	Severe Tropical Storms	Severe weather could impact the project. Hurricanes could have a significant impact on the project.	Severe weather events, depending on severity, could impact the costs and the schedule.	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE	N/A	Project Schedule
PR-4	Fuel Prices	Rising fuel prices for marine and off-road diesel could impact the contract costs.	This would likely have significant impact to equipment costs (dredging)	Very Likely	Significant	HIGH	Very Unlikely	Negligible	LOW	Cost Engineering	Contract Cost
PR-5	Communities May Not View the Project Favorably	While the local communities have not opposed the project or officially withdrawn support, many do not favor the project.	Enough opposition could impact implementation of the project.	Very Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE	Project Manager	Project Schedule
PR-6	Equipment Availability	Impacts due to non-availability of the most efficient dredge type to perform the work	Could have a significant impact to cost if have to convert to a sole source negotiation; critical imapct to schedule if need to re-advertise or wait for available equipment- especially since we are working with strict environmental windows	Unlikely	Significant	MODERATE	Unlikely	Critical	MODERATE	Cost Engineering	Project Cost & Schedule
PR-7	Material Availability	Impacts due to non-availability of materials, especially for mitigation work	Could have a significant impact to cost if we have to purchase fill material vs obtaining from within project; could also impact cost if we have to purchase material from further away if local quarries do not have available quantities	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW	Cost Engineering	Project Cost & Schedule
PR-8	Labor	Dredge labor on larger size dredges are union wages and are regulated on the Davis-Bacon Act.	No unusual increases are anticipated during the life of this project.	Unlikely	Marginal	LOW	Very Unlikely	Negligible	LOW	Cost Engineering	Project Cost & Schedule
EXT-1	Consideration for Low and Unknown External Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	N/A	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

USACE Jacksonville District District

SAJ - Lake Worth Inlet Navigation Pilot Study

Initial Risk Register Development Meeting

Date Tuesday, September 11, 2012 Jacksonville District

No.	Name	Section	Title
1	Dan Abecassis	USACE - SAJ	PD-D, Economist
2	Steve Bratos	USACE - SAJ	EN-WC, Hydrodynamics Modeler
3	Stephen Conger	USACE - SAJ	EN-DW, Levee Design
4	Angela Dunn	USACE - SAJ	PD-ES, NEPA
5	Al Fletcher	USACE - SAJ	PM-WN, Operations manager
6	Pat Griffin	USACE - SAJ	PD-ES, NEPA
7	Mike Hensch	USACE - SAJ	PM-WN, Operations manager
8	Russ Jones	USACE - SAJ	PD-EQ, Water Quality
9	Max Millstein	USACE - SAJ	PD-D, Economist
10	Mike Neves	USACE - SAJ	EN-GS, Soils
11	Barbara Nist	USACE - SAJ	EN-GG, Geotechnical
12	Cynthia Perez	USACE - SAJ	PM-WN, Project Manager
13	Philip Sylvestor	USACE - SAJ	PM-WF, Ship Simulation
14	Jennifer Tyler	USACE - SAJ	EN-TC, Cost Estimating
15	Lynn Zediak	USACE - SAJ	RE-A, Real Estate Acquisition
16	Joelle Verhagen	USACE - SAJ	PD-EC, ODMDS Manager
17	Ian Mcclary	USACE - SAJ	CT, Contracting
18	Glenn Matlock	USACE - NWW	Chief, Cost MCX, Risk Facilitator
19	Stacey Roth	USACE - SAJ	PD-PN, Planning
20	Sheldon Shuff	USACE - SAJ	OC, Office of Council

SAJ Lake Worth Inlet Navigation Pilot Study

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$71,922,819**
Baseline Estimate Cost Contingency Amount ->	$16,519,056
Baseline Estimate Construction Cost (80% Confidence) ->	**$88,441,875**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**34.2 Months**
Schedule Contingency Duration ->	29.6 Months
Project Schedule Duration (80% Confidence) ->	**63.8 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$5,305,047**

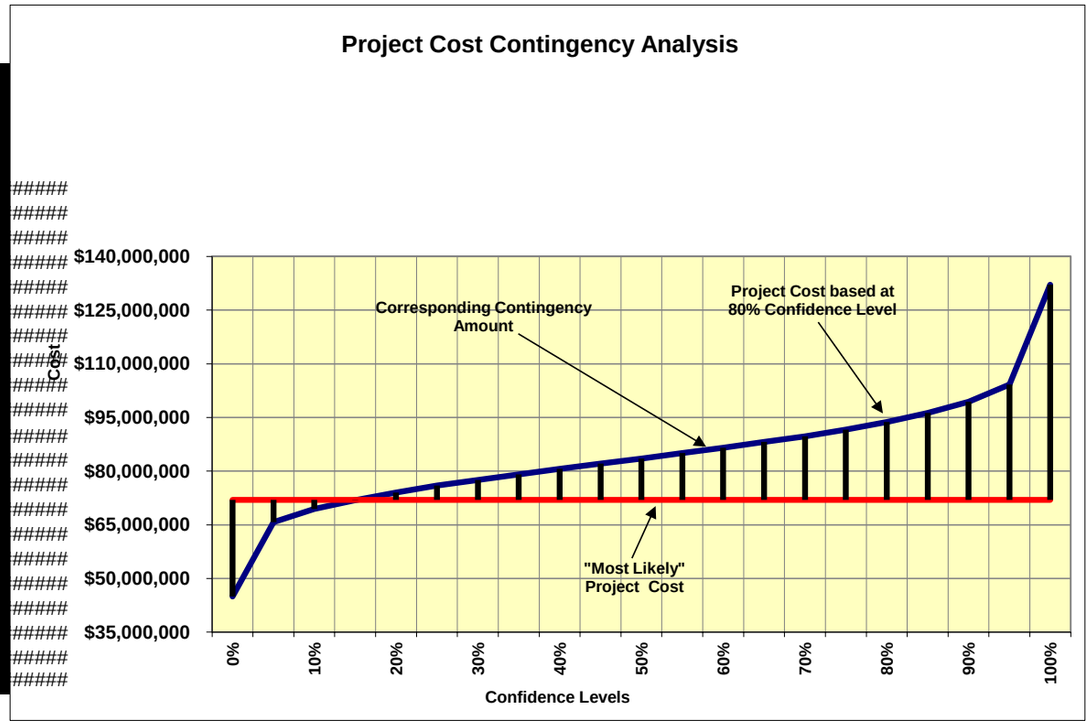
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$21,824,102**
Project Contingency Percentage (80% Confidence) ->	**30%**

Project Cost (80% Confidence) ->	**$93,746,921**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

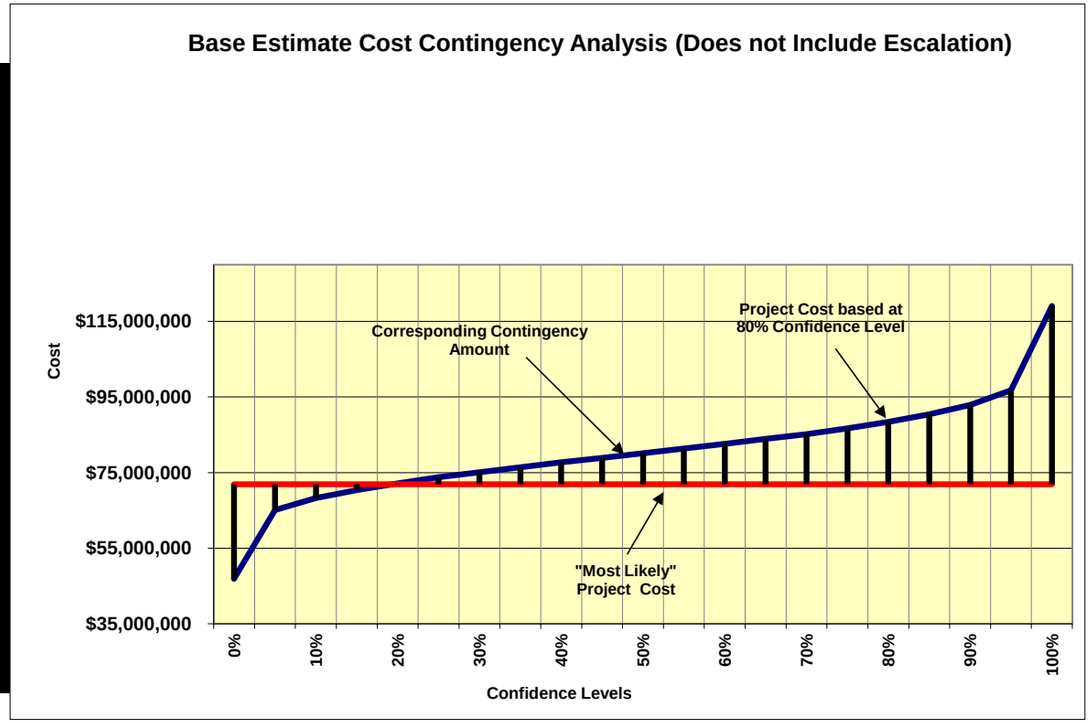
Most Likely Cost Estimate	$71,922,819		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$44,937,192	($26,985,627)	-37.52%
5%	$65,750,489	($6,172,330)	-8.58%
10%	$69,462,070	($2,460,749)	-3.42%
15%	$71,921,378	$(1,441)	0.00%
20%	$74,040,629	$2,117,810	2.94%
25%	$75,940,431	$4,017,612	5.59%
30%	$77,530,976	$5,608,157	7.80%
35%	$79,117,936	$7,195,117	10.00%
40%	$80,650,767	$8,727,948	12.14%
45%	$82,082,008	$10,159,189	14.13%
50%	$83,527,428	$11,604,609	16.13%
55%	$85,056,641	$13,133,822	18.26%
60%	$86,529,673	$14,606,854	20.31%
65%	$88,132,005	$16,209,186	22.54%
70%	$89,717,642	$17,794,824	24.74%
75%	$91,610,142	$19,687,323	27.37%
80%	$93,746,921	$21,824,102	30.34%
85%	$96,221,729	$24,298,910	33.78%
90%	$99,382,841	$27,460,023	38.18%
95%	$104,167,897	$32,245,078	44.83%
100%	$132,111,209	$60,188,390	83.68%



- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

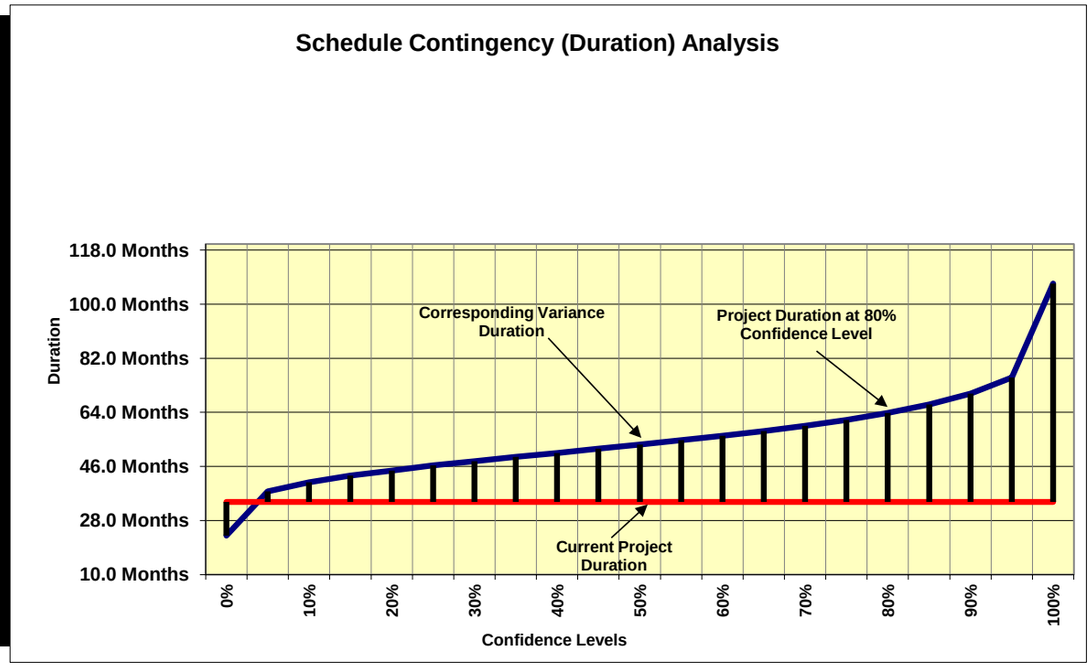
Most Likely Cost Estimate	$71,922,819		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$46,940,483	($24,982,335.68)	-34.73%
5%	$65,107,160	($6,815,658.76)	-9.48%
10%	$68,294,750	($3,628,068.51)	-5.04%
15%	$70,349,862	($1,572,956.53)	-2.19%
20%	$72,166,881	$244,061.75	0.34%
25%	$73,760,730	$1,837,911.47	2.56%
30%	$75,093,105	$3,170,286.17	4.41%
35%	$76,423,574	$4,500,755.23	6.26%
40%	$77,726,671	$5,803,851.84	8.07%
45%	$78,903,725	$6,980,906.72	9.71%
50%	$80,105,590	$8,182,770.94	11.38%
55%	$81,376,008	$9,453,189.04	13.14%
60%	$82,589,699	$10,666,879.75	14.83%
65%	$83,913,666	$11,990,847.15	16.67%
70%	$85,183,731	$13,260,912.08	18.44%
75%	$86,725,815	$14,802,996.61	20.58%
80%	$88,441,875	$16,519,055.81	22.97%
85%	$90,415,882	$18,493,063.68	25.71%
90%	$92,933,453	$21,010,634.67	29.21%
95%	$96,749,475	$24,826,656.63	34.52%
100%	$119,103,755	$47,180,936.17	65.60%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

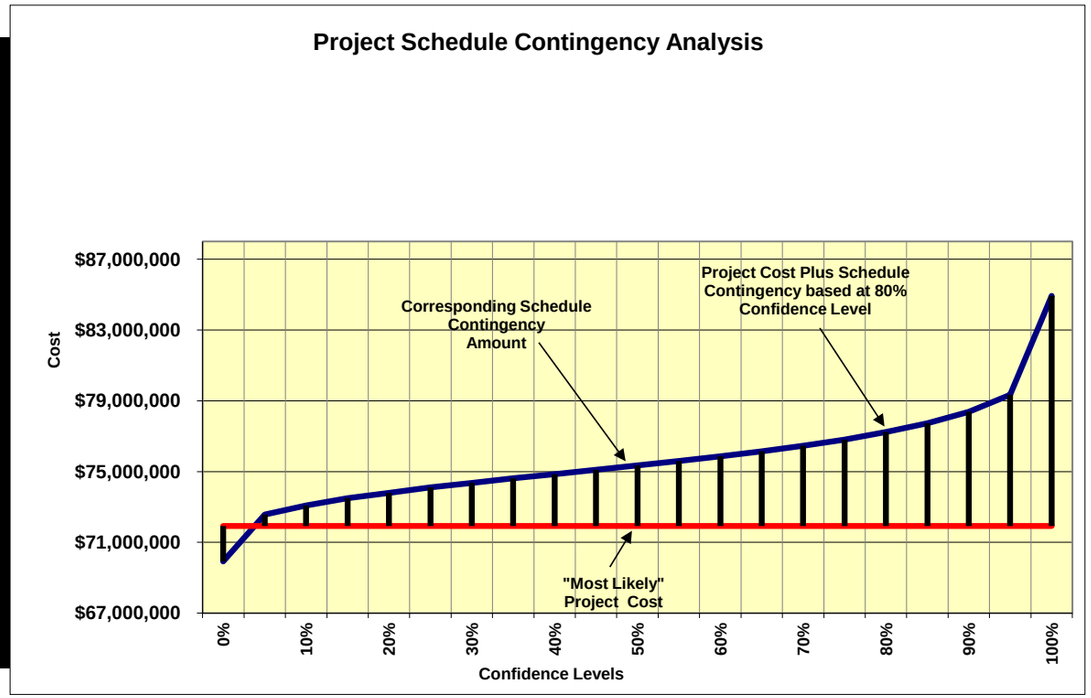
Most Likely Schedule Duration	34.2 Months		
Confidence Level	Project Duration	Contingency	Contingency %
0%	23.0 Months	-11.2 Months	-32.77%
5%	37.7 Months	3.6 Months	10.52%
10%	40.7 Months	6.5 Months	19.09%
15%	42.9 Months	8.8 Months	25.71%
20%	44.6 Months	10.5 Months	30.65%
25%	46.3 Months	12.2 Months	35.65%
30%	47.8 Months	13.6 Months	39.88%
35%	49.2 Months	15.1 Months	44.07%
40%	50.5 Months	16.3 Months	47.83%
45%	51.9 Months	17.8 Months	51.99%
50%	53.3 Months	19.1 Months	55.97%
55%	54.7 Months	20.6 Months	60.21%
60%	56.2 Months	22.0 Months	64.45%
65%	57.7 Months	23.6 Months	69.00%
70%	59.5 Months	25.3 Months	74.16%
75%	61.4 Months	27.3 Months	79.89%
80%	63.8 Months	29.6 Months	86.78%
85%	66.6 Months	32.4 Months	94.97%
90%	70.2 Months	36.0 Months	105.50%
95%	75.6 Months	41.4 Months	121.35%
100%	106.8 Months	72.7 Months	212.77%



- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$71,922,819		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$69,919,528	($2,003,291)	-2.79%
5%	$72,566,148	$643,329	0.89%
10%	$73,090,139	$1,167,320	1.62%
15%	$73,494,334	$1,571,516	2.19%
20%	$73,796,567	$1,873,748	2.61%
25%	$74,102,519	$2,179,700	3.03%
30%	$74,360,690	$2,437,871	3.39%
35%	$74,617,180	$2,694,362	3.75%
40%	$74,846,915	$2,924,097	4.07%
45%	$75,101,101	$3,178,282	4.42%
50%	$75,344,657	$3,421,838	4.76%
55%	$75,603,452	$3,680,633	5.12%
60%	$75,862,793	$3,939,974	5.48%
65%	$76,141,158	$4,218,339	5.87%
70%	$76,456,730	$4,533,912	6.30%
75%	$76,807,145	$4,884,327	6.79%
80%	$77,227,865	$5,305,047	7.38%
85%	$77,728,665	$5,805,846	8.07%
90%	$78,372,207	$6,449,388	8.97%
95%	$79,341,240	$7,418,421	10.31%
100%	$84,930,273	$13,007,454	18.09%

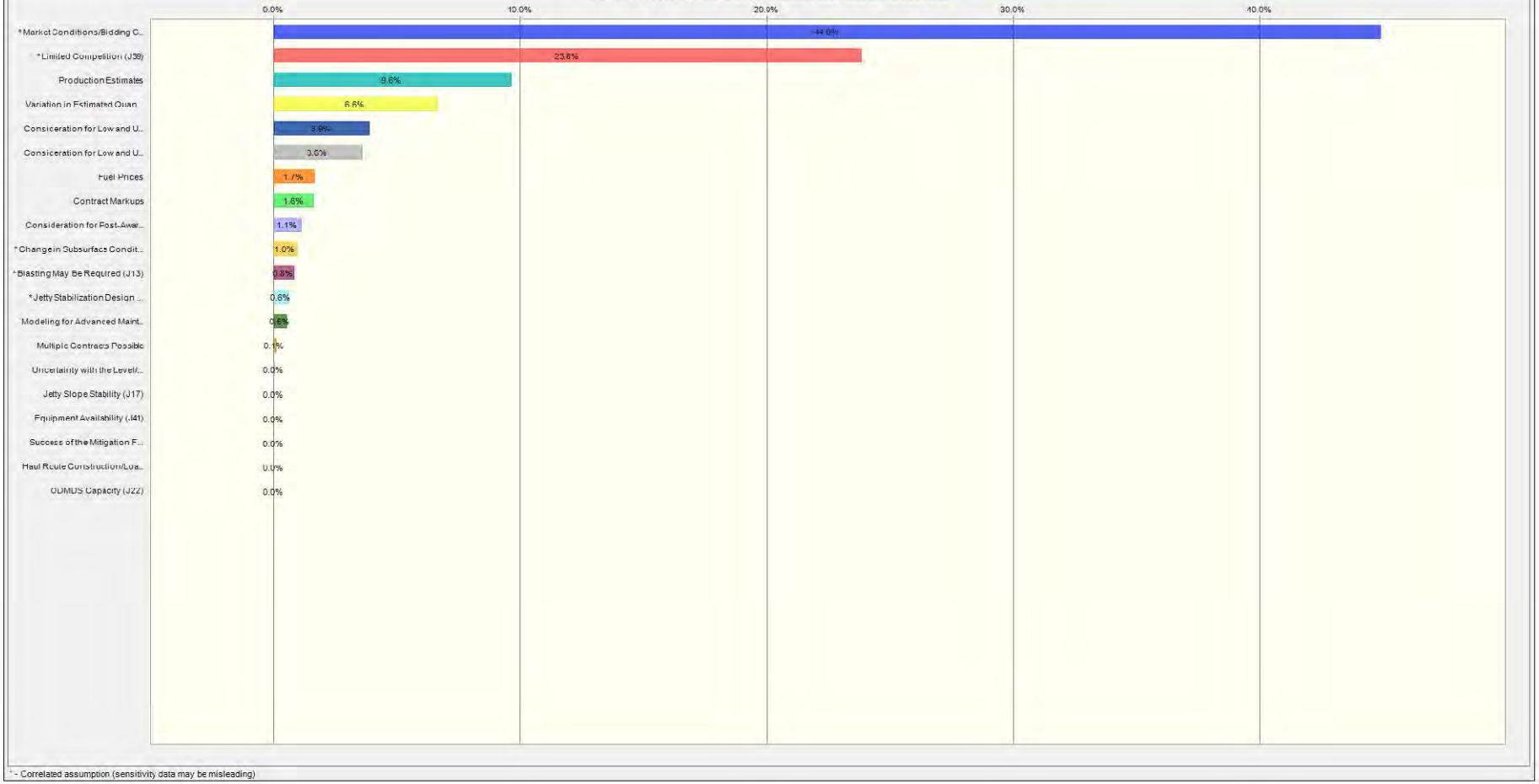


SAJ Lake Worth Inlet Navigation Pilot Study

10,000 Trials

Contribution to Variance View

Sensitivity: PROJECT CONTINGENCY (BASELINE ESTIMATE)



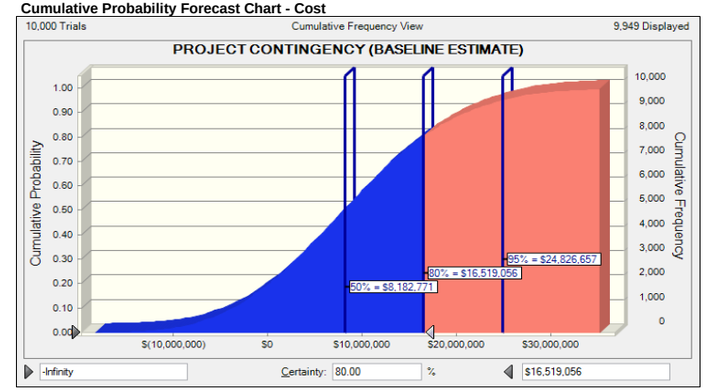
* - Correlated assumption (sensitivity data may be misleading)

SAJ Lake Worth Inlet Navigation Pilot Study

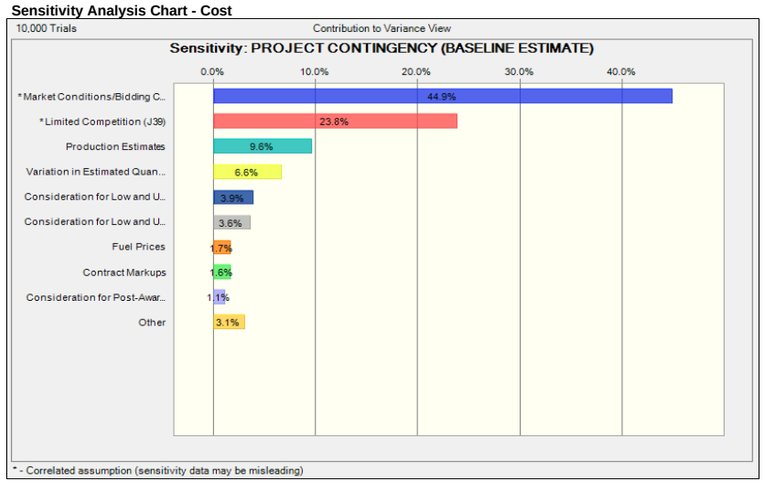
Risk No.	Risk/Opportunity Event	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Variance Distribution	Correlation to Other(s)	Probability of Occurrence	Crystal Ball Simulation: Expected Values ($$$): Low	Expected Values ($$$): Most Likely	Expected Values ($$$): High	Contingency Model	Notes	Expected Values (%s): Low	Expected Values (%s): Most Likely	Expected Values (%s): High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-3	Economic Modeling Accuracy	Unlikely	Critical	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CONTRACT ACQUISITION RISKS														
CA-2	Multiple Contracts Possible	Likely	Marginal	MODERATE	Triangular		100%	$ -	$ -	$ 1,394,609	$ -		0.00%	0.00%	1.94%
	TECHNICAL RISKS														
TL-2	Blasting May Be Required	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-3, TL-8	20%	$ -	$ -	$ 7,742,500	$ -	*Correlated to Risks TL-3 and TL-8 by a factor of 0.75*	0.00%	0.00%	10.77%
TL-3	Change in Subsurface Conditions	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-2	35%	$ (1,033,078)	$ -	$ 5,273,379	$ -	*Correlated to Risk TL-2 by a factor of 0.75*	-1.44%	0.00%	7.33%
TL-4	Modeling for Advanced Maintenance Conservative	Likely	Significant	HIGH	Yes-No/Triangular		65%	$ (3,453,802)	$ -	$ -	$ -		-4.80%	0.00%	0.00%
TL-7	Port May Construct Additional Berths (Slip 3)	Unlikely	Significant	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TL-8	Jetty Slope Stability	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-2	5%	$ -	$ -	$ 3,577,045	$ -	*Correlated to Risk TL-2 by a factor of 0.75*	0.00%	0.00%	4.97%
TL-9	Jetty Stabilization Design	Likely	Significant	HIGH	Yes-No/Uniform		50%	$ (89,426)	$ -	$ 178,852	$ -		-0.12%	0.00%	0.25%
	LANDS AND DAMAGES RISKS														
LD-1	Extension of the Beach Disposal Template	Likely	Significant	HIGH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	REGULATORY AND ENVIRONMENTAL RISKS														
RE-3	ODMDS Capacity	Unlikely	Significant	MODERATE	Yes-No/Triangular		35%	$ -	$ -	$ 320,000	$ -		0.00%	0.00%	0.44%
RE-4	Uncertainty with the Level/Amount of Mitigation	Unlikely	Significant	MODERATE	Yes-No/Triangular		35%	$ (1,226,850)	$ -	$ 1,226,850	$ -		-1.71%	0.00%	1.71%
RE-6	Success of the Mitigation Features	Unlikely	Significant	MODERATE	Yes-No/Uniform		15%	$ -	$ -	$ 1,840,275	$ -		0.00%	0.00%	2.56%
RE-7	Environmental Work Windows	Likely	Critical	HIGH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CONSTRUCTION RISKS														
CON-1	Variation in Estimated Quantities	Likely	Significant	HIGH	Triangular		100%	$ (6,896,376)	$ -	$ 2,298,816	$ -		-9.59%	0.00%	3.20%
CON-3	Haul Route Construction/Loading Restriction	Likely	Marginal	MODERATE	Triangular		100%	$ -	$ -	$ 154,141	$ -		0.00%	0.00%	0.21%
CON-4	Construction Schedule Accuracy	Likely	Marginal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CON-5	Air Quality	Likely	Marginal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CON-MOD	Consideration for Post-Award Construction Claims and	Likely	Marginal	MODERATE	Triangular		100%	$ -	$ -	$ 3,629,672	$ -		0.00%	0.00%	5.05%
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Production Estimates	Unlikely	Significant	MODERATE	Triangular		100%	$ (3,629,672)	$ -	$ 7,259,343	$ -		-5.05%	0.00%	10.09%
EST-2	Contract Markups	Likely	Marginal	MODERATE	Triangular		100%	$ (1,291,260)	$ -	$ 3,876,263	$ -		-1.80%	0.00%	5.39%
	LOW AND UNKNOWN INTERNAL RISKS														
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	MODERATE	Triangular		100%	$ (3,596,141)	$ -	$ 3,596,141	$ -		-5.00%	0.00%	5.00%
	Programmatic Risks														
PR-1	Market Conditions/Bidding Climate	Very Likely	Significant	HIGH	Triangular	PR-2	100%	$ (7,259,343)	$ -	$ 14,518,686	$ -	*Correlated to PR-2 by a factor of 0.67*	-10.09%	0.00%	20.19%
PR-2	Limited Competition	Unlikely	Significant	MODERATE	Yes-No/Triangular	PR-1	35%	$ -	$ -	$ 5,023,330	$ -	*Correlated to PR-1 by a factor of 0.67*	0.00%	0.00%	6.98%
PR-4	Fuel Prices	Very Likely	Significant	HIGH	Triangular		100%	$ (1,085,030)	$ -	$ 3,470,028	$ -		-1.51%	0.00%	4.82%
PR-6	Equipment Availability	Unlikely	Significant	MODERATE	Yes-No/Triangular		35%	$ -	$ -	$ 1,640,969	$ -		0.00%	0.00%	2.28%
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	MODERATE	Triangular		100%	$ (3,596,141)	$ -	$ 3,596,141	$ -		-5.00%	0.00%	5.00%
											$ -				

PROJECT CONTINGENCY (BASELINE ESTIMATE)	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
	0%	$71,922,819	-$24,982,336	**$46,940,483**	**-34.73%**
	5%	$71,922,819	-$6,815,659	**$65,107,160**	**-9.48%**
	10%	$71,922,819	-$3,628,069	**$68,294,750**	**-5.04%**
	15%	$71,922,819	-$1,572,957	**$70,349,862**	**-2.19%**
	20%	$71,922,819	$244,062	**$72,166,881**	**0.34%**
	25%	$71,922,819	$1,837,911	**$73,760,730**	**2.56%**
	30%	$71,922,819	$3,170,286	**$75,093,105**	**4.41%**
	35%	$71,922,819	$4,500,755	**$76,423,574**	**6.26%**
	40%	$71,922,819	$5,803,852	**$77,726,671**	**8.07%**
	45%	$71,922,819	$6,980,907	**$78,903,725**	**9.71%**
	50%	$71,922,819	$8,182,771	**$80,105,590**	**11.38%**
	55%	$71,922,819	$9,453,189	**$81,376,008**	**13.14%**
	60%	$71,922,819	$10,666,880	**$82,589,699**	**14.83%**
	65%	$71,922,819	$11,990,847	**$83,913,666**	**16.67%**
	70%	$71,922,819	$13,260,912	**$85,183,731**	**18.44%**
	75%	$71,922,819	$14,802,997	**$86,725,815**	**20.58%**
	80%	$71,922,819	$16,519,056	**$88,441,875**	**22.97%**
	85%	$71,922,819	$18,493,064	**$90,415,882**	**25.71%**
	90%	$71,922,819	$21,010,635	**$92,933,453**	**29.21%**
	95%	$71,922,819	$24,826,657	**$96,749,475**	**34.52%**
	100%	$71,922,819	$47,180,936	**$119,103,755**	**65.60%**

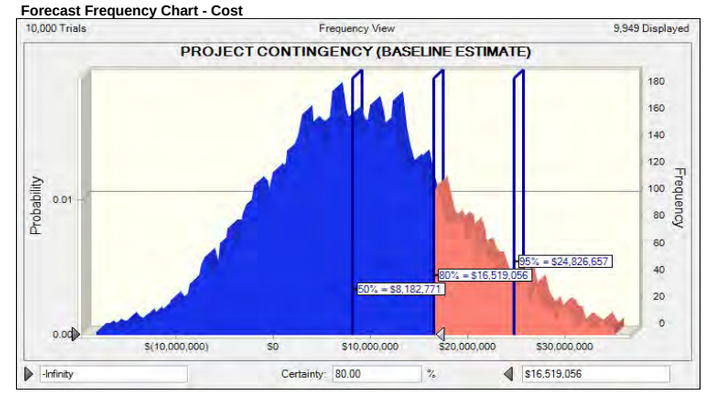
Cumulative Probability Forecast Chart - Cost



Sensitivity Analysis Chart - Cost



Forecast Frequency Chart - Cost



USACE Jacksonville District District
SAJ - Lake Worth Inlet Navigation Pilot Study

CWWBS No.	Project Cost
01 Lands and Damages	$0.00
02 Relocations	$20,000.00
06 Fish and Wildlife Facilities	$11,882,746.61
10 Breakwaters and Seawalls	$2,086,804.25
12 Navigation Ports and Harbors	$50,233,296.91
30 Planning, Engineering, and Design	$2,647,524.00
31 Construction Management	$5,052,447.00
Total	$71,922,818.77

Category	Project Cost
Labor Cost	$1,870,240.24
Equipment Cost	$3,281,937.93
Material Cost	$3,425,779.69
Sub Bid Cost	$434,285.00
User Cost	$47,804,168.73
Direct Cost	$59,363,699.96
Contract Cost	$72,593,431.28
Project Cost	$72,617,913.77

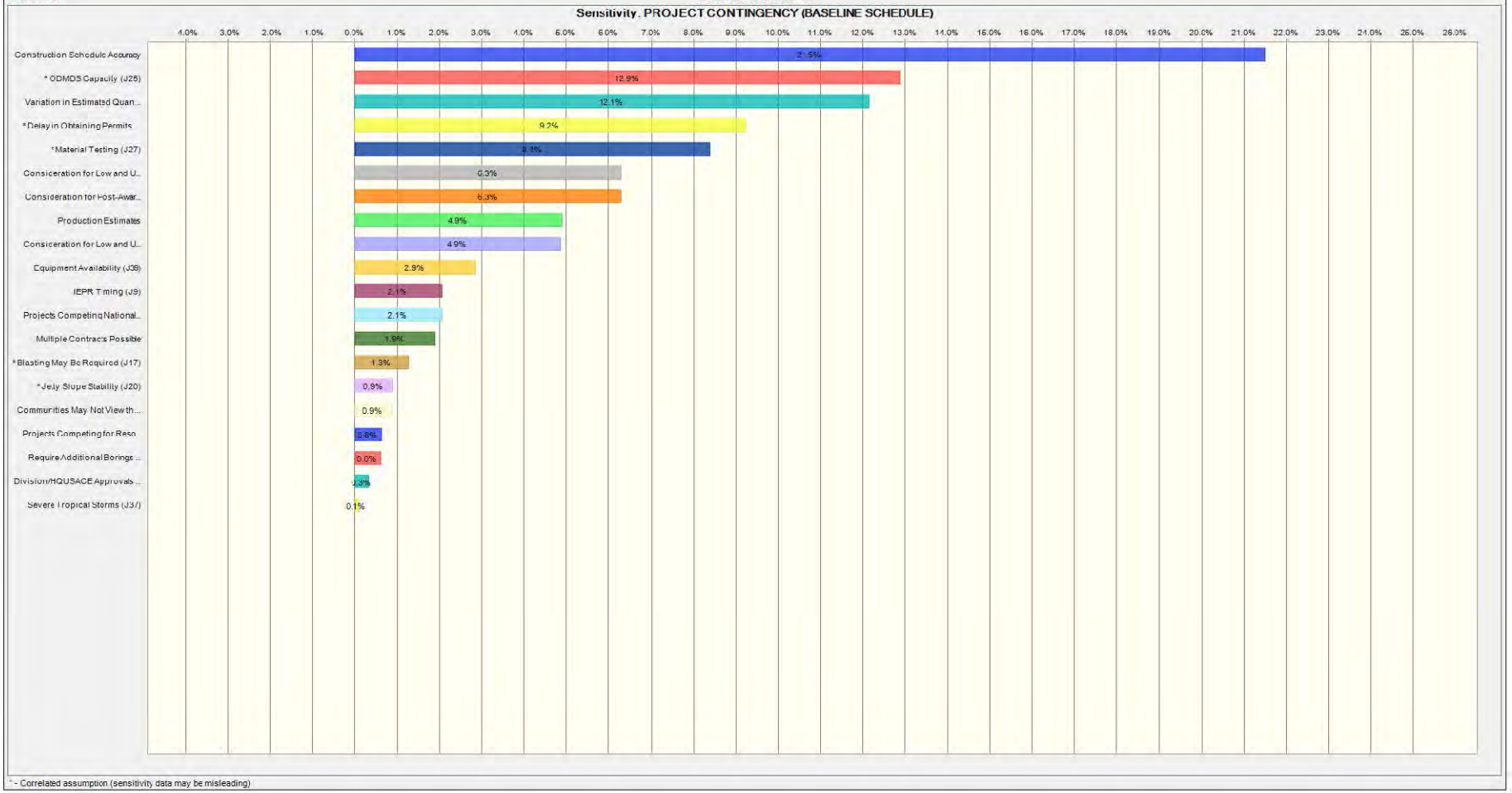
Construction Costs	Project Cost
06 Fish and Wildlife Facilities	$10,835,454.52
10 Breakwaters and Seawalls	$2,086,804.25
12 Navigation Ports and Harbors	$50,233,296.91
Total	$63,155,555.68

Non-Construction Costs	Project Cost
01 Lands and Damages	$0.00
02 Relocations	$20,000.00
06 Fish and Wildlife Facilities	$1,047,292.09
30 Planning, Engineering, and Design	$2,647,524.00
31 Construction Management	$5,052,447.00
Total	$8,767,263.09

SAJ Lake Worth Inlet Navigation Pilot Study

10,000 Trials

Contribution to Variance View



* - Correlated assumption (sensitivity data may be misleading)

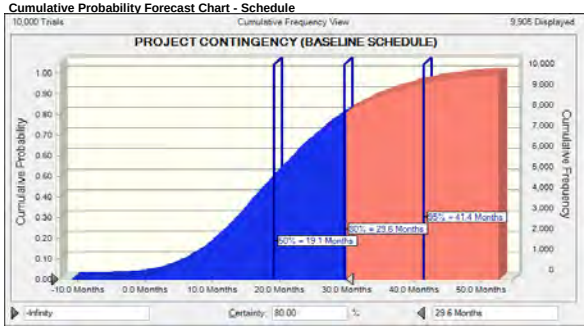
SAJ Lake Worth Inlet Navigation Pilot Study

		Project Schedule						Crystal Ball Simulation							
								Expected Values (Months)					Expected Values (%s)		
Risk No.	Risk/Opportunity Event	Likelihood*	Impact*	Risk Level*	Variance Distribution	Correlation to Other(s)	Probability of Occurrence	Low	Most Likely	High	Contingency Model	Notes	Low	Most Likely	High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-1	IEPR Timing	Unlikely	Crisis	HIGH	Yes-No/Uniform		35%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	35.13%
PPM-2	Division/HQUSACE Approvals	Unlikely	Significant	MODERATE	Yes-No/Uniform		35%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	17.57%
PPM-4	Projects Competing for Resources	Likely	Marginal	MODERATE	Yes-No/Uniform		65%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	8.78%
PPM-5	Projects Competing Nationally for Funding	Likely	Significant	HIGH	Yes-No/Uniform		65%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	17.57%
	CONTRACT ACQUISITION RISKS														
CA-2	Multiple Contracts Possible	Very Likely	Marginal	MODERATE	Triangular		100%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	8.78%
	TECHNICAL RISKS														
TL-1	Require Additional Borings	Likely	Marginal	MODERATE	Yes-No/Triangular		65%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	8.78%
TL-2	Blasting May Be Required	Unlikely	Significant	MODERATE	Yes-No/Uniform	TL-8	20%	0.0 Months	0.0 Months	12.0 Months	0.0 Months	*Correlated to Risk TL-8 by a factor of 0.75*	0.00%	0.00%	35.13%
TL-6	Uncertainty with a Design Feature (Peanut Island)	Likely	Marginal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TL-7	Port May Construct Additional Berths (Slip 3)	Unlikely	Significant	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TL-8	Jetty Slope Stability	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-2	20%	0.0 Months	0.0 Months	6.6 Months	0.0 Months	*Correlated to Risk TL-2 by a factor of 0.75*	0.00%	0.00%	19.32%
	LANDS AND DAMAGES RISKS														
LD-1	Extension of the Beach Disposal Template	Likely	Significant	HIGH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	REGULATORY AND ENVIRONMENTAL RISKS														
RE-2	Delay in Obtaining Permits	Likely	Marginal	MODERATE	Yes-No/Uniform	RE-3	65%	0.0 Months	0.0 Months	4.0 Months	0.0 Months	*Correlated to Risk RE-3 by a factor of 0.75*	0.00%	0.00%	11.71%
RE-3	ODMDS Capacity	Unlikely	Critical	MODERATE	Yes-No/Triangular	RE-2	35%	0.0 Months	0.0 Months	24.0 Months	0.0 Months	*Correlated to Risk RE-2 by a factor of 0.75*	0.00%	0.00%	70.27%
RE-7	Environmental Work Windows	Likely	Significant	HIGH	Uniform		100%	-8.0 Months	0.0 Months	0.0 Months	0.0 Months		-23.42%	0.00%	0.00%
RE-8	Material Testing	Very Unlikely	Crisis	HIGH	Yes-No/Uniform		10%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	35.13%
	CONSTRUCTION RISKS														
CON-1	Variation in Estimated Quantities	Unlikely	Significant	MODERATE	Triangular		100%	-3.0 Months	0.0 Months	6.0 Months	0.0 Months		-8.78%	0.00%	17.57%
CON-4	Construction Schedule Accuracy	Likely	Significant	HIGH	Triangular		100%	-4.0 Months	0.0 Months	8.0 Months	0.0 Months		-11.71%	0.00%	23.42%
CON-MOD	Consideration for Post-Award Construction Claims and	Likely	Marginal	MODERATE	Triangular		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	17.57%
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Production Estimates	Unlikely	Significant	MODERATE	Triangular		100%	-2.0 Months	0.0 Months	4.0 Months	0.0 Months		-5.86%	0.00%	11.71%
	LOW AND UNKNOWN INTERNAL RISKS														
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	MODERATE	Triangular		100%	-3.0 Months	0.0 Months	3.0 Months	0.0 Months		-8.78%	0.00%	8.78%
	Programmatic Risks														
PR-3	Severe Tropical Storms	Unlikely	Significant	MODERATE	Yes-No/Triangular		35%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	8.78%
PR-5	Communities May Not View the Project Favorably	Unlikely	Significant	MODERATE	Yes-No/Uniform		35%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	17.57%
PR-6	Equipment Availability	Unlikely	Critical	MODERATE	Yes-No/Triangular		35%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	35.13%
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	MODERATE	Triangular		100%	-3.0 Months	0.0 Months	3.0 Months	0.0 Months		-8.78%	0.00%	8.78%
											0.0 Months				

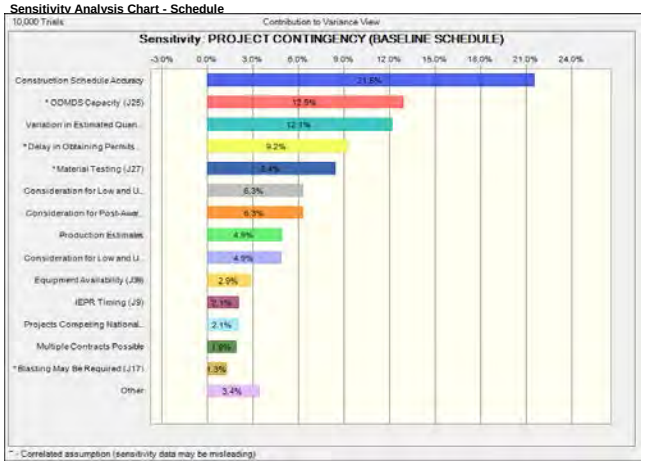
Contingency Summary Table - Schedule

	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
PROJECT CONTINGENCY (BASELINE SCHEDULE)	0%	34.2 Months	-11.2 Months	**23.0 Months**	**-32.77%**
	5%	34.2 Months	3.6 Months	**37.7 Months**	**10.52%**
	10%	34.2 Months	6.5 Months	**40.7 Months**	**19.09%**
	15%	34.2 Months	8.8 Months	**42.9 Months**	**25.71%**
	20%	34.2 Months	10.5 Months	**44.6 Months**	**30.65%**
	25%	34.2 Months	12.2 Months	**46.3 Months**	**35.65%**
	30%	34.2 Months	13.6 Months	**47.8 Months**	**39.88%**
	35%	34.2 Months	15.1 Months	**49.2 Months**	**44.07%**
	40%	34.2 Months	16.3 Months	**50.5 Months**	**47.83%**
	45%	34.2 Months	17.8 Months	**51.9 Months**	**51.99%**
	50%	34.2 Months	19.1 Months	**53.3 Months**	**55.97%**
	55%	34.2 Months	20.6 Months	**54.7 Months**	**60.21%**
	60%	34.2 Months	22.0 Months	**56.2 Months**	**64.45%**
	65%	34.2 Months	23.6 Months	**57.7 Months**	**69.00%**
	70%	34.2 Months	25.3 Months	**59.5 Months**	**74.16%**
	75%	34.2 Months	27.3 Months	**61.4 Months**	**79.89%**
	80%	34.2 Months	29.6 Months	**63.8 Months**	**86.78%**
	85%	34.2 Months	32.4 Months	**66.6 Months**	**94.97%**
	90%	34.2 Months	36.0 Months	**70.2 Months**	**105.50%**
	95%	34.2 Months	41.4 Months	**75.6 Months**	**121.35%**
	100%	34.2 Months	72.7 Months	**106.8 Months**	**212.77%**

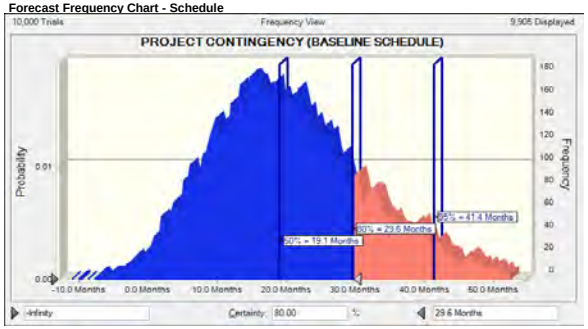
Cumulative Probability Forecast Chart - Schedule



Sensitivity Analysis Chart - Schedule



Forecast Frequency Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Enter Estimated Total Project Cost (Price Level)	**$71,922,819**
Max. Anticipated Annual Amount	**$25,283,744**
Enter Current OMB Escalation Rate	**1.70%**
Enter Current Project Location Escalation Rate	**1.70%**
Enter Assumed Monthly Recurring Cost Rate	**8.50%**

	Date	Escalation Delta Amount	Monthly Recurring Cost Amount	Total Schedule Contingency
Enter Current Project Start	1-Oct-12			
Enter Baseline Project Completion	6-Aug-15			
Project Completion at 0% Confidence	30-Aug-14		($2,003,290.86)	($2,003,290.86)
Project Completion at 5% Confidence	23-Nov-15		$643,329.06	$643,329.06
Project Completion at 10% Confidence	20-Feb-16		$1,167,319.95	$1,167,319.95
Project Completion at 15% Confidence	29-Apr-16		$1,571,515.64	$1,571,515.64
Project Completion at 20% Confidence	19-Jun-16		$1,873,748.16	$1,873,748.16
Project Completion at 25% Confidence	10-Aug-16		$2,179,700.38	$2,179,700.38
Project Completion at 30% Confidence	23-Sep-16		$2,437,870.74	$2,437,870.74
Project Completion at 35% Confidence	5-Nov-16		$2,694,361.56	$2,694,361.56
Project Completion at 40% Confidence	14-Dec-16		$2,924,096.56	$2,924,096.56
Project Completion at 45% Confidence	27-Jan-17		$3,178,282.05	$3,178,282.05
Project Completion at 50% Confidence	9-Mar-17		$3,421,838.47	$3,421,838.47
Project Completion at 55% Confidence	22-Apr-17		$3,680,632.90	$3,680,632.90
Project Completion at 60% Confidence	5-Jun-17		$3,939,974.12	$3,939,974.12
Project Completion at 65% Confidence	22-Jul-17		$4,218,339.19	$4,218,339.19
Project Completion at 70% Confidence	14-Sep-17		$4,533,911.59	$4,533,911.59
Project Completion at 75% Confidence	13-Nov-17		$4,884,326.58	$4,884,326.58
Project Completion at 80% Confidence	23-Jan-18		$5,305,046.59	$5,305,046.59
Project Completion at 85% Confidence	18-Apr-18		$5,805,846.06	$5,805,846.06
Project Completion at 90% Confidence	6-Aug-18		$6,449,388.05	$6,449,388.05
Project Completion at 95% Confidence	17-Jan-19		$7,418,421.32	$7,418,421.32
Project Completion at 100% Confidence	24-Aug-21		$13,007,453.92	$13,007,453.92

Entry Required
Do Not Overwrite
Summary Data -- Do Not Overwrite

SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-1	IEPR Timing	Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

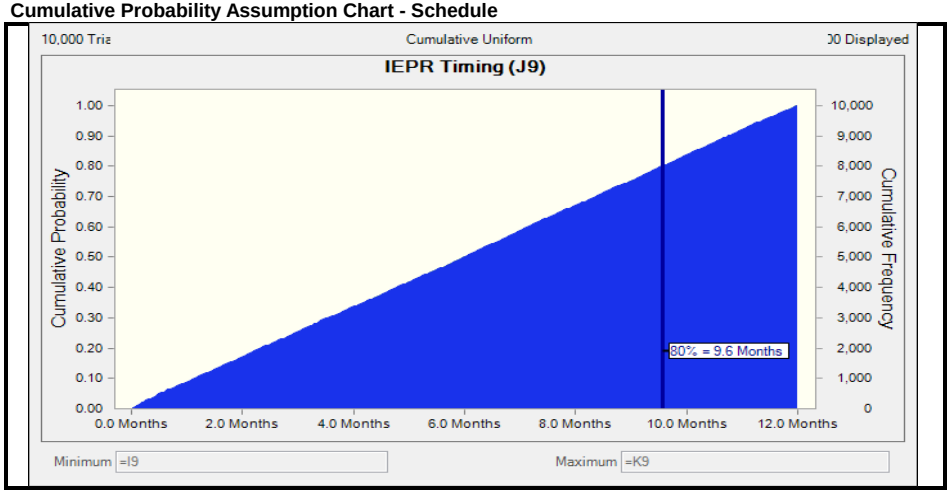
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-1	IEPR Timing	Unlikely	Crisis	HIGH	N/A	N/A	N/A	0.0 Months	0.0 Months	12.0 Months	

Description	If the IEPR takes longer than 4 months, then the authorization may be delayed up to one fiscal year. This has impact to the preconstruction schedule. This is a program milestone.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that delay of the IEPR could push the project off by one fiscal year.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	1.2 Months
20%	N/A	2.3 Months
30%	N/A	3.5 Months
40%	N/A	4.8 Months
50%	N/A	6.0 Months
60%	N/A	7.1 Months
70%	N/A	8.4 Months
80%	N/A	9.6 Months
90%	N/A	10.8 Months
100%	N/A	12.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-2	Division/HQUSACE Approvals	Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

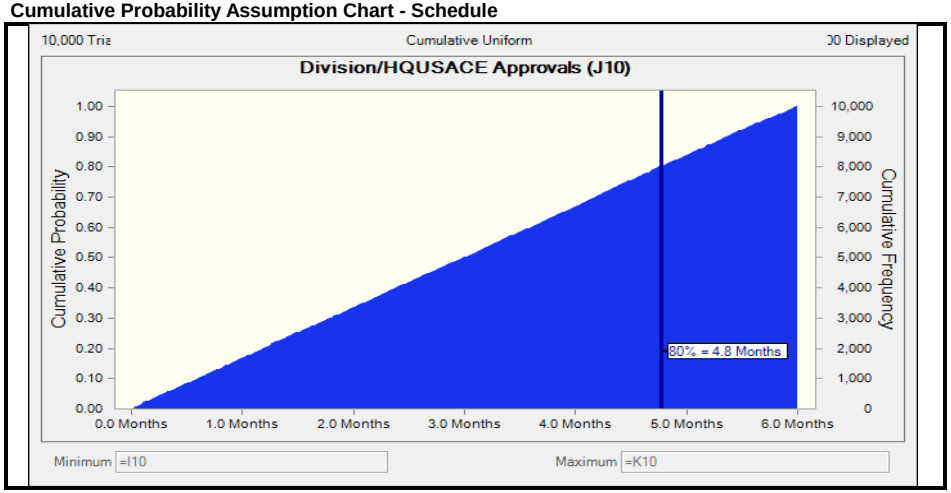
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-2	Division/HQUSACE Approvals	Unlikely	Significant	MODERATE	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

Description	If SAD/HQ does not approve report for public release as DP 2, then it could have a significant impact on the schedule. This has impact to the preconstruction schedule. This is a program milestone.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the project could be delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.6 Months
20%	N/A	1.2 Months
30%	N/A	1.8 Months
40%	N/A	2.4 Months
50%	N/A	3.0 Months
60%	N/A	3.6 Months
70%	N/A	4.2 Months
80%	N/A	4.8 Months
90%	N/A	5.4 Months
100%	N/A	6.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	PPM-3	Economic Modeling Accuracy	Unlikely	Critical	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk*

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	PPM-3	Economic Modeling Accuracy	Unlikely	Marginal	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	Although highly unlikely, if the economic benefit/modeling was determined to be inaccurate through the ATR or IEPR process, it could significantly impact the project. It is not likely that the whole project will not be economically justified. However, there is the possibility that the NED scope could change (i.e. the navigation depth), presenting a significant change to the cost and schedule. *This could be a show-stopping risk.
Development of Low Values	*Per PDT meeting 11/28/30- REMOVE from analysis. Model has been reviewed and ATR'd so risk of any issues has greatly decreased.
Development of High Values	*Per PDT meeting 11/28/30- REMOVE from analysis. Model has been reviewed and ATR'd so risk of any issues has greatly decreased.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	N/A
10%	N/A	N/A
20%	N/A	N/A
30%	N/A	N/A
40%	N/A	N/A
50%	N/A	N/A
60%	N/A	N/A
70%	N/A	N/A
80%	N/A	N/A
90%	N/A	N/A
100%	N/A	N/A

SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-4	Projects Competing for Resources	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

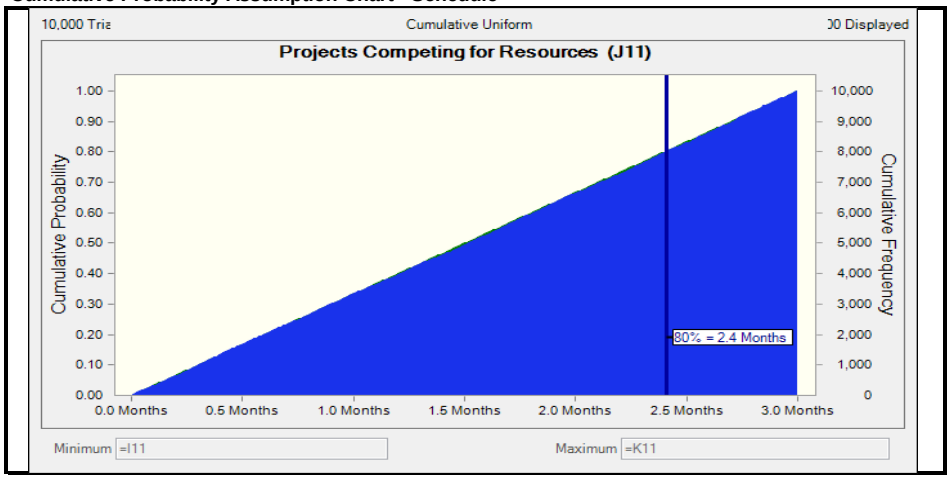
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-4	Projects Competing for Resources	Likely	Marginal	MODERATE	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	3.0 Months	

Description	There is typically a great deal of competition for the same resources. This has a delay impact to the preconstruction schedule (feasibility and PED)
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that scarcity of project resources could delay the project by up to 4 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.3 Months
20%	N/A	0.6 Months
30%	N/A	0.9 Months
40%	N/A	1.2 Months
50%	N/A	1.5 Months
60%	N/A	1.8 Months
70%	N/A	2.1 Months
80%	N/A	2.4 Months
90%	N/A	2.7 Months
100%	N/A	3.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-5	Projects Competing Nationally for Funding	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

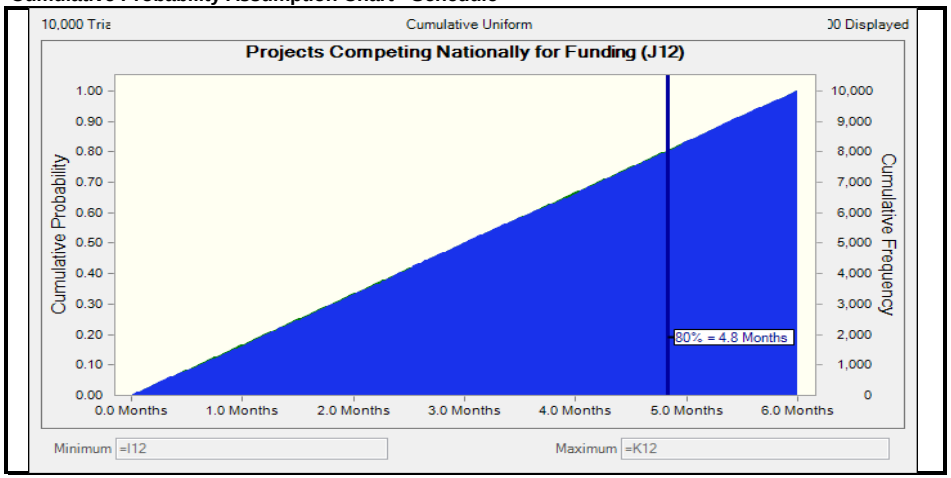
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-5	Projects Competing Nationally for Funding	Likely	Significant	HIGH	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

Description	Typically, several projects nationally are competing for funding. However, since this is a Pilot project, it has better chances of obtaining funds. This could have an impact to cost and schedule. Cost impacts would most likely be captured by the schedule. There is also risk of obtaining reduced increments (less than optimal funding).
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the project could be delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.6 Months
20%	N/A	1.2 Months
30%	N/A	1.8 Months
40%	N/A	2.4 Months
50%	N/A	3.0 Months
60%	N/A	3.6 Months
70%	N/A	4.2 Months
80%	N/A	4.8 Months
90%	N/A	5.4 Months
100%	N/A	6.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CA-2	Multiple Contracts Possible	Likely	Marginal	MODERATE	Triangular	N/A	N/A	$0	$0	$1,394,609	

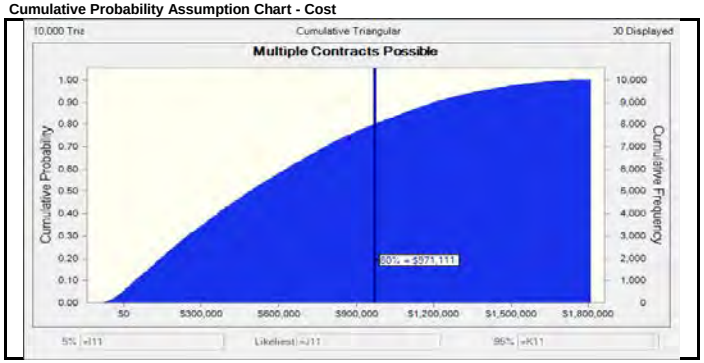
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CA-2	Multiple Contracts Possible	Very Likely	Marginal	MODERATE	Triangular	N/A	N/A	0.0 Months	0.0 Months	3.0 Months	

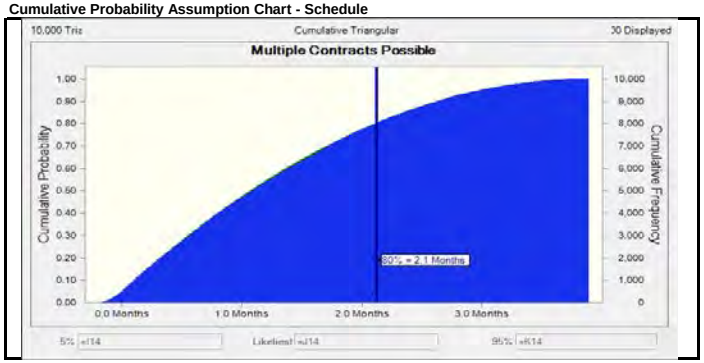
Description	There could be more than one contract due to the funding limitations. Also, there could be one main contract with options. If funding limitations drive the strategy to multiple contracts, it could impact the costs and schedule. There could be up to 3 separate contracts. The risk would impact the contractor mobilizations, markups, and potential efficiencies.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that there are three separate contracts: (1) wildlife facilities, (2) dredging, (3) seawalls. Assum the wildlife facilities work's mobilization costs double, and that there is an added 5% markup (small business). Also assume that there will be an increase to PED, CM, and Contracting costs (assume 5% increase to 30 and 31 accounts). Assume total delay of 3 months due to extra contact award processes.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($89,956)	'-0.2 Months
10%	$46,211	0.1 Months
20%	$145,825	0.3 Months
30%	$247,934	0.6 Months
40%	$365,798	0.8 Months
50%	$490,872	1.1 Months
60%	$631,234	1.4 Months
70%	$784,545	1.7 Months
80%	$971,111	2.1 Months
90%	$1,207,552	2.6 Months
100%	$1,801,557	3.9 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-1	Require Additional Borings	Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

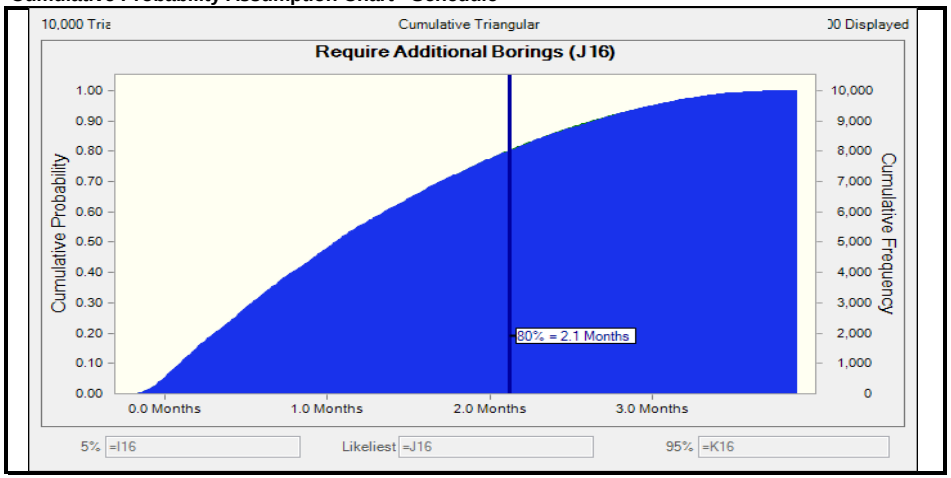
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-1	Require Additional Borings	Likely	Marginal	MODERATE	Yes-No/Triangular	N/A	N/A	0.0 Months	0.0 Months	3.0 Months	

Description	Although the design is quite well developed, the borings are not complete. The borings cannot begin until the initiation of PED. It will take at least 8 months from the development of the boring scope to receipt of the results/report. This will be a delay to the current schedule. This was not in the PM's schedule. It will be added to the schedule and reflected in the estimates.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the schedule could be delayed by up to 3 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	'-0.2 Months
10%	N/A	0.1 Months
20%	N/A	0.3 Months
30%	N/A	0.5 Months
40%	N/A	0.8 Months
50%	N/A	1.1 Months
60%	N/A	1.4 Months
70%	N/A	1.7 Months
80%	N/A	2.1 Months
90%	N/A	2.6 Months
100%	N/A	3.8 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-2	Blasting May Be Required	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-3, TL-8	0.75	$0	$0	$7,742,500	*Correlated to Risks TL-3 and TL-8 by a factor of 0.75*

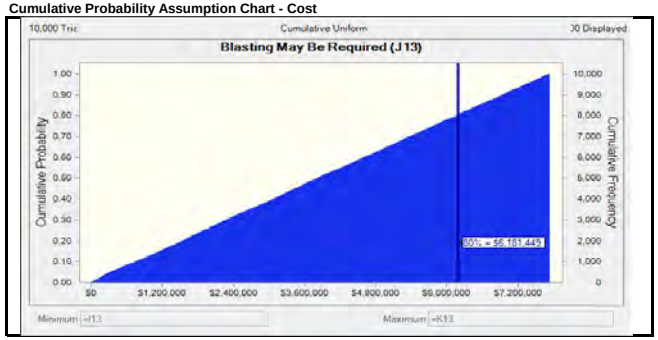
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-2	Blasting May Be Required	Unlikely	Significant	MODERATE	Yes-No/Uniform	TL-8	0.75	0.0 Months	0.0 Months	12.0 Months	*Correlated to Risk TL-8 by a factor of 0.75*

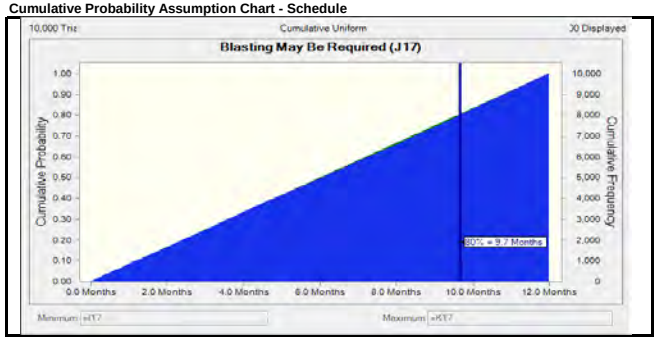
Description	The PDT is fairly confident that blasting will not be required. There is no blasting in the current estimate. They could be blasting required in up to 20% of the present project footprint. This could have a major impact to the costs. It may impact the work that can take place in the work windows (no blasting in winter due to manatees); could impact the schedule because we would need permits.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that blasting would be needed and could increase cost. From studies being done on 2 other harbor deepening projects nearby, blasting costs have been estimated to be anywhere from $11/CY (75' spacing) to $19/CY (37.5' spacing) Depending on the spacing. Our geologist estimated that worst case scenario we would have to blast up to 25% of an area that is 2,200,000 SF and 20' thick which equates to roughly 407,500 CY. Based on the cost estimates on other projects, we could have cost impacts in the range of $4,482,500 for the $11/CY and $7,742,500 for the $19/CY. If a permit is needed for blasting, it could delay the schedule up to 1 year.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$1,316	0.0 Months
10%	$769,359	1.2 Months
20%	$1,561,875	2.4 Months
30%	$2,288,168	3.6 Months
40%	$3,077,828	4.8 Months
50%	$3,819,022	6.1 Months
60%	$4,617,076	7.3 Months
70%	$5,389,395	8.5 Months
80%	$6,181,449	9.7 Months
90%	$6,954,935	10.8 Months
100%	$7,741,467	12.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-3	Change in Subsurface Conditions	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-2	0.75	($1,033,078)	$0	$5,273,379	*Correlated to Risk TL-2 by a factor of 0.75*

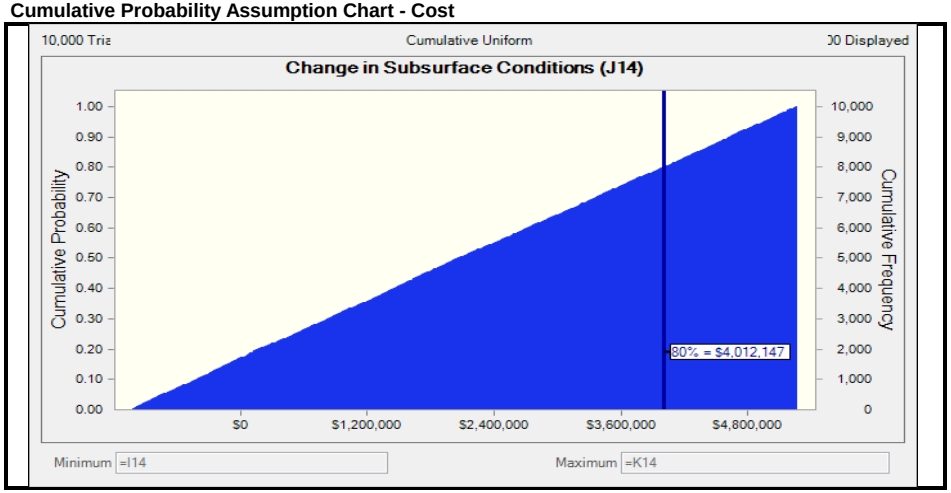
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-3	Change in Subsurface Conditions	Unlikely	Marginal	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	Less or more stiff material (rock) could have an impact on the ultimate quantities. It could also impact the overall footprint (prism). It could also impact the required mitigation. This could have a significant impact on the costs. This is not at all likely for the deepening, but more likely for the widening. Overall, still unlikely.
Development of Low Values	The best case scenario is if there is a presence of large rock that meets the mitigation criteria we could use the rock from the project to construct the hardbottom mitigation areas instead of purchasing rock. Based on early investigations which only turned up think layers of rock, this is unlikely but may be able to get 10% of our hardbottom mitigation quantity from within the project.
Development of High Values	The worst case scenario is that there is up to 15% less beach quality material than assumed so the Mechanical Dredging costs increase and the Pipeline Dredging Costs decrease since more material would have to go to the ODMDS versus the beach. Low probability (35%)

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($1,031,970)	N/A
10%	($405,851)	N/A
20%	$175,829	N/A
30%	$826,316	N/A
40%	$1,459,193	N/A
50%	$2,055,407	N/A
60%	$2,729,833	N/A
70%	$3,365,901	N/A
80%	$4,012,147	N/A
90%	$4,637,413	N/A
100%	$5,273,142	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

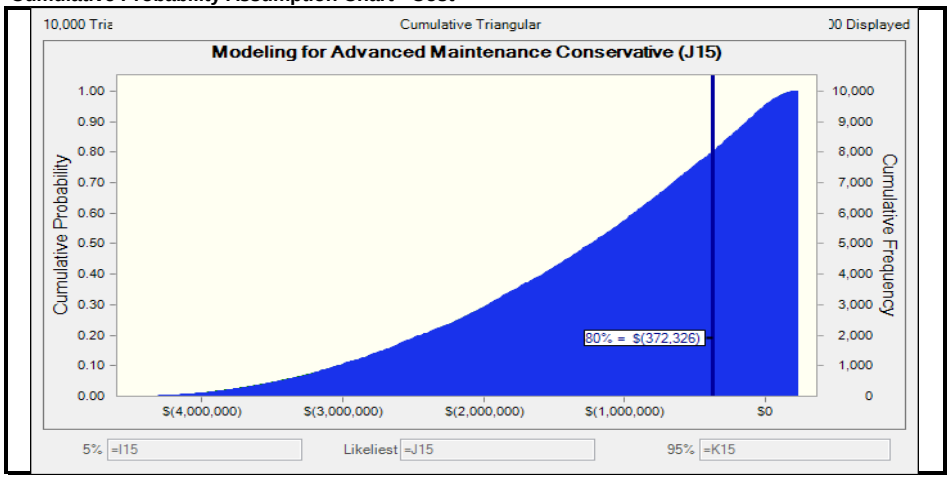
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	TL-4	Modeling for Advanced Maintenance Conservative	Likely	Significant	HIGH	Yes-No/Triangular	N/A	N/A	($3,453,802)	$0	$0	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	TL-4	Modeling for Advanced Maintenance Conservative	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	The PDT has identified that the assumptions made for the advanced maintenance dredging activities are extremely conservative. This could present opportunity for savings with respect to the advance maintenance dredging. This could be an *opportunity* for cost savings.
Development of Low Values	The best case scenario is that the advance maintenance dredging could be reduced by up to 50%.
Development of High Values	The worst case scenario is no change to baseline cost or schedule.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($4,445,574)	N/A
10%	($3,027,523)	N/A
20%	($2,437,908)	N/A
30%	($1,962,841)	N/A
40%	($1,575,077)	N/A
50%	($1,232,300)	N/A
60%	($930,960)	N/A
70%	($651,454)	N/A
80%	($372,326)	N/A
90%	($127,023)	N/A
100%	$212,483	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-6	Uncertainty with a Design Feature (Peanut Island)	Likely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-6	Uncertainty with a Design Feature (Peanut Island)	Likely	Marginal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk*

Description	There may be a competitor for the activity planned for Peanut Island that may impact the currently planned design for this feature. Likely would require some reconfiguration, but could probably be handled with no net effect to construction costs. However, it may produce a marginal delay. *After follow-up research, the PDT concluded that this would not impact the cost or schedule of the project.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the project could be delayed up to 3 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	N/A
10%	N/A	N/A
20%	N/A	N/A
30%	N/A	N/A
40%	N/A	N/A
50%	N/A	N/A
60%	N/A	N/A
70%	N/A	N/A
80%	N/A	N/A
90%	N/A	N/A
100%	N/A	N/A

SAJ Lake Worth Inlet Navigation Pilot Study

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	**TL-7**	**Port May Construct Additional Berths (Slip 3)**	**Unlikely**	**Significant**	**MODERATE**	**N/A**	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk borne by the project*

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	**TL-7**	**Port May Construct Additional Berths (Slip 3)**	**Unlikely**	**Significant**	**MODERATE**	**N/A**	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk borne by the project*

Description	There may be a sponsor driven scope change that would cause a reformulation of feasibility and design activities. Momentum for the Port's contemplated activity at Slip 3 is growing. This would have a ripple effect on the entire project scope. *After follow-up research, the PDT concluded that this would not impact the cost or schedule of the project.
Development of Low Values	The best case scenario is that the port would not request any changes to the current project scope and design, with or without new berths.
Development of High Values	The worst case scenario is that the Port would request a change in project scope and design, based on changing berth conditions. In this event, though, it is more likely that a new separate project study would be initiated, rather than delaying the current study.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	N/A
10%	N/A	N/A
20%	N/A	N/A
30%	N/A	N/A
40%	N/A	N/A
50%	N/A	N/A
60%	N/A	N/A
70%	N/A	N/A
80%	N/A	N/A
90%	N/A	N/A
100%	N/A	N/A

SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-8	Jetty Slope Stability	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-2	0.75	$0	$0	$3,577,045	*Correlated to Risk TL-2 by a factor of 0.75*

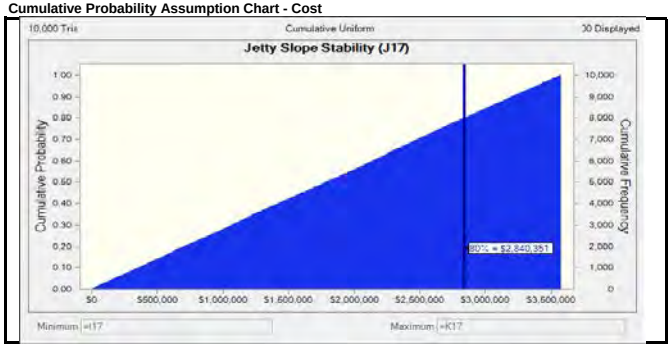
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-8	Jetty Slope Stability	Unlikely	Critical	MODERATE	Yes-No/Uniform	TL-2	0.75	0.0 Months	0.0 Months	6.6 Months	*Correlated to Risk TL-2 by a factor of 0.75*

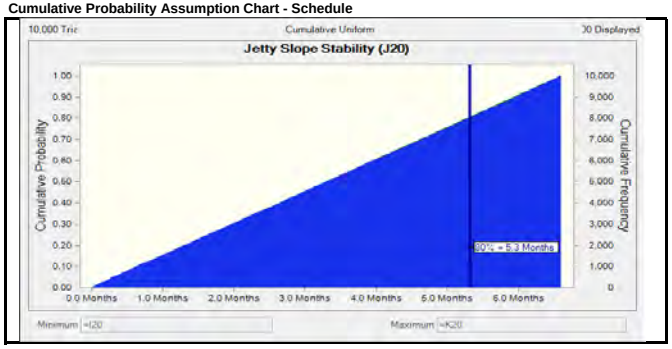
Description	If blasting is required, then there is some concern regarding the jetty slope stability. Current information suggests that it is not very likely to blast in proximity to the jetty (failure). However, there is a chance of blasting which could affect the jetty. This is highly correlated to the blasting risk, itself. *This is only an issue if blasting occurs and there is only a 5% chance that blasting would be required.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that blasting in the proximity of the jetty would occur, and that 1) jetty stability would have to be re-analyzed 2) sheetpile would be installed first (which it already is anyway) 3) additional sheetpile would be needed. This could add cost and impact the schedule. Assume that the sheetpile wall could be lengthened to 600 LF (3 times the length of current proposed sheetpile wall) to stabilize and protect the jetty in anticipation of blasting. Assume that it takes 3 times as long to complete the sheetpile wall construction (Currently 67 days for 200 LF).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$12	0.0 Months
10%	$356,179	0.6 Months
20%	$701,477	1.3 Months
30%	$1,067,643	2.0 Months
40%	$1,421,474	2.7 Months
50%	$1,781,139	3.3 Months
60%	$2,143,818	4.0 Months
70%	$2,482,517	4.7 Months
80%	$2,840,351	5.3 Months
90%	$3,206,482	6.0 Months
100%	$3,576,458	6.6 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-9	Jetty Stabilization Design	Likely	Significant	HIGH	Yes-No/Uniform	N/A	N/A	($89,426)	$0	$178,852	

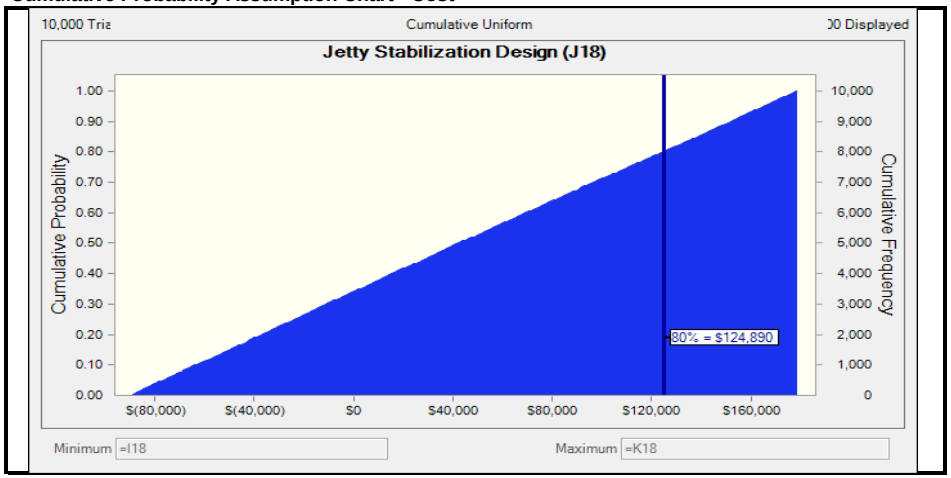
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-9	Jetty Stabilization Design	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	A cursory level design based on many assumptions was the basis for determining the need for jetty stabilization and to what extent. Could have a significant impact to project cost if the location and amount of sheetpile has been underestimated; it could also be a cost savings if it is determined by a detailed design investigation during PED that jetty stabilization is not needed (this is only likely if we dredge to a shallower depth than what is authorized. The current project
Development of Low Values	The best case scenario is that the assumptions used in feasibility report are very similar to the actual site conditions and the jetty design is very similar to the cursory design.
Development of High Values	The worst case scenario is that the actual site conditions differ dramatically from the assumptions used in the feasibility report, impacting the schedule and cost. Costs for jetty stabilization could potentially triple. *Length is unlikely to change, but other design details could change. Possibility for costs to decrease by up to 5% or increase almost 10%; there is a 50% chance of this happening.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($89,407)	N/A
10%	($63,394)	N/A
20%	($36,601)	N/A
30%	($10,790)	N/A
40%	$15,746	N/A
50%	$42,447	N/A
60%	$69,607	N/A
70%	$96,847	N/A
80%	$124,890	N/A
90%	$152,369	N/A
100%	$178,816	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
LD-1	**Extension of the Beach Disposal Template**	**Likely**	**Significant**	**HIGH**	**N/A**	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk*

Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
LD-1	**Extension of the Beach Disposal Template**	**Likely**	**Significant**	**HIGH**	**N/A**	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk*

Description	The PDT is seriously contemplating extension of the beach disposal template from the current template configuration. The issue is the potential addition of an additional 2,000 feet of extension. This would mean additional land acquisition. There is also the potential risk of condemnations, which could significantly delay the project. There is the chance of obtaining with funds other than this project. *After follow-up research, the PDT concluded that this would
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that an additional 2,000 feet of extension will be necessary, increasing the costs of the real estate acquisition and the disposal costs. Assume that the real estate costs double and that the pipeline dredging costs increase by up to 20%. Assume up to 6 months of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	N/A
10%	N/A	N/A
20%	N/A	N/A
30%	N/A	N/A
40%	N/A	N/A
50%	N/A	N/A
60%	N/A	N/A
70%	N/A	N/A
80%	N/A	N/A
90%	N/A	N/A
100%	N/A	N/A

SAJ Lake Worth Inlet Navigation Pilot Study

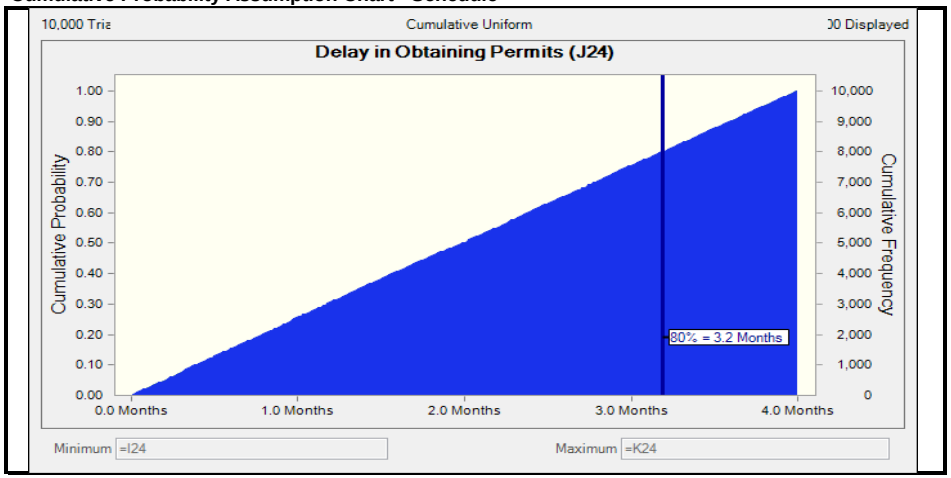
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	RE-2	Delay in Obtaining Permits	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	RE-2	Delay in Obtaining Permits	Likely	Marginal	MODERATE	Yes-No/Uniform	RE-3	0.75	0.0 Months	0.0 Months	4.0 Months	*Correlated to Risk RE-3 by a factor of 0.75*

Description	There may be some delay in obtaining a permit from FDEP due to geotechnical uncertainties for any of the beach placements (since the geotechnical data is not complete). Currently, the data suggests rock in the settling basin. However, presence of sand would require disposal to beaches.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that delay in btaining permits delays the project up to 4 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.4 Months
20%	N/A	0.8 Months
30%	N/A	1.2 Months
40%	N/A	1.6 Months
50%	N/A	2.0 Months
60%	N/A	2.4 Months
70%	N/A	2.8 Months
80%	N/A	3.2 Months
90%	N/A	3.6 Months
100%	N/A	4.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-3	ODMDS Capacity	Unlikely	Significant	MODERATE	es-No/Triangul	N/A	N/A	$0	$0	$320,000	

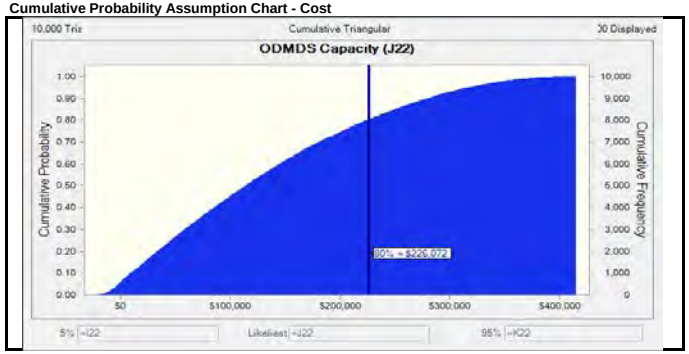
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-3	ODMDS Capacity	Unlikely	Critical	MODERATE	es-No/Triangul	N/A	N/A	0.0 Months	0.0 Months	24.0 Months	*Correlated to Risk RE-2 by a factor of 0.75*

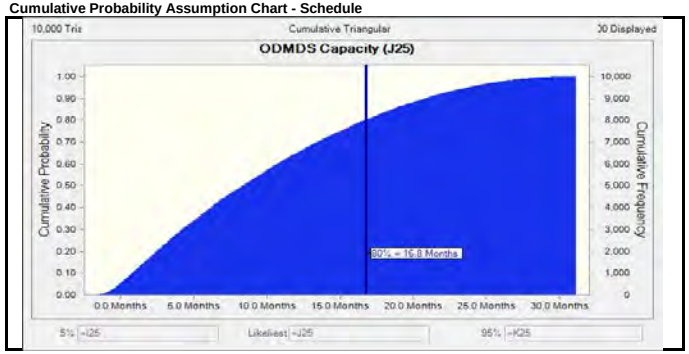
Description	There is a current restriction on the volume per annum to be placed in the ODMDS. If there is no expansion to the current ODMDS, then there would not be capacity to accept the material from this project. The current ODMDS has the technical capacity for the material, but there is a restriction which impacts the volume required for this project. Issue is whether or not the material would migrate outside the boundaries of the site.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that Risk: could be additional $320K. (ODMDS Capacity Modeling:$25K; ODMDS Expansion: environ assessment $100K, Benthis survey: $120K; labor: $75K

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($21,355)	-1.6 Months
10%	$9,955	0.9 Months
20%	$34,643	2.5 Months
30%	$59,416	4.3 Months
40%	$86,340	6.2 Months
50%	$114,712	8.4 Months
60%	$146,021	10.8 Months
70%	$181,097	13.5 Months
80%	$226,072	16.8 Months
90%	$280,868	20.9 Months
100%	$412,867	30.8 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

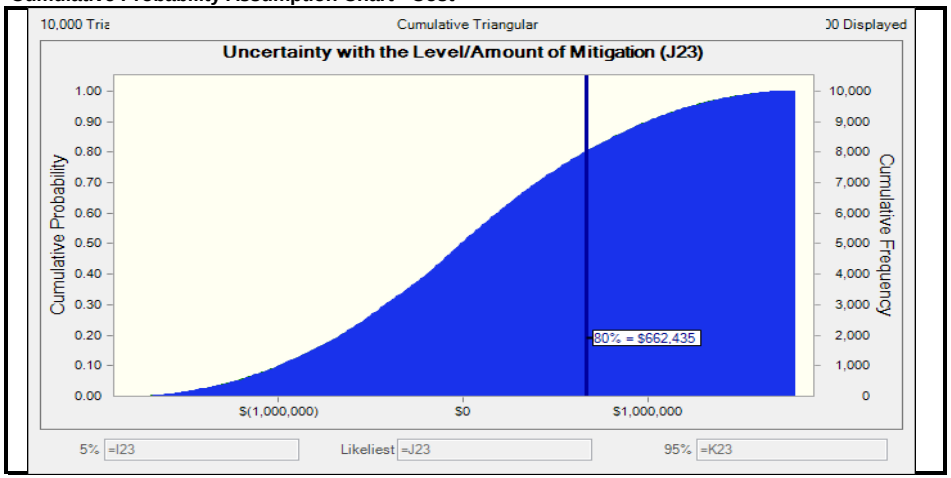
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	RE-4	Uncertainty with the Level/Amount of Mitigation	Unlikely	Significant	MODERATE	es-No/Triangul	N/A	N/A	($1,226,850)	$0	$1,226,850	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	RE-4	Uncertainty with the Level/Amount of Mitigation	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	The mitigation modeling that has already been accomplished is not fully complete. There are 2 models that need to be completed. At this time, the ultimate level and mount of mitigation is not certain. NMFS may require different amounts and levels that are currently contemplated, as reflected in the cost estimate. This could have an impact on the costs.
Development of Low Values	The best case scenario is up to a 10% savings
Development of High Values	The worst case scenario is that mitigation costs could increase by up to 10%.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($1,755,666)	N/A
10%	($986,338)	N/A
20%	($652,916)	N/A
30%	($417,341)	N/A
40%	($189,616)	N/A
50%	($7,244)	N/A
60%	$189,925	N/A
70%	$403,574	N/A
80%	$662,435	N/A
90%	$995,732	N/A
100%	$1,779,043	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-6	Success of the Mitigation Features	Unlikely	Significant	MODERATE	Yes-No/Uniform	N/A	N/A	$0	$0	$1,840,275	

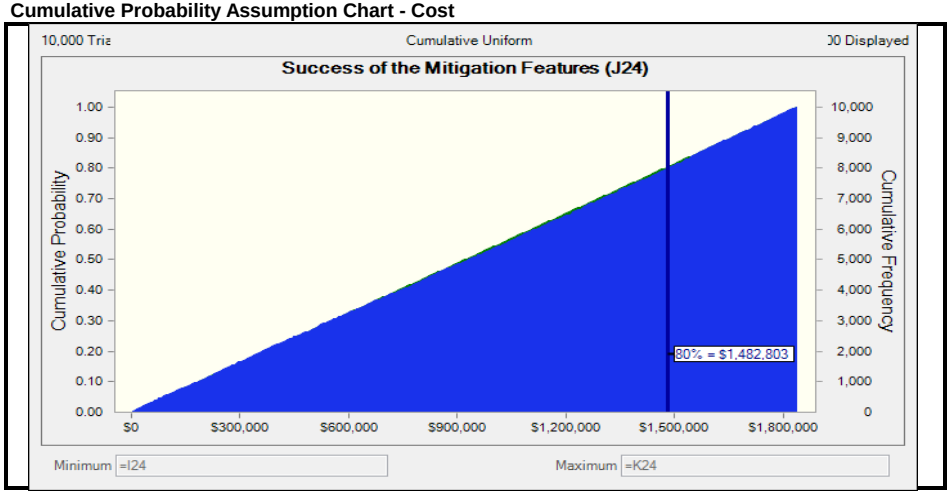
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-6	Success of the Mitigation Features	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	There is a track record of success with these measures. There will be a 5-year monitoring requirement to determine effectiveness. If issues arise, rework may be necessary. This could impact the costs. *There is a 15% chance of this happening.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that mitigation costs could increase by up to 15%.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$96	N/A
10%	$184,895	N/A
20%	$364,601	N/A
30%	$552,123	N/A
40%	$745,443	N/A
50%	$932,838	N/A
60%	$1,118,361	N/A
70%	$1,302,917	N/A
80%	$1,482,803	N/A
90%	$1,657,546	N/A
100%	$1,840,166	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-7	Environmental Work Windows	Likely	Critical	HIGH	N/A	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk borne by the project*

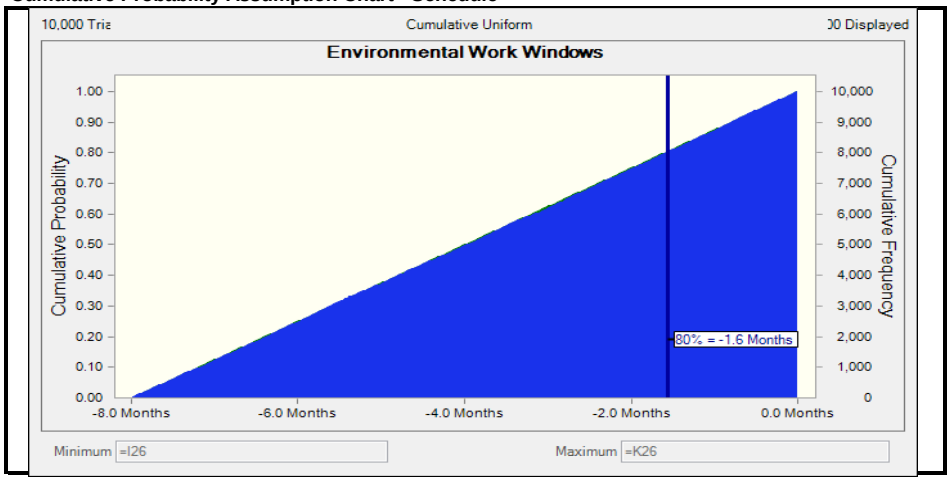
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-7	Environmental Work Windows	Likely	Significant	HIGH	Uniform	N/A	N/A	-8.0 Months	0.0 Months	0.0 Months	

Description	There are restrictions on dredging and excavation due to manatees. There is a large critical habitat for manatees (Lake Worth Inner Channel). There is currently a restriction on the O&M permit that does not allow mechanical dredging. There is not a set work window for the manatees. The PDT is attempting to use mechanical dredging in the new work taking place under this project. There is a possibility that a concession to be made to restrict to no night time
Development of Low Values	The best case scenario is 12 hour dredging is allowed during the window so work does not have to cease completely which would shave about 8 months off the schedule. It is assumed that due to the decreased EWT during the 12-hour restriction, the cost would be comparable to what is modeled in the estimate for multiple mobilizations.
Development of High Values	The worst case scenario is no change to baseline cost or schedule. This scenario (6 month work stoppage) is covered in the estimate by including additonal full re-mobilizations and by the schedule accounting for no work during the timeframes.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	'-8.0 Months
10%	N/A	'-7.2 Months
20%	N/A	'-6.4 Months
30%	N/A	'-5.6 Months
40%	N/A	'-4.8 Months
50%	N/A	'-4.0 Months
60%	N/A	'-3.2 Months
70%	N/A	'-2.4 Months
80%	N/A	'-1.6 Months
90%	N/A	'-0.8 Months
100%	N/A	0.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-8	Material Testing	Very Unlikely	Significant	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

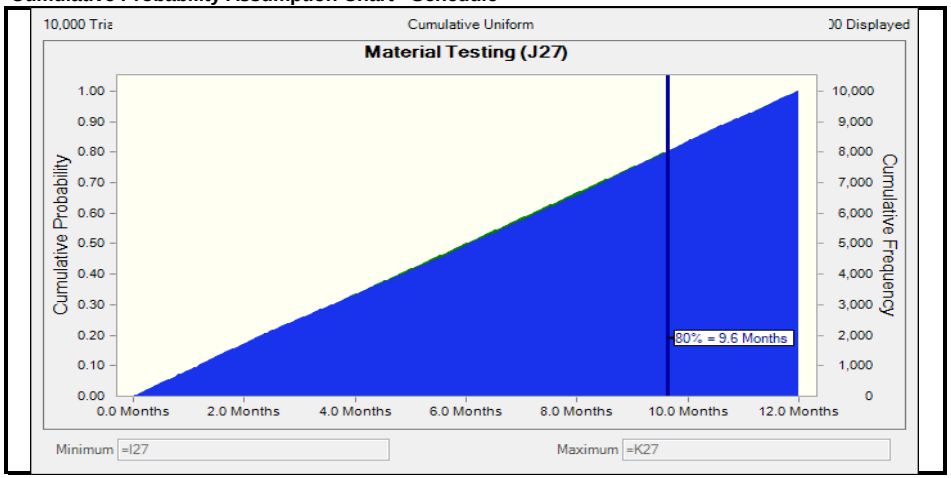
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
RE-8	Material Testing	Very Unlikely	Crisis	HIGH	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	12.0 Months	

Description	Many projects these days are completely dependent on ocean disposal but need to pass testing to ensure it is suitable material before we can take the material offshore. Material testing normally happens during PED a year or so before construction as the suitability is only good for a 3 year period. Material testing is mandatory. If it does not pass, it would need another placement area.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that this could cause a delay of up to one year.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	1.2 Months
20%	N/A	2.3 Months
30%	N/A	3.6 Months
40%	N/A	4.9 Months
50%	N/A	6.1 Months
60%	N/A	7.3 Months
70%	N/A	8.5 Months
80%	N/A	9.6 Months
90%	N/A	10.8 Months
100%	N/A	12.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-1	Variation in Estimated Quantities	Likely	Significant	HIGH	Triangular	N/A	N/A	($6,896,376)	$0	$2,298,816	

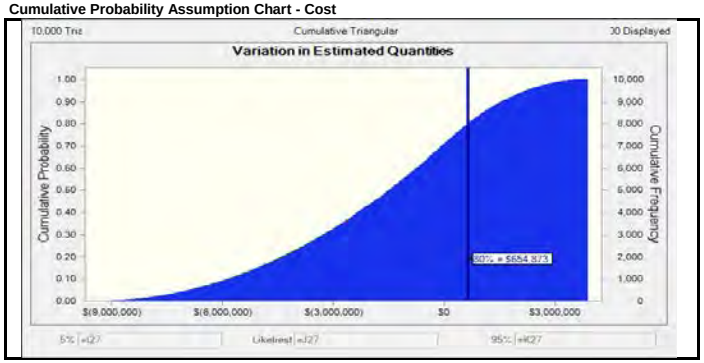
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-1	Variation in Estimated Quantities	Unlikely	Significant	MODERATE	Triangular	N/A	N/A	-3.0 Months	0.0 Months	6.0 Months	

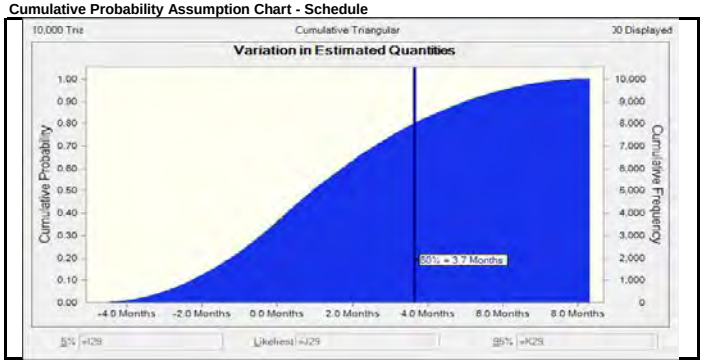
Description	There may be some uncertainty in the quantities due to potential scope changes.This could impact the contract costs. If quantities are off by 15%, could be almost 9.5% increase in project cost.; if quantities are off, could increase or decrease construction duration.
Development of Low Values	The best case scenario is that quanties underrun by up to 15%.
Development of High Values	The worst case scenario is that quantities overrun by up to 5%. *Changed the high from 25% to 5% because quantities are well established.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($9,333,083)	'-4.6 Months
10%	($5,786,730)	'-2.3 Months
20%	($4,323,568)	'-1.2 Months
30%	($3,219,622)	'-0.4 Months
40%	($2,324,749)	0.3 Months
50%	($1,459,606)	1.0 Months
60%	($719,022)	1.8 Months
70%	($44,109)	2.6 Months
80%	$654,873	3.7 Months
90%	$1,568,427	5.0 Months
100%	$3,851,383	8.3 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-3	Haul Route Construction/Loading Restriction	Likely	Marginal	MODERATE	Triangular	N/A	N/A	$0	$0	$154,141	

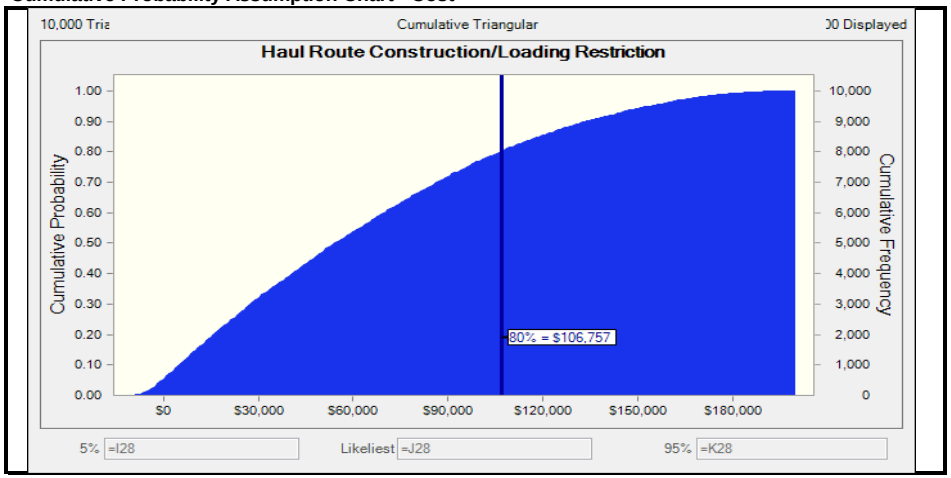
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-3	Haul Route Construction/Loading Restriction	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	There is a limitation on the construction on the inlet channels that may cause the contractor to use smaller and more lightly loaded barges. This could impact contractor productivity, and therefore contract costs. *The production for the seagrass mitigation has been adjusted in the estimate to account for loading restrictions
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the productivity rate for the seagrass mitigation decreases by up to 20%.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($10,019)	N/A
10%	$5,246	N/A
20%	$16,058	N/A
30%	$27,750	N/A
40%	$41,059	N/A
50%	$54,390	N/A
60%	$69,858	N/A
70%	$86,860	N/A
80%	$106,757	N/A
90%	$133,977	N/A
100%	$197,953	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-4	Construction Schedule Accuracy	Likely	Marginal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	*Captured by Schedule Risk Model*

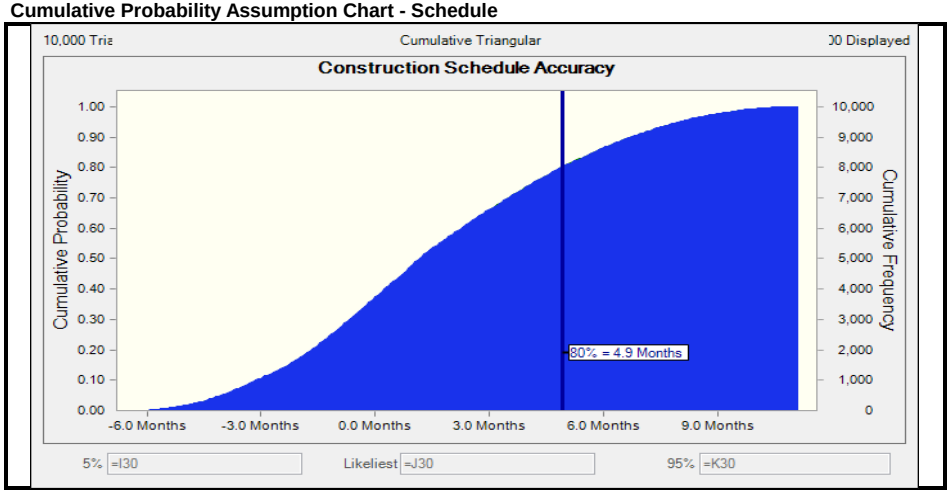
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-4	Construction Schedule Accuracy	Likely	Significant	HIGH	Triangular	N/A	N/A	-4.0 Months	0.0 Months	8.0 Months	

Description	There are many factors not considered in the current construction schedule, including the work windows, severe weather, permit delays, restrictions, etc. This could impact both cost and schedule.
Development of Low Values	The best case scenario is that the overall schedule improves by up to 4 months.
Development of High Values	The worst case scenario is that the overall schedule is delayed by up to 8 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	'-6.2 Months
10%	N/A	'-3.1 Months
20%	N/A	'-1.7 Months
30%	N/A	'-0.7 Months
40%	N/A	0.3 Months
50%	N/A	1.2 Months
60%	N/A	2.3 Months
70%	N/A	3.5 Months
80%	N/A	4.9 Months
90%	N/A	6.7 Months
100%	N/A	11.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	CON-5	Air Quality	Likely	Marginal	MODERATE	N/A	N/A	N/A	N/A	N/A	N/A	*Removed from study - No longer a risk*

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	CON-5	Air Quality	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	The contractor will have to comply with clean air restrictions. This could impact contractor productivity, and therefore contract costs. *After follow-up research, the PDT concluded that this would not impact the cost or schedule of the project.
Development of Low Values	This items has been removed as a project risk.
Development of High Values	This items has been removed as a project risk.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	N/A
10%	N/A	N/A
20%	N/A	N/A
30%	N/A	N/A
40%	N/A	N/A
50%	N/A	N/A
60%	N/A	N/A
70%	N/A	N/A
80%	N/A	N/A
90%	N/A	N/A
100%	N/A	N/A

SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-MOD	Consideration for Post-Award Construction Claims and Modifications	Likely	Marginal	MODERATE	Triangular	N/A	N/A	$0	$0	$3,629,672	

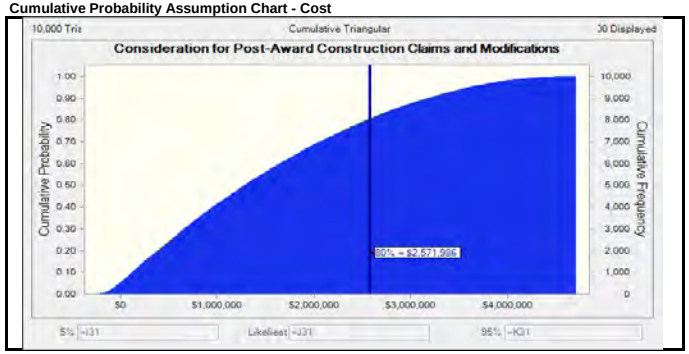
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-MOD	Consideration for Post-Award Construction Claims and Modifications	Likely	Marginal	MODERATE	Triangular	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

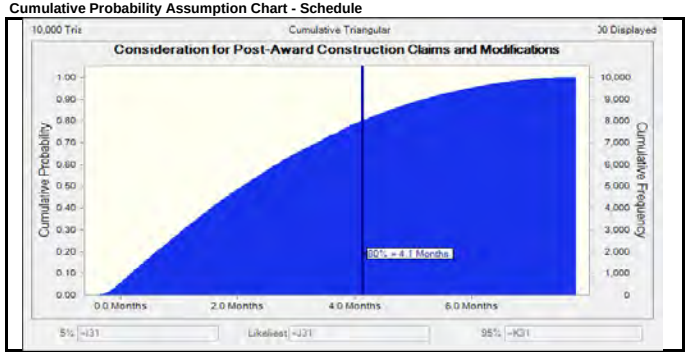
Description	There is inherent risk of construction modifications and claims that arise after contract award due to issues such as weather, schedules dictated by O&M cycles, differing site conditions, user directed changes or omissions, inaccurate surveys, and variations in estimated quantities (minor). Post-award construction contract modifications and claims could impact the ultimate contract costs and delay the overall schedule.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the construction costs increase by up to 5% and that the project is delayed up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($243,829)	-0.4 Months
10%	$129,916	0.2 Months
20%	$403,093	0.6 Months
30%	$668,156	1.1 Months
40%	$956,249	1.6 Months
50%	$1,289,911	2.1 Months
60%	$1,653,461	2.7 Months
70%	$2,070,208	3.4 Months
80%	$2,571,986	4.1 Months
90%	$3,197,820	5.2 Months
100%	$4,671,182	7.8 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-1	Production Estimates	Unlikely	Significant	MODERATE	Triangular	N/A	N/A	($3,629,672)	$0	$7,259,343	

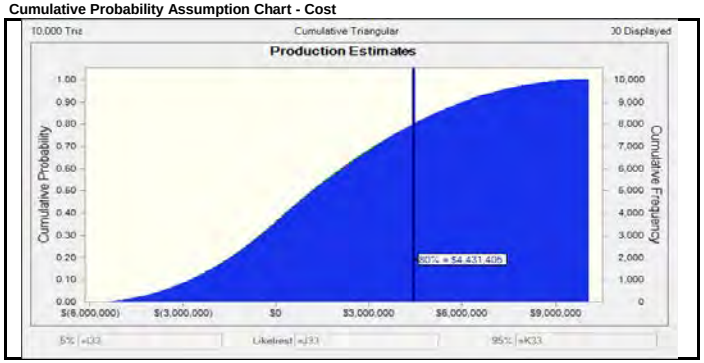
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-1	Production Estimates	Unlikely	Significant	MODERATE	Triangular	N/A	N/A	-2.0 Months	0.0 Months	4.0 Months	

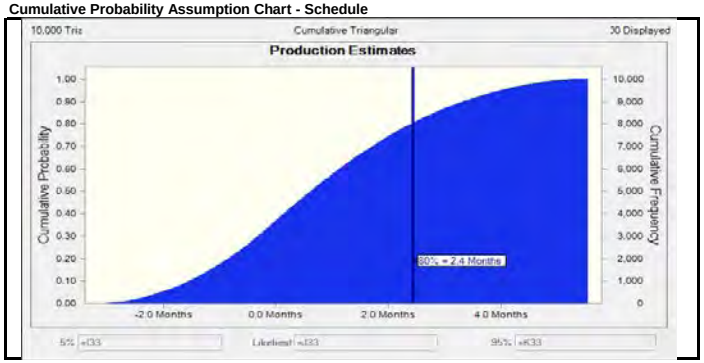
Description	Possibility of production estimates not accurately depicting production we will actually see on job. If production estimates are off, unit costs could be innaccurate and construction duration could be shorter or longer
Development of Low Values	The best case scenario is that the overall costs are conservative, causing an overall savings of up to 5% and 2 months schedule improvement
Development of High Values	The worst case scenario is that overall costs are not conservative, causing an overall cost increase of up to 5% and adding 4 months of schedule delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($5,720,047)	'-3.1 Months
10%	($2,746,950)	'-1.5 Months
20%	($1,459,992)	'-0.8 Months
30%	($475,669)	'-0.3 Months
40%	$340,299	0.2 Months
50%	$1,187,556	0.6 Months
60%	$2,183,353	1.1 Months
70%	$3,230,719	1.7 Months
80%	$4,431,405	2.4 Months
90%	$6,053,849	3.3 Months
100%	$9,992,169	5.5 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-2	Contract Markups	Likely	Marginal	MODERATE	Triangular	N/A	N/A	($1,291,260)	$0	$3,876,263	

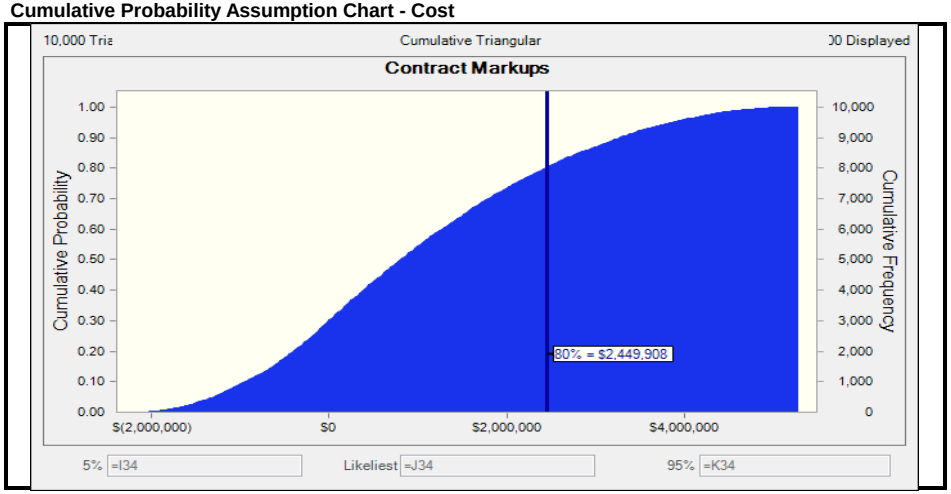
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EST-2	Contract Markups	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	We have used average large dredging contractor markups for many years but the actual markups bid for the contracts could vary from this.
Development of Low Values	The best case scenario is that all of the JOOH markups will be 8% for prime and 4% for subcontractors.
Development of High Values	The worst case scenario is that all JOOHs will be up to 15% for prime work and 10% for subcontractors.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($2,167,517)	N/A
10%	($939,647)	N/A
20%	($391,886)	N/A
30%	$9,829	N/A
40%	$395,946	N/A
50%	$810,578	N/A
60%	$1,278,666	N/A
70%	$1,799,552	N/A
80%	$2,449,908	N/A
90%	$3,279,487	N/A
100%	$5,236,260	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	MODERATE	Triangular	N/A	N/A	($3,596,141)	$0	$3,596,141	

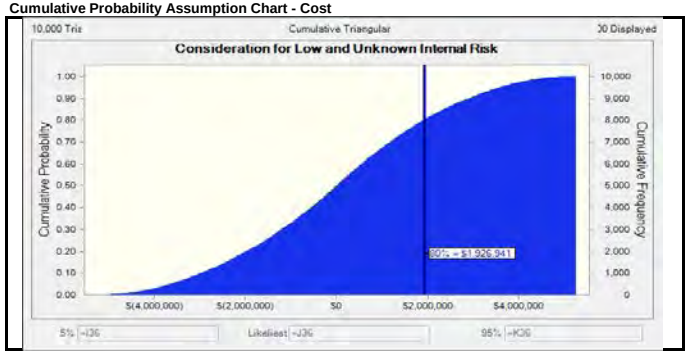
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	MODERATE	Triangular	N/A	N/A	-3.0 Months	0.0 Months	3.0 Months	

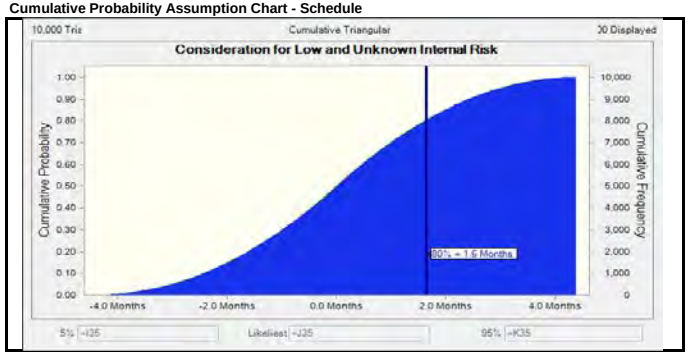
Description	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns. This could impact cost and schedule.
Development of Low Values	The best case scenario is that costs improve by up to 5% and schedule is improved by up to 3 months.
Development of High Values	The worst case scenario is that project costs increase by up to 5% and the overall schedule is delayed by up to 3 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($5,221,328)	'-4.3 Months
10%	($2,939,087)	'-2.4 Months
20%	($1,950,076)	'-1.6 Months
30%	($1,187,274)	'-1.0 Months
40%	($517,896)	'-0.4 Months
50%	$35,544	0.0 Months
60%	$571,199	0.5 Months
70%	$1,193,041	1.0 Months
80%	$1,926,941	1.6 Months
90%	$2,934,013	2.4 Months
100%	$5,181,626	4.4 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-1	Market Conditions/Bidding Climate	Very Likely	Significant	HIGH	Triangular	PR-2	0.67	($7,259,343)	$0	$14,518,686	*Correlated to PR-2 by a factor of 0.67*

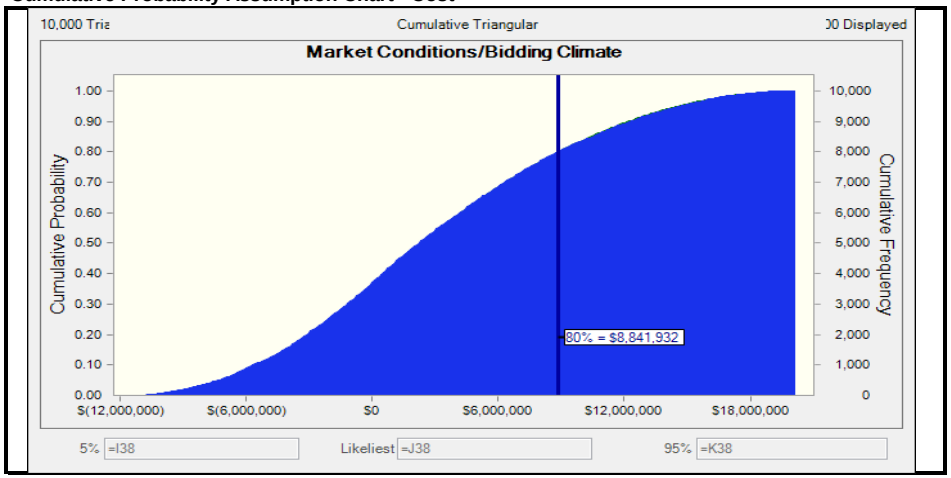
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-1	Market Conditions/Bidding Climate	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	There is inherent variability and volatility in the dredging industry that could impact the ultimate contract costs. This could have significant impact on the costs.
Development of Low Values	The best case scenario is that ultimate contract costs are up to 10% less than currently estimated.
Development of High Values	The worst case scenario is that contract costs are up to 20% more than currently estimated.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($11,382,003)	N/A
10%	($5,642,715)	N/A
20%	($3,102,854)	N/A
30%	($1,159,785)	N/A
40%	$532,807	N/A
50%	$2,230,710	N/A
60%	$4,199,357	N/A
70%	$6,333,899	N/A
80%	$8,841,932	N/A
90%	$12,351,217	N/A
100%	$20,079,017	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-2	Limited Competition	Unlikely	Significant	MODERATE	Yes-No/Triangular	PR-1	0.67	$0	$0	$5,023,330	*Correlated to PR-1 by a factor of 0.67*

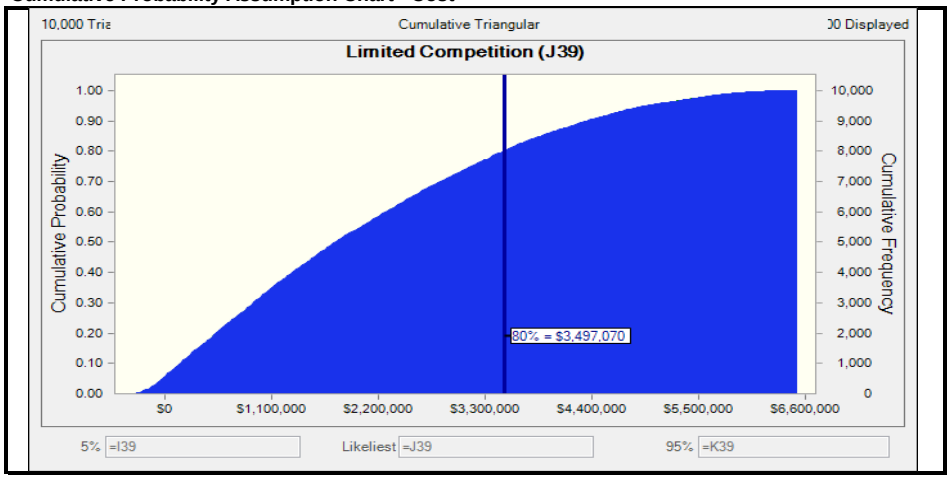
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-2	Limited Competition	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	There may be too few bidders, limiting competition and driving prices up. The Government is configuring the project with a barge mounted excavator in order to not limited competition.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that the lack of competition may drive the dredging contracts up to 10% higher than currently estimated.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($332,252)	N/A
10%	$162,744	N/A
20%	$538,423	N/A
30%	$921,958	N/A
40%	$1,315,492	N/A
50%	$1,768,837	N/A
60%	$2,295,785	N/A
70%	$2,851,934	N/A
80%	$3,497,070	N/A
90%	$4,351,879	N/A
100%	$6,467,194	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-3	Severe Tropical Storms	Unlikely	Marginal	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

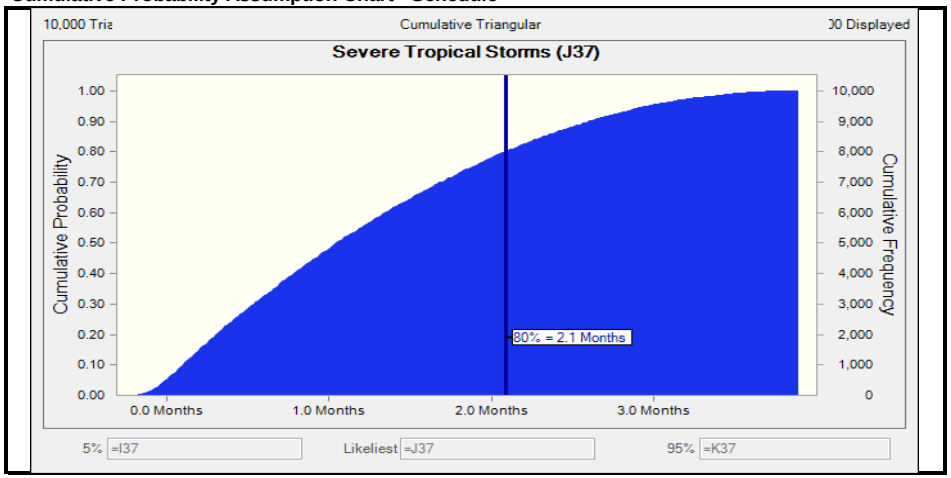
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-3	Severe Tropical Storms	Unlikely	Significant	MODERATE	Yes-No/Triangular	N/A	N/A	0.0 Months	0.0 Months	3.0 Months	

Description	Severe weather could impact the project. Hurricanes could have a significant impact on the project. Severe weather events, depending on severity, could impact the costs and the schedule.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that severe tropical storms do occur and delay the project by up to 3 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	'-0.2 Months
10%	N/A	0.1 Months
20%	N/A	0.3 Months
30%	N/A	0.5 Months
40%	N/A	0.8 Months
50%	N/A	1.1 Months
60%	N/A	1.4 Months
70%	N/A	1.7 Months
80%	N/A	2.1 Months
90%	N/A	2.6 Months
100%	N/A	3.8 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-4	Fuel Prices	Very Likely	Significant	HIGH	Triangular	N/A	N/A	($1,085,030)	$0	$3,470,028	

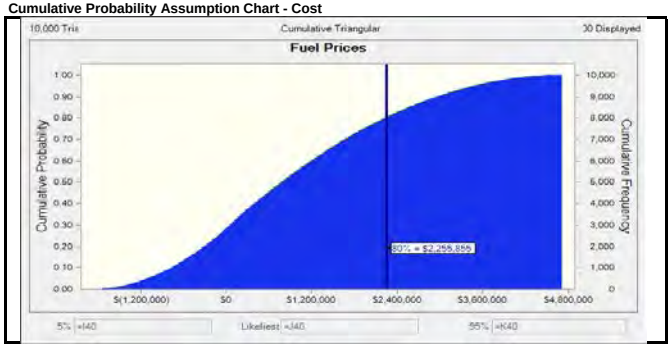
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-4	Fuel Prices	Very Unlikely	Negligible	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

Description	Rising fuel prices for marine and off-road diesel could impact the contract costs. This would likely have significant impact to equipment costs (dredging). The estimate currently assumes a cost of $3.475/gallon for marine diesel.
Development of Low Values	The best case scenario is that the cost of marine diesel could drop to as low as $3.00/gallon at price level costs.
Development of High Values	The worst case scenario is that the cost of marine diesel could increase to as much as $5.00/gallon at price level costs.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($1,826,469)	N/A
10%	($755,127)	N/A
20%	($293,883)	N/A
30%	$65,899	N/A
40%	$413,008	N/A
50%	$798,852	N/A
60%	$1,221,061	N/A
70%	$1,692,716	N/A
80%	$2,255,855	N/A
90%	$2,981,275	N/A
100%	$4,695,902	N/A

Cumulative Probability Assumption Chart - Cost



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-5	Communities May Not View the Project Favorably	Very Unlikely	Marginal	LOW	N/A	N/A	N/A	N/A	N/A	N/A	

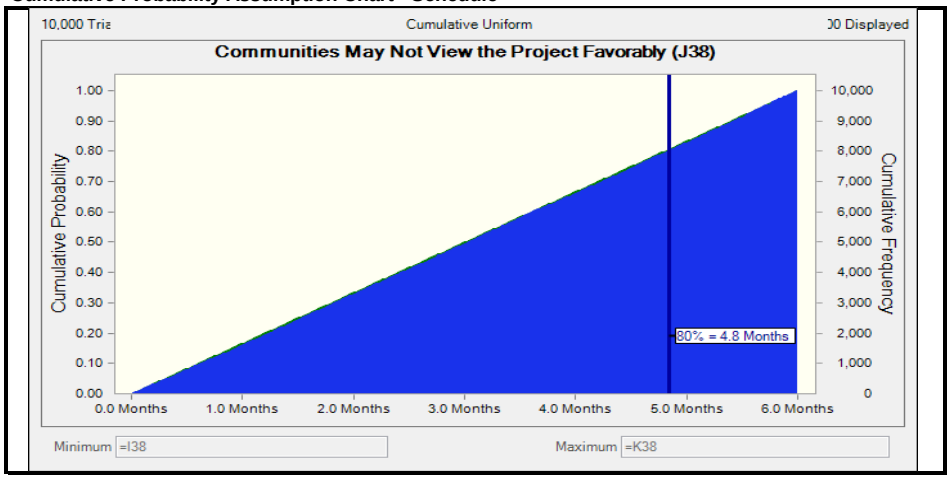
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-5	Communities May Not View the Project Favorably	Unlikely	Significant	MODERATE	Yes-No/Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

Description	While the local communities have not opposed the project or officially withdrawn support, many do not favor the project. Enough opposition could impact implementation of the project.
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that lack of local support could delay the project by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.6 Months
20%	N/A	1.2 Months
30%	N/A	1.8 Months
40%	N/A	2.4 Months
50%	N/A	3.0 Months
60%	N/A	3.6 Months
70%	N/A	4.2 Months
80%	N/A	4.8 Months
90%	N/A	5.4 Months
100%	N/A	6.0 Months

Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-6	Equipment Availability	Unlikely	Significant	MODERATE	Yes-No/Triangular	N/A	N/A	$0	$0	$1,640,969	

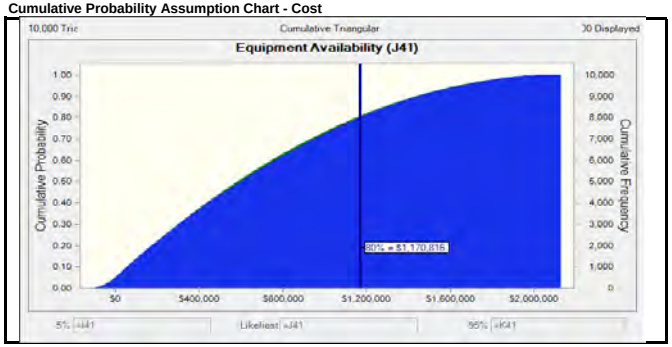
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-6	Equipment Availability	Unlikely	Critical	MODERATE	Yes-No/Triangular	N/A	N/A	0.0 Months	0.0 Months	12.0 Months	

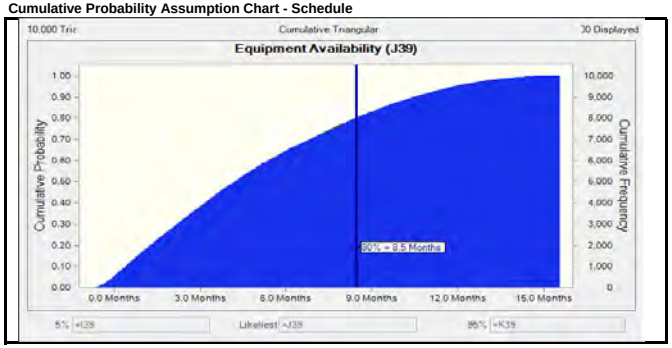
Description	Impacts due to non-availability of the most efficient dredge type to perform the work. Could have a significant impact to cost if have to convert to a sole source negotiation; critical impact to schedule if need to re-advertise or wait for available equipment-especially since we are working with strict environmental windows
Development of Low Values	The best case scenario is no change to baseline cost or schedule.
Development of High Values	The worst case scenario is that equipment costs could increase by up to50% and the project could be delayed by up to 1 year.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($108,267)	'-0.8 Months
10%	$59,243	0.4 Months
20%	$177,123	1.3 Months
30%	$307,059	2.2 Months
40%	$445,027	3.2 Months
50%	$603,288	4.2 Months
60%	$767,332	5.4 Months
70%	$954,422	6.9 Months
80%	$1,170,816	8.5 Months
90%	$1,447,484	10.5 Months
100%	$2,107,627	15.2 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



SAJ Lake Worth Inlet Navigation Pilot Study

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	MODERATE	Triangular	N/A	N/A	($3,596,141)	$0	$3,596,141	

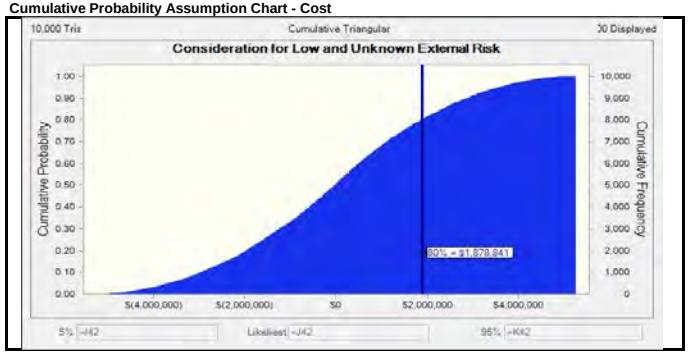
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	MODERATE	Triangular	N/A	N/A	-3.0 Months	0.0 Months	3.0 Months	

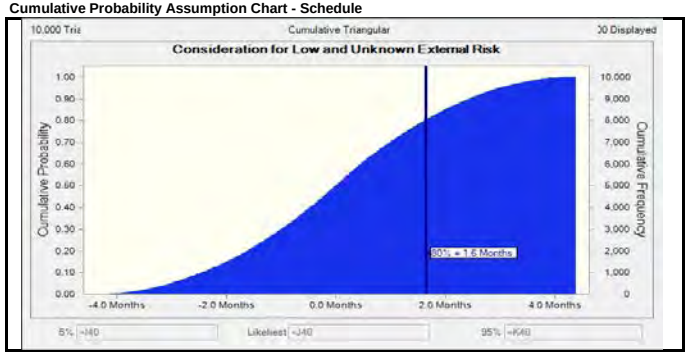
Description	There is inherent risk in all projects that could contribute to cost and schedule variance due to uknowns. This could impact cost and schedule.
Development of Low Values	The best case scenario is that costs improve by up to 5% and schedule is improved by up to 3 months.
Development of High Values	The worst case scenario is that project costs increase by up to 5% and the overall schedule is delayed by up to 3 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($5,252,634)	'-4.3 Months
10%	($2,936,918)	'-2.4 Months
20%	($1,943,276)	'-1.6 Months
30%	($1,219,264)	'-1.0 Months
40%	($562,950)	'-0.5 Months
50%	($13,894)	0.0 Months
60%	$513,597	0.5 Months
70%	$1,116,210	1.0 Months
80%	$1,878,841	1.6 Months
90%	$2,899,153	2.5 Months
100%	$5,207,445	4.3 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Crystal Ball Report - Full

Simulation started on 12/10/2012 at 16:45:51
Simulation stopped on 12/10/2012 at 16:47:57

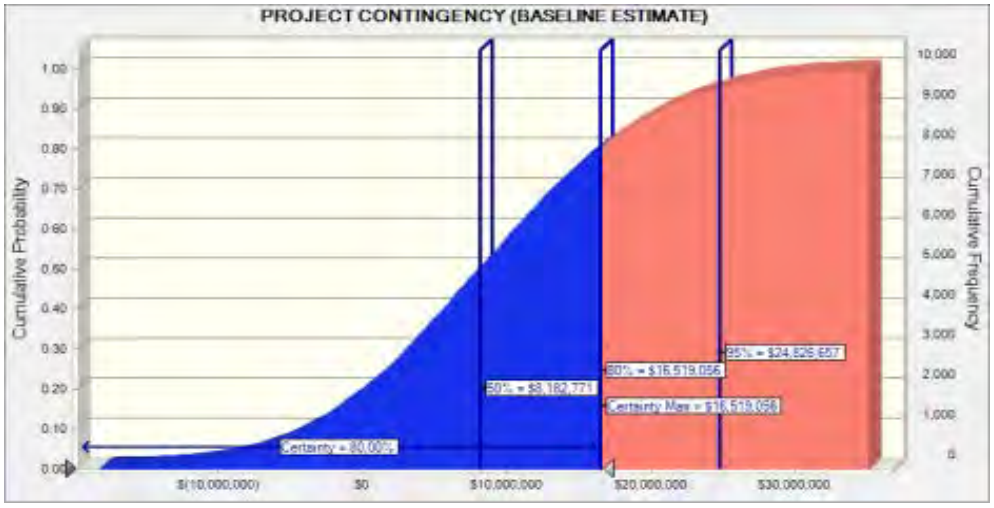
Run preferences:	
Number of trials run	10,000
Monte Carlo	
Seed	999
Precision control on	
Confidence level	95.00%
Run statistics:	
Total running time (sec)	123.66
Trials/second (average)	81
Random numbers per sec	5,176
Crystal Ball data:	
Assumptions	64
Correlations	6
Correlated groups	5
Decision variables	0
Forecasts	2

Forecasts

Worksheet: [SAJ_LakeWorthInlet-CSRA-REV3.xlsx]Cost Risk Model

Forecast: PROJECT CONTINGENCY (BASELINE ESTIMATE) **Cell: L44**

Summary:
Certainty level is 80.00%
Certainty range is from -Infinity to $16,519,056
Entire range is from $(24,982,336) to $47,180,936
Base case is $0
After 10,000 trials, the std. error of the mean is $95,821



Statistics:	Forecast values
Trials	10,000
Mean	$8,480,253
Median	$8,182,787
Mode	---
Standard Deviation	$9,582,080
Variance	################
Skewness	0.1700
Kurtosis	2.96
Coeff. of Variability	1.13
Minimum	$(24,982,336)
Maximum	$47,180,936
Range Width	$72,163,272
Mean Std. Error	$95,821

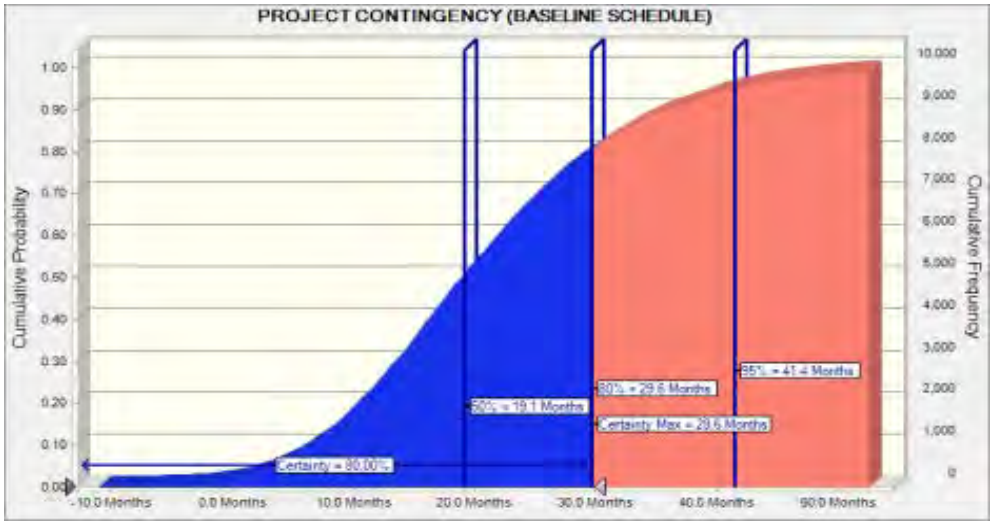
Forecast: PROJECT CONTINGENCY (BASELINE ESTIMATE) (cont'd) **Cell: L44**

Percentiles:	Forecast values
0%	$(24,982,336)
10%	$(3,628,069)
20%	$244,062
30%	$3,170,286
40%	$5,803,852
50%	$8,182,771
60%	$10,666,880
70%	$13,260,912
80%	$16,519,056
90%	$21,010,635
100%	$47,180,936

Worksheet: [SAJ_LakeWorthInlet-CSRA-REV3.xlsx]Schedule Risk Model

Forecast: PROJECT CONTINGENCY (BASELINE SCHEDULE) **Cell: L42**

Summary:
Certainty level is 80.00%
Certainty range is from -Infinity to 29.6 Months
Entire range is from -11.2 Months to 72.7 Months
Base case is 0.0 Months
After 10,000 trials, the std. error of the mean is 0.1 Months



Statistics:	Forecast values
Trials	10,000
Mean	20.4 Months
Median	19.1 Months
Mode	---
Standard Deviation	11.6 Months
Variance	134.1 Months
Skewness	0.5830
Kurtosis	3.40
Coeff. of Variability	0.5684
Minimum	-11.2 Months
Maximum	72.7 Months
Range Width	83.9 Months
Mean Std. Error	0.1 Months

Forecast: PROJECT CONTINGENCY (BASELINE SCHEDULE) (cont'd) **Cell: L42**

Percentiles:	Forecast values
0%	-11.2 Months
10%	6.5 Months
20%	10.5 Months
30%	13.6 Months
40%	16.3 Months
50%	19.1 Months
60%	22.0 Months
70%	25.3 Months
80%	29.6 Months
90%	36.0 Months
100%	72.7 Months

End of Forecasts

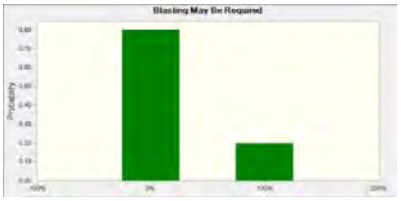
Assumptions

Worksheet: [SAJ_LakeWorthInlet-CSRA-REV3.xlsx]Cost Risk Model

Assumption: Blasting May Be Required — Cell: H13

Yes-No distribution with parameters:

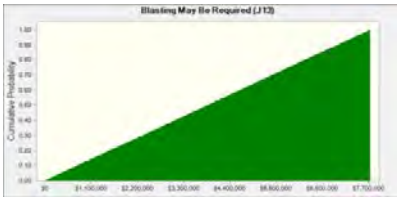
Probability of Yes(1)	0.2	(=H13)



Assumption: Blasting May Be Required (J13) — Cell: J13

Uniform distribution with parameters:

Minimum	$0	(=I13)
Maximum	$7,742,500	(=K13)

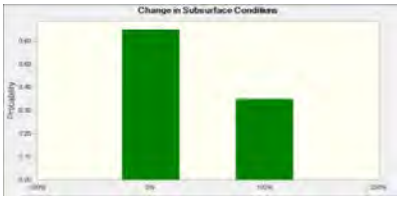


Correlated with:	Coefficient
Jetty Stabilization Design (J18) (J18)	0.75
Change in Subsurface Conditions (J14) (J14)	0.75

Assumption: Change in Subsurface Conditions — Cell: H14

Yes-No distribution with parameters:

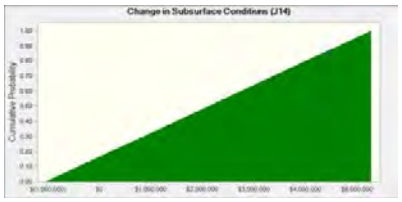
Probability of Yes(1)	0.35	(=H14)



Assumption: Change in Subsurface Conditions (J14) **Cell: J14**

Uniform distribution with parameters:

Minimum	$(1,033,078)	(=I14)
Maximum	$5,273,379	(=K14)

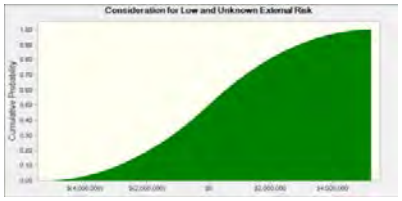


Correlated with:	Coefficient
Blasting May Be Required (J13) (J13)	0.75

Assumption: Consideration for Low and Unknown External Risk **Cell: J42**

Triangular distribution with parameters:

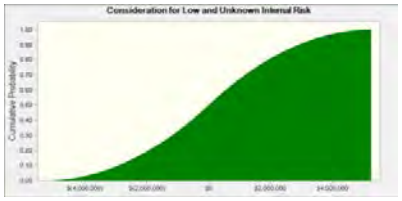
5%	$(3,596,141)	(=I42)
Likeliest	$0	(=J42)
95%	$3,596,141	(=K42)



Assumption: Consideration for Low and Unknown Internal Risk **Cell: J36**

Triangular distribution with parameters:

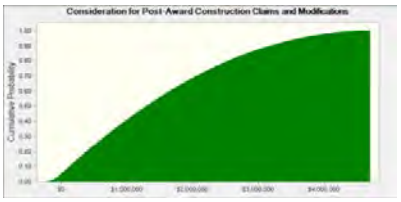
5%	$(3,596,141)	(=I36)
Likeliest	$0	(=J36)
95%	$3,596,141	(=K36)



Assumption: Consideration for Post-Award Construction Claims and Modifications **Cell: J31**

Triangular distribution with parameters:

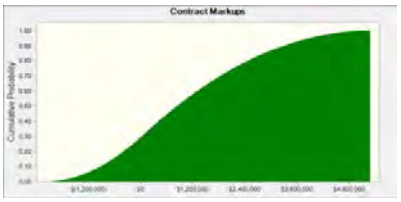
5%	$0	(=I31)
Likeliest	$0	(=J31)
95%	$3,629,672	(=K31)



Assumption: Contract Markups **Cell: J34**

Triangular distribution with parameters:

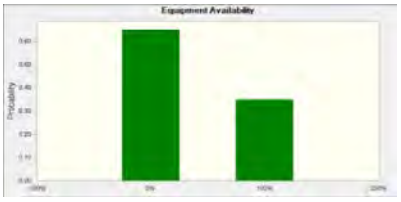
5%	$(1,291,260)	(=I34)
Likeliest	$0	(=J34)
95%	$3,876,263	(=K34)



Assumption: Equipment Availability **Cell: H41**

Yes-No distribution with parameters:

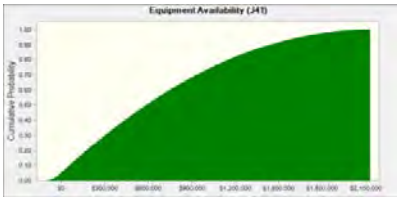
Probability of Yes(1)	0.35	(=H41)



Assumption: Equipment Availability (J41) **Cell: J41**

Triangular distribution with parameters:

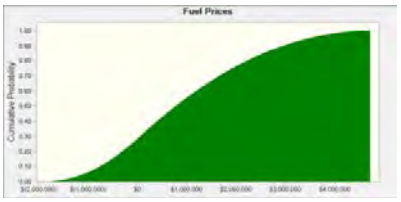
5%	$0	(=I41)
Likeliest	$0	(=J41)
95%	$1,640,969	(=K41)



Assumption: Fuel Prices **Cell: J40**

Triangular distribution with parameters:

5%	$(1,085,030)	(=I40)
Likeliest	$0	(=J40)
95%	$3,470,028	(=K40)



Assumption: Haul Route Construction/Loading Restriction **Cell: J28**

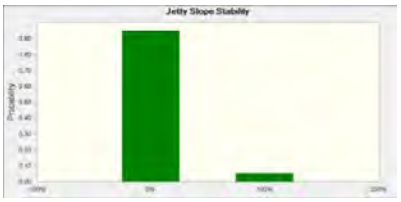
Triangular distribution with parameters:

5%	$0	(=I28)
Likeliest	$0	(=J28)
95%	$154,141	(=K28)

Assumption: Jetty Slope Stability **Cell: H17**

Yes-No distribution with parameters:

Probability of Yes(1)	0.05	(=H17)



Assumption: Jetty Slope Stability (J17) **Cell: J17**

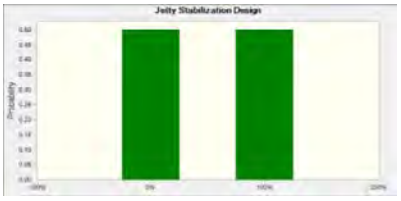
Uniform distribution with parameters:

Minimum	$0	(=I17)
Maximum	$3,577,045	(=K17)

Assumption: Jetty Stabilization Design **Cell: H18**

Yes-No distribution with parameters:

Probability of Yes(1)	0.5	(=H18)

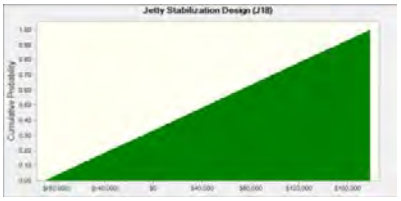


Assumption: Jetty Stabilization Design (J18) **Cell: J18**

Uniform distribution with parameters:

Minimum	$(89,426)	(=I18)
Maximum	$178,852	(=K18)

Assumption: Jetty Stabilization Design (J18) (cont'd) **Cell: J18**

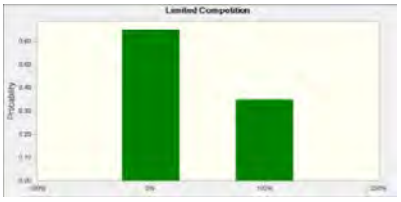


Correlated with:	Coefficient
Blasting May Be Required (J13) (J13)	0.75

Assumption: Limited Competition **Cell: H39**

Yes-No distribution with parameters:

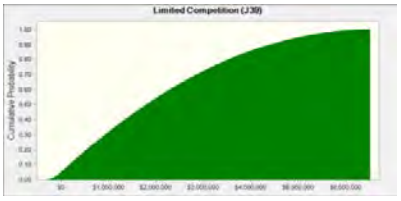
Probability of Yes(1)	0.35	(=H39)



Assumption: Limited Competition (J39) **Cell: J39**

Triangular distribution with parameters:

5%	$0	(=I39)
Likeliest	$0	(=J39)
95%	$5,023,330	(=K39)

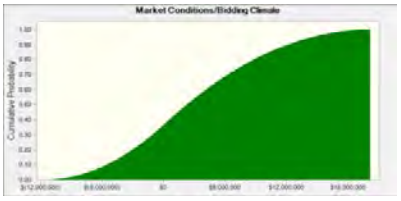


Correlated with:	Coefficient
Market Conditions/Bidding Climate (J38)	0.67

Assumption: Market Conditions/Bidding Climate **Cell: J38**

Triangular distribution with parameters:

5%	$(7,259,343)	(=I38)
Likeliest	$0	(=J38)
95%	$14,518,686	(=K38)

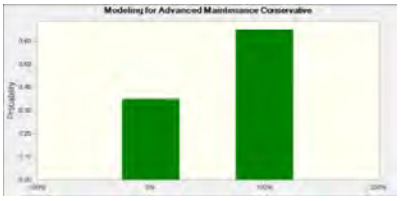


Correlated with:	Coefficient
Limited Competition (J39) (J39)	0.67

Assumption: Modeling for Advanced Maintenance Conservative **Cell: H15**

Yes-No distribution with parameters:

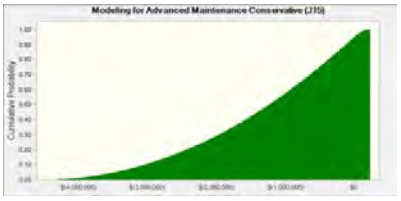
Probability of Yes(1)	0.65	(=H15)



Assumption: Modeling for Advanced Maintenance Conservative (J15) **Cell: J15**

Triangular distribution with parameters:

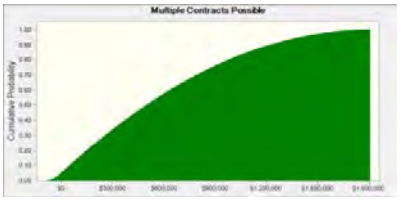
5%	$(3,453,802)	(=I15)
Likeliest	$0	(=J15)
95%	$0	(=K15)



Assumption: Multiple Contracts Possible **Cell: J11**

Triangular distribution with parameters:

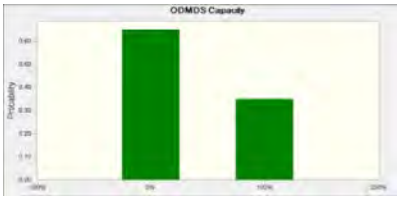
5%	$0	(=I11)
Likeliest	$0	(=J11)
95%	$1,394,609	(=K11)



Assumption: ODMDS Capacity **Cell: H22**

Yes-No distribution with parameters:

Probability of Yes(1)	0.35	(=H22)



Assumption: ODMDS Capacity (J22) **Cell: J22**

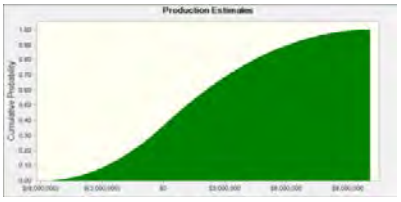
Triangular distribution with parameters:

5%	$0	(=I22)
Likeliest	$0	(=J22)
95%	$320,000	(=K22)

Assumption: Production Estimates **Cell: J33**

Triangular distribution with parameters:

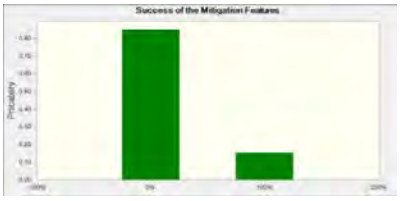
5%	$(3,629,672)	(=I33)
Likeliest	$0	(=J33)
95%	$7,259,343	(=K33)



Assumption: Success of the Mitigation Features **Cell: H24**

Yes-No distribution with parameters:

Probability of Yes(1)	0.15	(=H24)



Assumption: Success of the Mitigation Features (J24) **Cell: J24**

Uniform distribution with parameters:

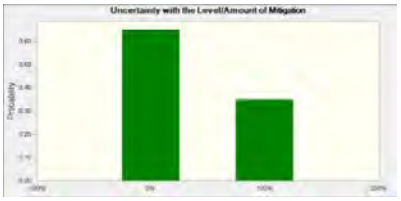
Minimum	$0	(=I24)
Maximum	$1,840,275	(=K24)

Assumption: Uncertainty with the Level/Amount of Mitigation **Cell: H23**

Yes-No distribution with parameters:

Probability of Yes(1)	0.35	(=H23)

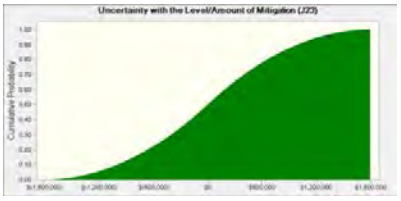
Assumption: Uncertainty with the Level/Amount of Mitigation (cont'd) **Cell: H23**



Assumption: Uncertainty with the Level/Amount of Mitigation (J23) **Cell: J23**

Triangular distribution with parameters:

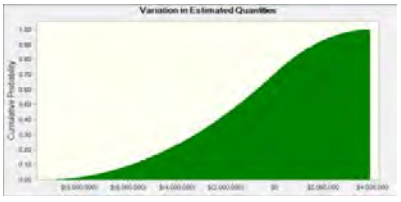
5%	$(1,226,850)	(=I23)
Likeliest	$0	(=J23)
95%	$1,226,850	(=K23)



Assumption: Variation in Estimated Quantities **Cell: J27**

Triangular distribution with parameters:

5%	$(6,896,376)	(=I27)
Likeliest	$0	(=J27)
95%	$2,298,816	(=K27)



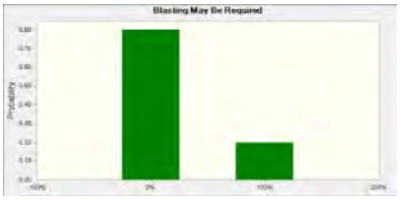
Worksheet: [SAJ_LakeWorthInlet-CSRA-REV3.xlsx]Schedule Risk Model

Assumption: Blasting May Be Required **Cell: H17**

Yes-No distribution with parameters:

Probability of Yes(1)	0.2	(=H17)

Assumption: Blasting May Be Required (cont'd) **Cell: H17**



Assumption: Blasting May Be Required (J17) **Cell: J17**

Uniform distribution with parameters:

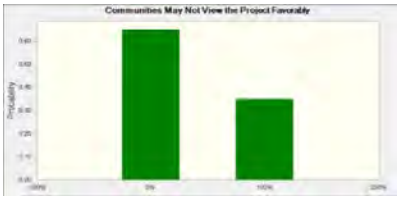
Minimum	0.0 Months	(=I17)
Maximum	12.0 Months	(=K17)

Correlated with:	Coefficient
Jetty Slope Stability (J20) (J20)	0.75

Assumption: Communities May Not View the Project Favorably **Cell: H38**

Yes-No distribution with parameters:

Probability of Yes(1)	0.35	(=H38)

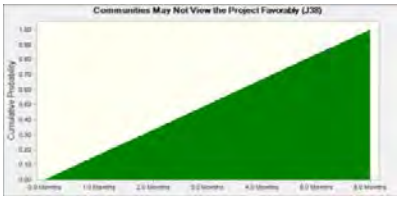


Assumption: Communities May Not View the Project Favorably (J38) **Cell: J38**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I38)
Maximum	6.0 Months	(=K38)

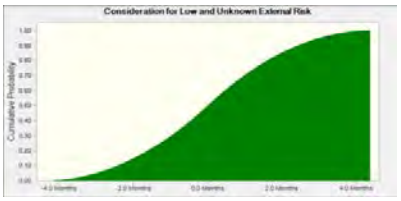
Assumption: Communities May Not View the Project Favorably (J38) (cont'd) **Cell: J38**



Assumption: Consideration for Low and Unknown External Risk **Cell: J40**

Triangular distribution with parameters:

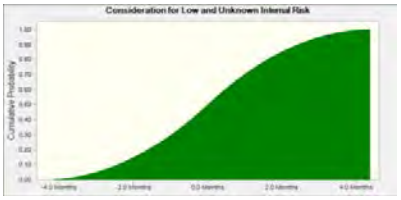
5%	-3.0 Months	(=I40)
Likeliest	0.0 Months	(=J40)
95%	3.0 Months	(=K40)



Assumption: Consideration for Low and Unknown Internal Risk **Cell: J35**

Triangular distribution with parameters:

5%	-3.0 Months	(=I35)
Likeliest	0.0 Months	(=J35)
95%	3.0 Months	(=K35)

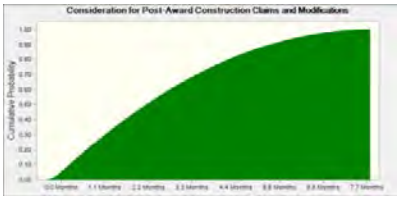


Assumption: Consideration for Post-Award Construction Claims and Modifications **Cell: J31**

Triangular distribution with parameters:

5%	0.0 Months	(=I31)
Likeliest	0.0 Months	(=J31)
95%	6.0 Months	(=K31)

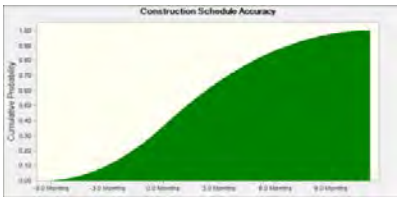
Assumption: Consideration for Post-Award Construction Claims and Modifications (cont'd **Cell: J31**



Assumption: Construction Schedule Accuracy **Cell: J30**

Triangular distribution with parameters:

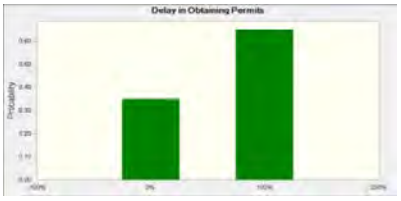
5%	-4.0 Months	(=I30)
Likeliest	0.0 Months	(=J30)
95%	8.0 Months	(=K30)



Assumption: Delay in Obtaining Permits **Cell: H24**

Yes-No distribution with parameters:

Probability of Yes(1)	0.65	(=H24)



Assumption: Delay in Obtaining Permits (J24) **Cell: J24**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I24)
Maximum	4.0 Months	(=K24)

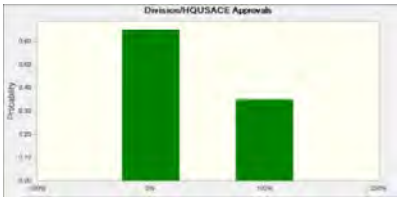
Assumption: Delay in Obtaining Permits (J24) (cont'd) **Cell: J24**

Correlated with:	Coefficient
ODMDS Capacity (J25) (J25)	0.75

Assumption: Division/HQUSACE Approvals **Cell: H10**

Yes-No distribution with parameters:

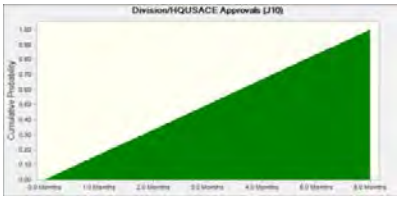
Probability of Yes(1)	0.35	(=H10)



Assumption: Division/HQUSACE Approvals (J10) **Cell: J10**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I10)
Maximum	6.0 Months	(=K10)



Assumption: Environmental Work Windows **Cell: J26**

Uniform distribution with parameters:

Minimum	-8.0 Months	(=I26)
Maximum	0.0 Months	(=K26)

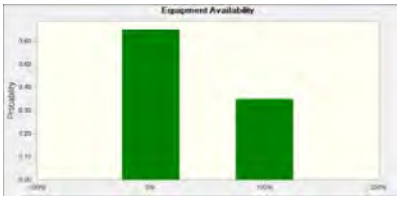
Assumption: Environmental Work Windows (cont'd) **Cell: J26**

Correlated with:	Coefficient
Material Testing (J27) (J27)	0.75

Assumption: Equipment Availability **Cell: H39**

Yes-No distribution with parameters:

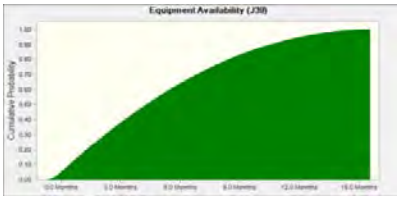
Probability of Yes(1)	0.35	(=H39)



Assumption: Equipment Availability (J39) **Cell: J39**

Triangular distribution with parameters:

5%	0.0 Months	(=I39)
Likeliest	0.0 Months	(=J39)
95%	12.0 Months	(=K39)

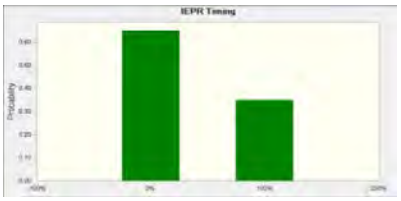


Assumption: IEPR Timing **Cell: H9**

Yes-No distribution with parameters:

Probability of Yes(1)	0.35	(=H9)

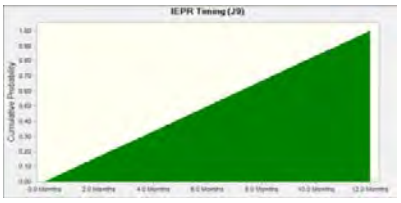
Assumption: IEPR Timing (cont'd) **Cell: H9**



Assumption: IEPR Timing (J9) **Cell: J9**

Uniform distribution with parameters:

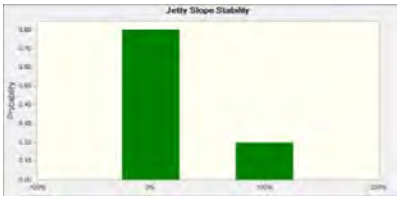
Minimum	0.0 Months	(=I9)
Maximum	12.0 Months	(=K9)



Assumption: Jetty Slope Stability **Cell: H20**

Yes-No distribution with parameters:

Probability of Yes(1)	0.2	(=H20)



Assumption: Jetty Slope Stability (J20) **Cell: J20**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I20)
Maximum	6.6 Months	(=K20)

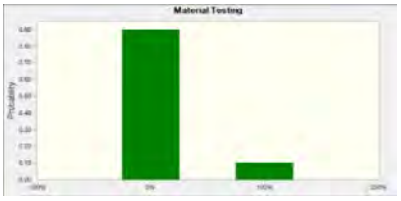
Assumption: Jetty Slope Stability (J20) (cont'd) **Cell: J20**

Correlated with:	Coefficient
Blasting May Be Required (J17) (J17)	0.75

Assumption: Material Testing **Cell: H27**

Yes-No distribution with parameters:

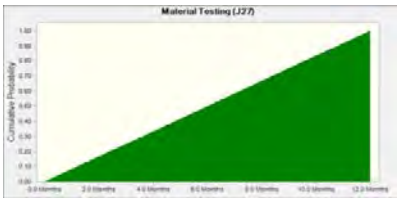
Probability of Yes(1)	0.1	(=H27)



Assumption: Material Testing (J27) **Cell: J27**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I27)
Maximum	12.0 Months	(=K27)



Correlated with:	Coefficient
Environmental Work Windows (J26)	0.75

Assumption: Multiple Contracts Possible **Cell: J14**

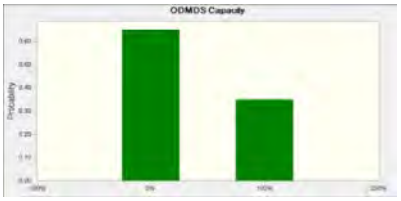
Triangular distribution with parameters:

5%	0.0 Months	(=I14)
Likeliest	0.0 Months	(=J14)
95%	3.0 Months	(=K14)

Assumption: ODMDS Capacity **Cell: H25**

Yes-No distribution with parameters:

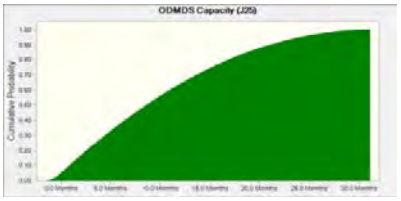
Probability of Yes(1)	0.35	(=H25)



Assumption: ODMDS Capacity (J25) **Cell: J25**

Triangular distribution with parameters:

5%	0.0 Months	(=I25)
Likeliest	0.0 Months	(=J25)
95%	24.0 Months	(=K25)

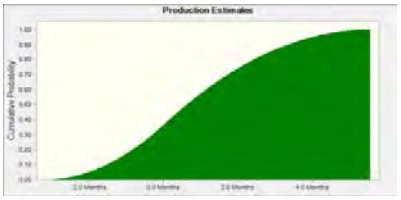


Correlated with:	Coefficient
Delay in Obtaining Permits (J24) (J24)	0.75

Assumption: Production Estimates **Cell: J33**

Triangular distribution with parameters:

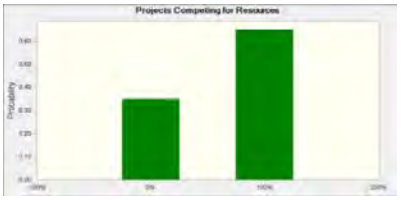
5%	-2.0 Months	(=I33)
Likeliest	0.0 Months	(=J33)
95%	4.0 Months	(=K33)



Assumption: Projects Competing for Resources **Cell: H11**

Yes-No distribution with parameters:

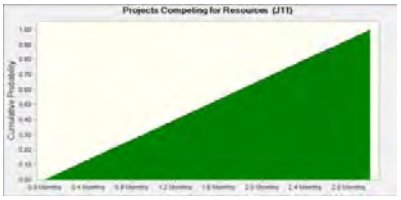
Probability of Yes(1)	0.65	(=H11)



Assumption: Projects Competing for Resources (J11) **Cell: J11**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I11)
Maximum	3.0 Months	(=K11)

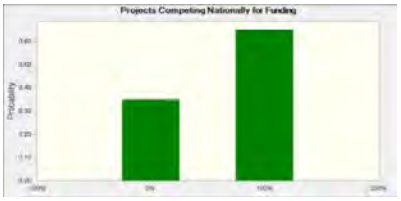


Assumption: Projects Competing Nationally for Funding **Cell: H12**

Yes-No distribution with parameters:

Probability of Yes(1)	0.65	(=H12)

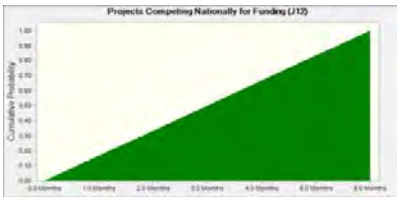
Assumption: Projects Competing Nationally for Funding (cont'd) **Cell: H12**



Assumption: Projects Competing Nationally for Funding (J12) **Cell: J12**

Uniform distribution with parameters:

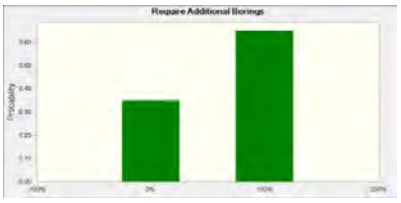
Minimum	0.0 Months	(=I12)
Maximum	6.0 Months	(=K12)



Assumption: Require Additional Borings **Cell: H16**

Yes-No distribution with parameters:

Probability of Yes(1)	0.65	(=H16)

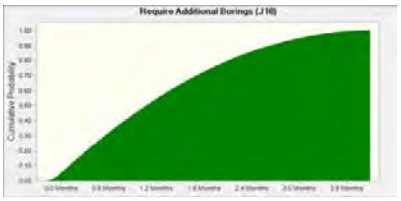


Assumption: Require Additional Borings (J16) **Cell: J16**

Triangular distribution with parameters:

5%	0.0 Months	(=I16)
Likeliest	0.0 Months	(=J16)
95%	3.0 Months	(=K16)

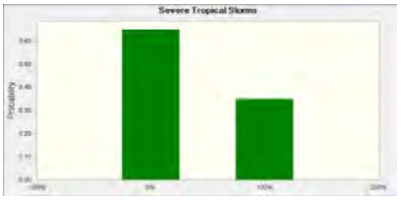
Assumption: Require Additional Borings (J16) (cont'd) **Cell: J16**



Assumption: Severe Tropical Storms **Cell: H37**

Yes-No distribution with parameters:

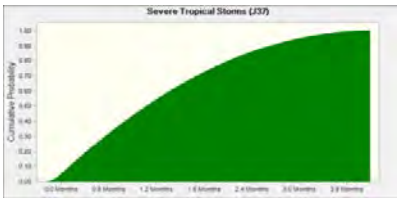
Probability of Yes(1)	0.35	(=H37)



Assumption: Severe Tropical Storms (J37) **Cell: J37**

Triangular distribution with parameters:

5%	0.0 Months	(=I37)
Likeliest	0.0 Months	(=J37)
95%	3.0 Months	(=K37)



Assumption: Variation in Estimated Quantities **Cell: J29**

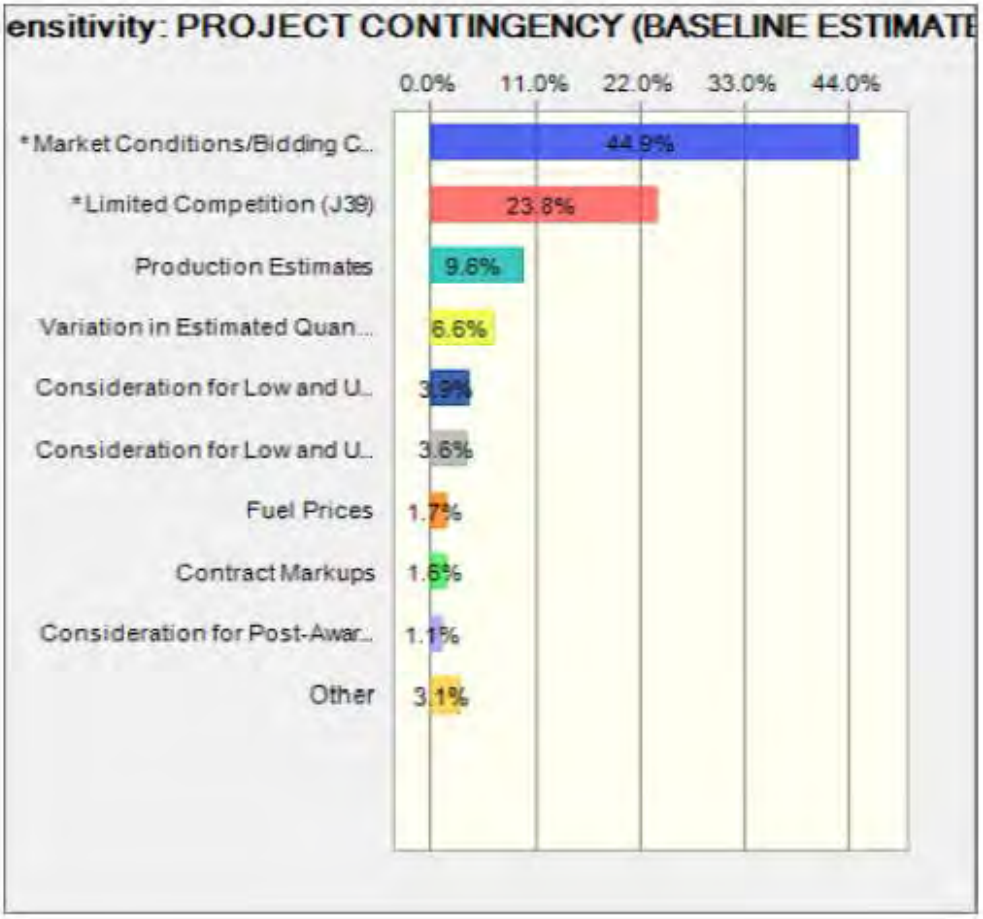
Triangular distribution with parameters:

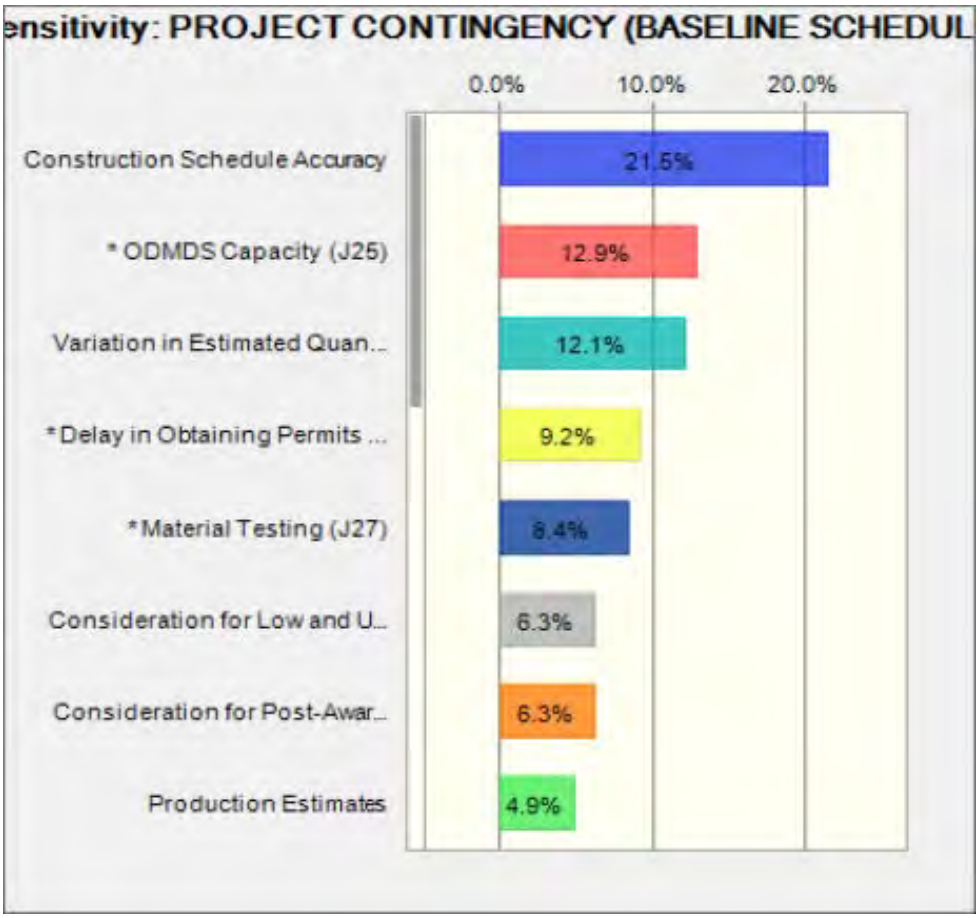
5%	-3.0 Months	(=I29)
Likeliest	0.0 Months	(=J29)
95%	6.0 Months	(=K29)

Assumption: Variation in Estimated Quantities (cont'd) **Cell: J29**

End of Assumptions

Sensitivity Charts





End of Sensitivity Charts

APPENDIX C

LAKE WORTH INLET

Palm Beach Harbor

Lake Worth Inlet Feasibility Study

Socio-Economic Appendix

Draft

April 2013

DRAFT

Table of Contents

1 Introduction 1

2 Background 2

2.1 General Study Area 4

2.1.1 Demographics 6

2.1.2 Local Economy 11

2.1.3 Hinterland Demand for Specific Goods 12

2.1.4 Hinterland Transit Connections 13

2.2 Existing Port Facilities 15

2.3 Multi-port Analysis 18

3 Existing Conditions 19

3.1 Historical and Existing Commodity Movements 19

3.2 Existing Vessel Fleet 23

4 Expected Future Conditions 25

4.1 Caveats of Growth Estimates and Projections 26

4.2 Future Commodity Movements 27

4.2.1 Fuel Oil and Diesel 28

4.2.2 Asphalt and Cement 30

4.2.3 Sugar and Molasses 37

4.2.4 Containerized Cargo 38

4.2.5 Non-Containerized General Cargo, Break Bulk and Specialty Shipments 38

4.2.6 Cruise Passengers 39

4.3 Future With- and Without-Project Vessel Movements 40

4.3.1 Design Vessel 42

4.3.2 Residual Fuel Oil and Diesel 43

4.3.3 Asphalt and Cement 44

4.3.4 Sugar and Molasses 44

4.3.5 Containerized Cargo 44

DRAFT

4.3.6 Non-Containerized General Cargo and Specialty Shipments 45
4.3.7 Cruise Passengers 45
4.3.8 Future Without- and With-Project Vessel Size Comparison Summary 46
5 National Economic Development Benefits 46
5.1 Economic Model Setup and Inputs 46
5.1.1 Methods and Key Assumptions 46
5.1.2 Vessel Operating Costs 48
5.1.3 Routes 49
5.2 Economic Modeling Results and Plan Selection 51
5.2.1 Annual Cost Savings for Intermediate Array of Alternatives 54
5.2.2 Annual Cost Savings for Final Array of Alternatives 55
5.2.3 Annual Cost Savings for the Recommended Plan 56
5.2.4 Cost Savings by Commodity 58
6 Advanced Maintenance and Life-cycle Cost Analysis 59
7 Sensitivity Analysis 61
7.1 Alternative Cement Growth Scenarios 61
7.2 Reduced Overall Growth Sensitivity Scenarios 63
7.2.1 No Growth after 20 Years 63
7.2.2 No Growth after Base Year 64
7.2.3 Existing Traffic with No Growth 65
7.2.4 7% Discount Rate 65
8 Regional Economic Development Benefits 66

List of Tables

Table 1. Summary of Pilots' Rules for Without-Project Conditions 4
Table 2. Population of Selected Florida Counties and Census County Divisions within Coastal South Florida 5
Table 3. Historical Population Growth Statistics for Select South Florida Counties 7
Table 4. Population Breakdown by Race and Ethnicity for Select South Florida Counties 8
Table 5. Employment as a Percentage of State Employment for Select South Florida Counties 11
Table 6. Employment by Industry for Three Major South Florida Counties 12
Table 7. Historical Total Tonnages for Port of Palm Beach and Annual Growth Rates 19

DRAFT

Table 8. Major Bulk Commodity Tonnages 1995-2010 20
Table 9. Long-term Growth Trends for Total Cargo and Total Cargo less Fuel Oil over 10 year and 14 year periods 21
Table 10. Annual Vessel Movements 23
Table 11. Vessel Movements by Draft 24
Table 12. Existing Fleet Vessel Characteristics by Vessel Type (2007-2009) 24
Table 13. Average Loaded Sailing Draft as a Percent of Design Draft by Vessel Type 25
Table 14. Palm Beach County and Surrounding County Population Projections 26
Table 15. Future Commodity Movement Forecasts for Port of Palm Beach (2017-2067) 27
Table 16. Annual Bulk Cement Cargo Tons through Port of Palm Beach 32
Table 17. Cement Throughput and Growth Rates through Port of Palm Beach, FL 32
Table 18. Historical Population Growth Rates 33
Table 19. Historical Residential Building Permits in South Florida Hinterland 33
Table 20. Historical Privately-owned Residential Building Permits for Select South Florida Counties by Year (1990-2009) 34
Table 21. Summary Description of Projection Methods for Cement 35
Table 22. Detailed Projected Import Tonnage of Cement Products through Port of Palm Beach 36
Table 23. Bahamas Celebration Cruise Passenger Statistics by Month in 2010 39
Table 24. Vessel Movements by Vessel Type and Class for Without Project 41
Table 25. Vessel Movements by Vessel Type and Class for 39FT Project 42
Table 26. Design Vessels Used for Ship Simulation 43
Table 27. Route Groups with Distances from HarborSym Inputs 49
Table 28. Intermediate Array of Alternatives Total Present-Value and Average Annual Benefits 54
Table 29. Intermediate Array of Alternatives Total and Average Annual Project Cost 55
Table 30. Summary of Intermediate Array of Alternatives Net Benefits and Benefit-Cost Ratios 55
Table 31. Final Array of Alternatives Total Present-Value and Average Annual Benefits 56
Table 32. Final Array of Alternatives Total and Average Annual Project Cost 56
Table 33. Summary of Final Array of Alternatives Net Benefits and Benefit-Cost Ratios 56
Table 34. Summary of Final Array of Alternatives Net Benefits and Benefit-Cost Ratios including Advanced Maintenance 57
Table 35. Summary of Recommended Plan Net Benefits and Benefit-cost Ratio without Advanced Maintenance 57
Table 36. Summary of Recommended Plan Net Benefits and Benefit-cost Ratio including Advanced Maintenance 58
Table 37. Summary of Benefits by Commodity 59

DRAFT

Table 38. Cost Comparison for Additional Advanced Maintenance Features 60
Table 39. Summary of Additional Advanced Maintenance Cost Savings 61
Table 40. Summary of Scenario 1 Cement Growth Sensitivity Analysis Net Benefits without Advanced Maintenance 63
Table 41. Summary of Scenario 1 Cement Growth Sensitivity Analysis Net Benefits including Advanced Maintenance 63
Table 42. Summary of No Growth after 20 Years Sensitivity Analysis Net Benefits without Advanced Maintenance 64
Table 43. Summary of No Growth after 20 Years Sensitivity Analysis Net Benefits including Advanced Maintenance 64
Table 44. Summary of No Growth after Base Year Sensitivity Analysis Net Benefits without Advanced Maintenance 64
Table 45. Summary of No Growth after Base Year Sensitivity Analysis Net Benefits including Advance Maintenance 65
Table 46. Summary of Existing Traffic with No Growth Sensitivity Analysis Net Benefits 65
Table 47. Benefit Cost Ratio and Net Benefits at 7% Discount Rate 66
Table 48. Regional Economic Development Job Impact Multipliers 67
Table 49. Regional Economic Development Job Impacts from Project Construction Expenditures 67

List of Figures

Figure 1. Project Location Map 1
Figure 2. Detailed Project Area and Immediate Surrounding Towns Map 2
Figure 3. Lake Worth Inlet Authorized Project Map and Surrounding Area Features 3
Figure 4. Map of Lake Worth Inlet Surrounding Cities and Towns in Palm Beach County, Florida 5
Figure 5. Florida Counties Map 6
Figure 6. Palm Beach County Area Median Age by Census Tract 9
Figure 7. Palm Beach County Area Median Household Income by Census Tract 9
Figure 8. South Florida Median Age by County 10
Figure 9. South Florida Median Household Income by County 10
Figure 10. Florida Counties and Hinterland of Port of Palm Beach 13
Figure 11. South Florida Major Roadways 14
Figure 12. South Florida Inland Movement of Maritime Cargo by Truck 15
Figure 13. Port of Palm Beach Existing Facilities and Berth Configuration 16
Figure 14. South Atlantic U.S. Ports Total Tonnage 18

DRAFT

Figure 15. Annual Major Bulk Cargo Tons (1996-2009) 20
Figure 16. Annual Cargo Tonnage less Fuel Oil 21
Figure 17. Comparison of Tonnage and Vessel Calls by Commodity Type 22
Figure 18. Example Graph of Differences between Estimated and Actual Growth 26
Figure 19. Port of Palm Beach Future Commodity Growth Projections 28
Figure 20. Ratio of low-sulfur light crude oil price to Henry Hub natural gas price on an energy equivalent basis, 1990-2035 29
Figure 21. Primary energy use by end-use sector, 2008-2035 (quadrillion Btu) 29
Figure 22. Residential Construction Expenditures: Historical and Projected 30
Figure 23. US Cement Production, Imports, and Consumption 31
Figure 24. Cement Imports through Port of Palm Beach, with Trend Lines 32
Figure 25. Cement Imports through South Florida Ports and South Florida Residential Building Permits (1996-2007) 35
Figure 26. Graph of Projected Import Tonnage of Cement Products through Port of Palm Beach 36
Figure 27. Calculations for Projected Cement Growth based on Historical Ratio of Residential Construction to Population Growth 37
Figure 28. U.S. Sugar Production, Use and Imports (1990-2019) 38
Figure 29. Recommended Plan Widening Features 53

DRAFT

1 Introduction

Palm Beach Harbor is a deep-draft harbor located in Palm Beach County, on the lower Atlantic coast of Florida. The closest major ports to Palm Beach Harbor are Port Everglades, in Ft. Lauderdale, and Miami Harbor, approximately 40 miles and 65 miles to the south, respectively (Figure 1). Canaveral Harbor is approximately 90 miles to the north.

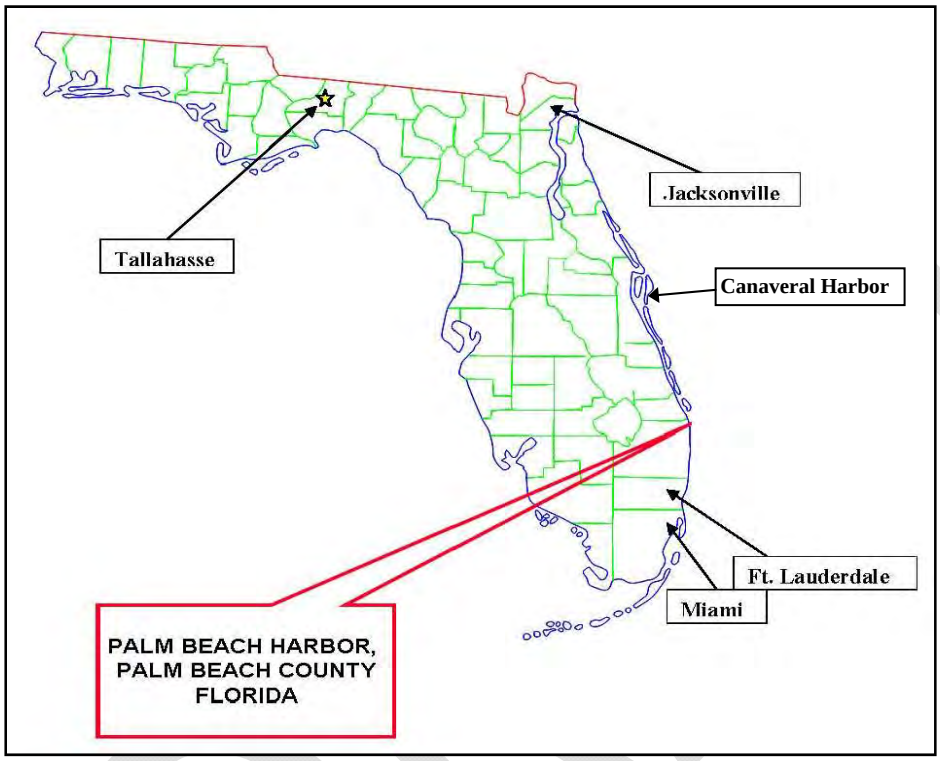


Figure 1. Project Location Map

The harbor entrance (known officially as Lake Worth Inlet) is an artificial cut through the barrier beach connecting Lake Worth, a coastal lagoon, with the Atlantic Ocean. The Atlantic Intracoastal Waterway passes through Lake Worth as well. Lake Worth Inlet contains a Federally-authorized channel, turning basin, and associated features which support a deepwater port, the Port of Palm Beach.

Communities bordering Palm Beach Harbor are Palm Beach Shores on the barrier island, Singer Island, to the north, Riviera Beach on the west shore of Lake Worth, and the town of Palm Beach on the barrier island to the south (Figure 2). West Palm Beach is located immediately south of Riviera Beach and is the largest community in the area.

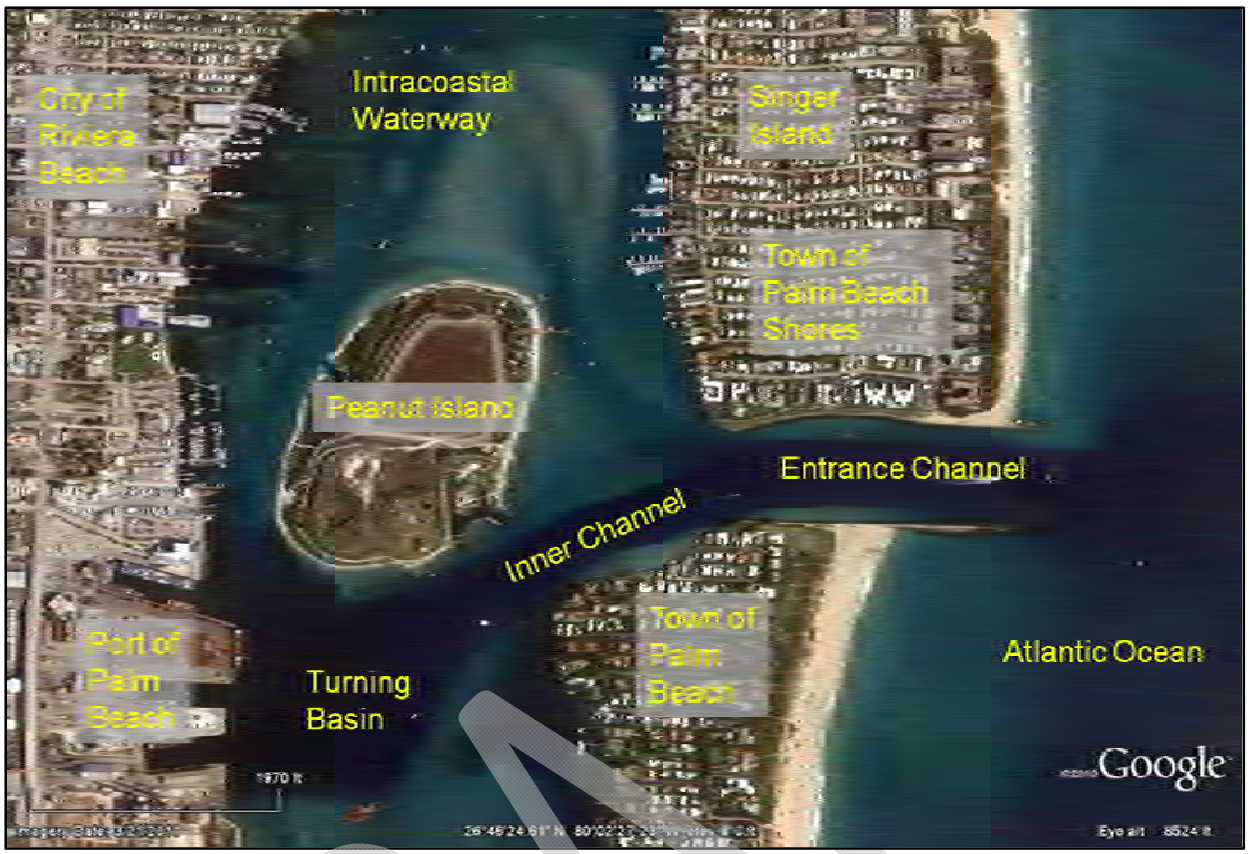


Figure 2. Detailed Project Area and Immediate Surrounding Towns Map

The existing Federal project at Palm Beach Harbor authorizes the maintenance of the inner channel and turning basin to a depth of 33 FT mean lower low water (MLLW). This feasibility study is evaluating the economic benefits of widening and deepening the existing channel and turning basin. To quantify these benefits, a computer simulation model called HarborSym[1] was used to model and simulate vessel traffic in the harbor over varying project conditions.

2 Background

The Port of Palm Beach is a niche port, meaning, a relatively small number of commodities make up a large portion of the total tonnage that transits through the port. For example, cement and concrete, molasses, sugar, and petroleum products represented only 10.1% of vessel calls in 2007. However, these same four commodity groups accounted for 59.7% of total tonnage that year. Niche ports also specialize in a particular cargo or market segment. In the case of Palm Beach, the Port is also home to an overnight cruise service to the Bahamas, a day-cruise that sails twice daily, and a containership operator that services the Caribbean islands on small container vessels. Palm Beach is also a niche port because of the specialized equipment for handling sugar and molasses, which no other port in South Florida can accommodate. Finally, the Port of Palm Beach has embraced its “niche port” status by further investing in assets suited to its target customers of smaller cargo and cruise operators.

[1] HarborSym Deepening Model, version 1.4.8, U.S. Army Corps of Engineers

The existing federal project (Figure 3) has a configuration that limits the maximum vessel draft, due to the authorized project depth of 33 FT, and vessel length, due to a sharp turn from the channel entrance into Lake Worth. Both of these limitations cause corresponding sailing restrictions, imposed by the Palm Beach Harbor Pilots Association, who pilot all foreign-flagged vessels and all deep-draft U.S.-flagged vessels transiting the harbor.

Figure 3. Lake Worth Inlet Authorized Project Map and Surrounding Area Features

The harbor pilots' existing restrictions are summarized in Table 1. These rules show that as cargo vessels increase in size, they face greater restrictions in terms of tide and current conditions, draft restrictions, and use of tugs, which means that the vessel will have less available time to transit through the harbor, and/or the entire voyage will be more costly. Additionally, large vessels may be forced to call light-loaded to either avoid restrictions or to even transit the harbor at all. All of these constraints increase total transportation costs. Therefore, this appendix is examining the economic benefits from transportation cost savings due to a wider and deeper navigation channel.

DRAFT

Table 1. Summary of Pilots' Rules for Without-Project Conditions

Rule #	Rule Description	Ship Types/Classes Affected	Applicable Condition	Tide Dependent?	Current Dependent?
1	One Way Traffic Only: No Passing, No Overtaking	All Vessels	Always	N	N
2	>= 600' LOA: Daylight Inbound Transit Only	All Single-screw Vessels >= 600' LOA	Daylight	N	N
3	>30' Sailing Draft: Restricted to High Slack Water (+/-0.5hrs); Daylight Inbound Transit Only	All Single-screw Vessels >30' Sailing Draft	Always/ Daylight	Y	Y
4	3rd Tug MAY be Req'd for ships >=600' LOA and >=28' Draft	All Single-Screw Vessels meeting dimension criteria	Always	N	N
5	3rd tug MAY be req'd for ships >=550' LOA and >30' draft OR >=85' beam and >30' draft	All Inbound Single-Screw Vessels meeting dimension criteria	Always	N	N
6	Petroleum-carrying vessels restricted to slack water only (+/-0.5hrs); daylight transit only	All Petroleum-carrying Tankers and Barges	Daylight	N	Y
7	Inbound Petroleum-carrying vessels restricted to 32'0" max sailing draft in high slack water, and 29'0" in low slack water	All Inbound Petroleum-carrying Tankers and Barges	Always	N	N
8	Large Cruise vessel restricted to slack-water (<2kts) transit when winds >=30 knots, and local tug may be required	Cruise - Bahamas Celebration	Always	N	Y
9	Safety Distance: 1/4 Mile fore and aft of all vessels	All Vessels	Always	N	N
10	33' 0" Max Sailing Draft at High Slack Water; 30' 0" Max Sailing Draft at low slack water	All (non-petroleum-carrying) Vessels	Always	Y	Y

Source: Palm Beach Harbor Pilots Association

2.1 General Study Area

While the footprint of the project is contained within Palm Beach Harbor, the surrounding area that will be most directly affected economically by the project includes a majority of Palm Beach County. Figure 4, below, shows the nearby cities within Palm Beach County. All labeled Florida counties are shown in Figure 5.

DRAFT

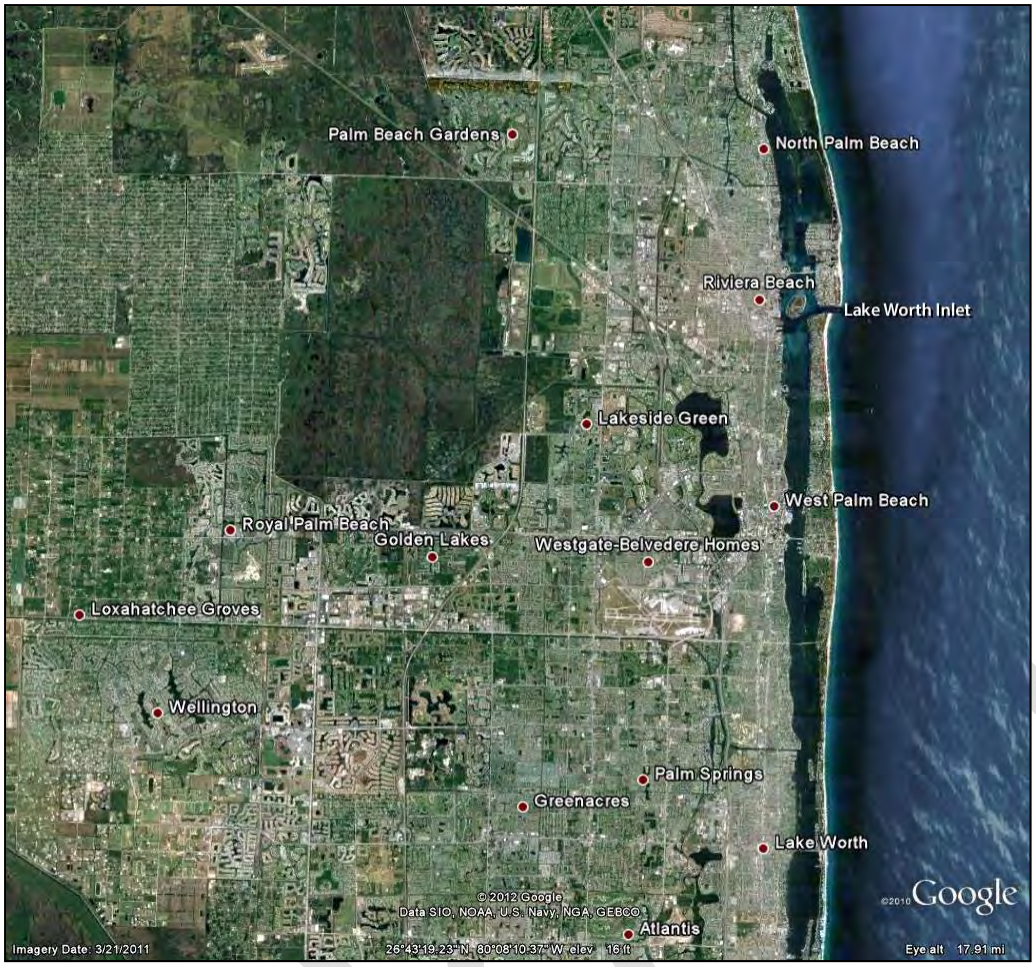


Figure 4. Map of Lake Worth Inlet Surrounding Cities and Towns in Palm Beach County, Florida

The level of hinterland population is an important factor in determining demand for consumption of goods that transit through the port. West Palm Beach has the greatest population in the immediate area, (Table 2), followed by the town of Lake Worth, further to the south. The rest of the most populous coastal South Florida counties, Broward and Miami-Dade, which are home to the cities of Ft. Lauderdale and Miami respectively, are even more heavily-populated metropolitan areas than Palm Beach County.

Table 2. Population of Selected Florida Counties and Census County Divisions within Coastal South Florida

Area	Population (2010)
Florida	18,801,310
Palm Beach County	1,320,134
West Palm Beach CCD	142,518
Riviera Beach CCD	101,148
Lake Worth CCD	207,482
Royal Palm Beach-West Jupiter CCD	103,335
Broward County	1,748,066
Ft. Lauderdale CCD	282,219
Miami-Dade County	2,496,435
Miami	908,839

Source: U.S. Census Bureau, 2010 Note: CCD = Census County Division

Figure 5. Florida Counties Map
Source: U.S. Census Bureau

2.1.1 Demographics

Population growth in the area has been rapid since 1950 (Table 3). This growth can be attributed to Florida's ideal climate and historically low property costs. Over the last 60 years Palm Beach County population increased from 114,688 to 1,320,134, an increase of over 1000%. Due to a more established community, Miami-Dade County achieved less growth than Palm Beach County, or the State as a whole. As seen in Table 3, Florida grew over 500% in the 60-year span. For the nine-county region shown, population statistics for the past sixty years are presented in Table 3.

Table 3. Historical Population Growth Statistics for Select South Florida Counties

Area	2010		2000		1990		1980		1970		1960		1950	
Florida	18,801,310		15,982,378		12,937,926		9,746,324		6,789,443		4,951,560		2,771,305	
	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%
Glades	12,884	0.2%	10,576	0.2%	7,591	0.2%	5,992	0.2%	3,669	0.1%	2,950	0.2%	2,199	0.3%
Hendry	39,140	0.7%	36,210	0.6%	25,773	0.6%	18,599	0.5%	11,859	0.5%	8,119	0.5%	6,051	0.8%
Lee	618,754	10.8%	440,888	7.7%	335,113	7.2%	205,266	5.7%	105,216	4.3%	54,539	3.3%	23,404	3.1%
Martin	146,318	2.6%	126,731	2.2%	100,900	2.2%	64,014	1.8%	28,035	1.1%	16,932	1.0%	7,807	1.0%
Miami-Dade	2,496,435	43.5%	2,253,362	39.3%	1,937,094	41.8%	1,625,781	45.2%	1,267,792	51.8%	935,047	57.2%	495,084	64.6%
Monroe	73,090	1.3%	79,589	1.4%	78,024	1.7%	63,188	1.8%	52,586	2.1%	47,921	2.9%	29,957	3.9%
Broward	1,748,066	30.5%	1,623,018	28.3%	1,255,488	27.1%	1,018,200	28.3%	620,100	25.3%	333,946	20.4%	83,933	10.9%
Okeechobee	39,996	0.7%	35,910	0.6%	29,627	0.6%	20,264	0.6%	11,233	0.5%	6,424	0.4%	3,454	0.5%
Palm Beach	1,320,134	23.0%	1,131,184	19.7%	863,518	18.6%	576,863	16.0%	348,753	14.2%	228,106	14.0%	114,688	15.0%
County SubTotal	6,494,817	40.6%	5,737,468	35.9%	4,633,128	35.8%	3,598,167	36.9%	2,449,243	36.1%	1,633,984	33.0%	766,577	27.7%

Source: U.S. Census Bureau

As a subset of Florida population, the summed total of these nine counties comprises a slowly increasing percentage of the Florida population over most of the period. Even though the populations of the counties have been increasing in absolute numbers, their share of Florida's population did not change substantially over the period from 1970-2000. From 2000 to 2010, the regional share of Florida population resumed increased at its fastest pace to its highest percentage ever, 40.6%.

Additionally, the proportional share of the population inside the nine country area has changed over the fifty year time period. Miami-Dade County's share of the nine-county population total population has declined from nearly 65% in 1950 to 43.5% in 2010. In contrast, Broward County's and Lee County's share of the regional total has increased nearly three-fold over the sixty-year period. Palm Beach County's share of the nine-county population has increased 8% over the last fifty years (over a 50% increase in share). While each county has seen an increase in its total population, the most rapid growth in population has been concentrated in Palm Beach, Broward, Martin, and Lee counties.

DRAFT

Of the total population of Florida, approximately 17% classify themselves as African Americans while 22.5% classify their heritage as Hispanic or Latino (Table 4). In the nine-county region, the populations of Miami-Dade and Broward counties contained some 49% of the Florida Latino population and some 31% of the Florida African American population. As a percentage, Hendry County' Latino population was almost double that of the Florida state average but the county has a significantly smaller total population when compared to Miami-Dade and Broward counties. Palm Beach County race and ethnicity percentages are the most similar to the state levels of the counties shown.

Table 4. Population Breakdown by Race and Ethnicity for Select South Florida Counties

County	White	African-American	Other	Total	Hispanic or Latino (of any race)
Florida	77.1%	17.0%	5.9%	100%	22.5%
Glades	72.4%	12.7%	14.9%	100%	21.1%
Hendry	62.1%	14.0%	23.9%	100%	49.2%
Lee	84.8%	9.1%	6.1%	100%	18.3%
Martin	88.6%	5.9%	5.5%	100%	12.2%
Miami-Dade	75.6%	19.9%	4.5%	100%	65.0%
Monroe	91.1%	6.3%	2.6%	100%	20.6%
Okeechobee	79.2%	8.6%	12.2%	100%	23.9%
Palm Beach	75.2%	18.3%	6.5%	100%	19.0%
Broward	65.1%	28.2%	6.7%	100%	25.1%

Source: U.S. Census Bureau, 2010

In the immediate project area, large differences in age from one census tract to another are clearly shown in Figure 6. The barrier islands and western suburbs have a relatively older population, while the more urban areas of Riviera Beach, West Palm Beach, and Lake Worth have a relatively younger population. Few areas shown are close to the national average, and most are highly polarized towards a younger or older population. This polarization is especially evident in the areas closest to the project.

Comparing median household incomes in the same area (Figure 7) shows a similar pattern to the polarization in median ages between census tracts. A notable exception is that the western suburban areas exhibit higher household incomes, while also having a relatively lower median age. Otherwise, with a few exceptions, there is a clear pattern of relatively younger areas having lower household incomes, especially in the areas closest to the project.

A similar pattern of median household income increasing with median age is exhibited across the three most populous counties in coastal South Florida. When median age is viewed at the county level (Figure 8), median age increases from Miami-Dade County to Broward County to Palm Beach County, and even further north to Martin County. Median household income also increases from Miami-Dade County northward (Figure 9). Palm Beach County has the highest median age and household income of the three most populous counties in coastal South Florida

DRAFT

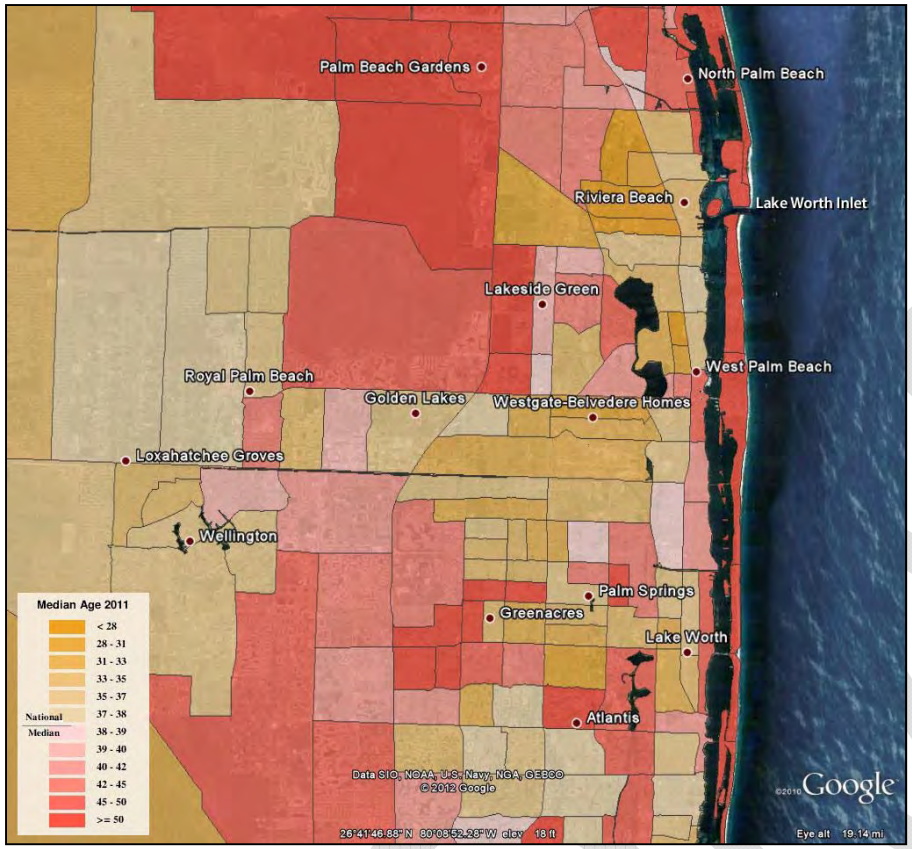


Figure 6. Palm Beach County Area Median Age by Census Tract
Source: The Nielsen Company, 2011

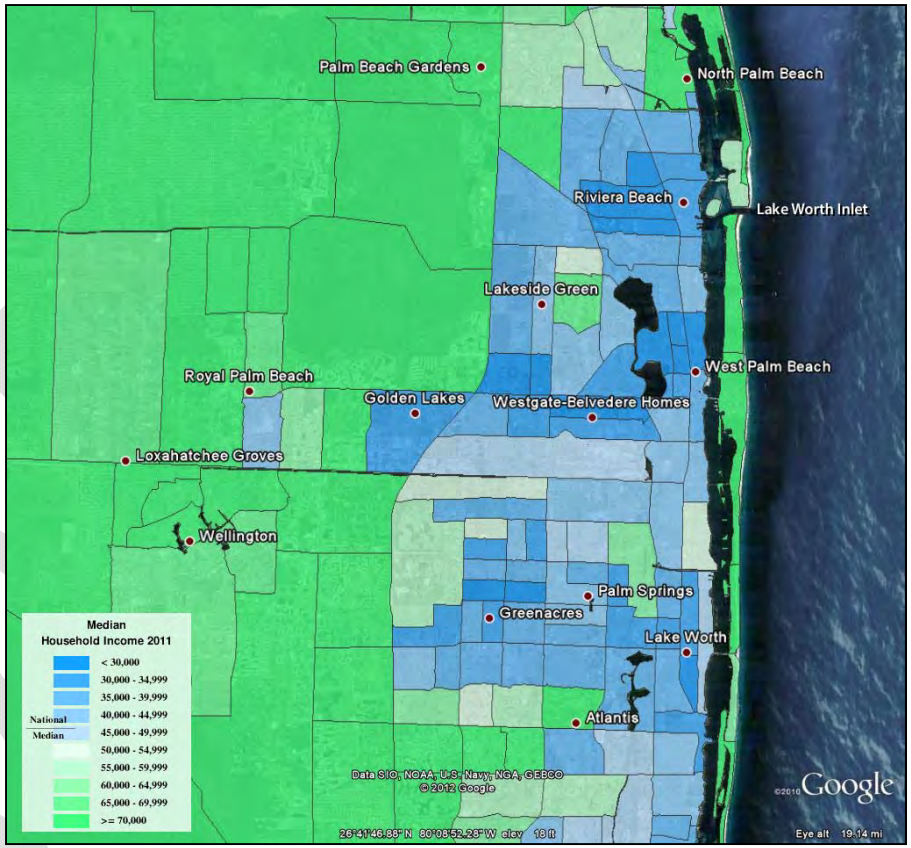


Figure 7. Palm Beach County Area Median Household Income by Census Tract
Source: The Nielsen Company, 2011

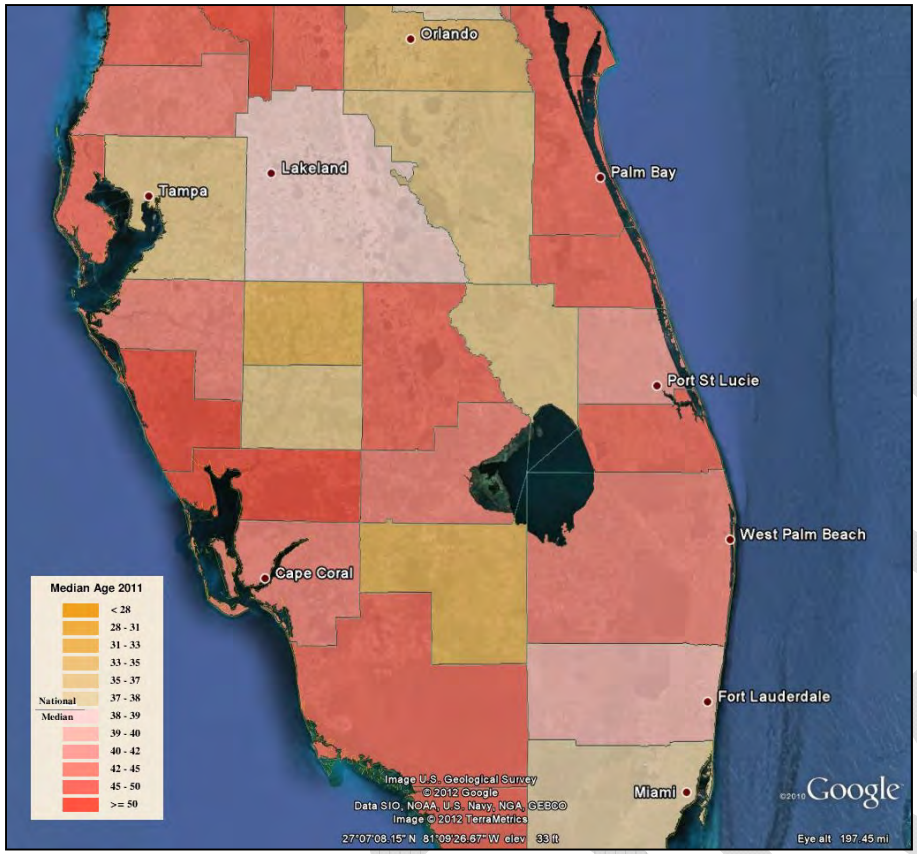


Figure 8. South Florida Median Age by County
Source: The Nielsen Company, 2011

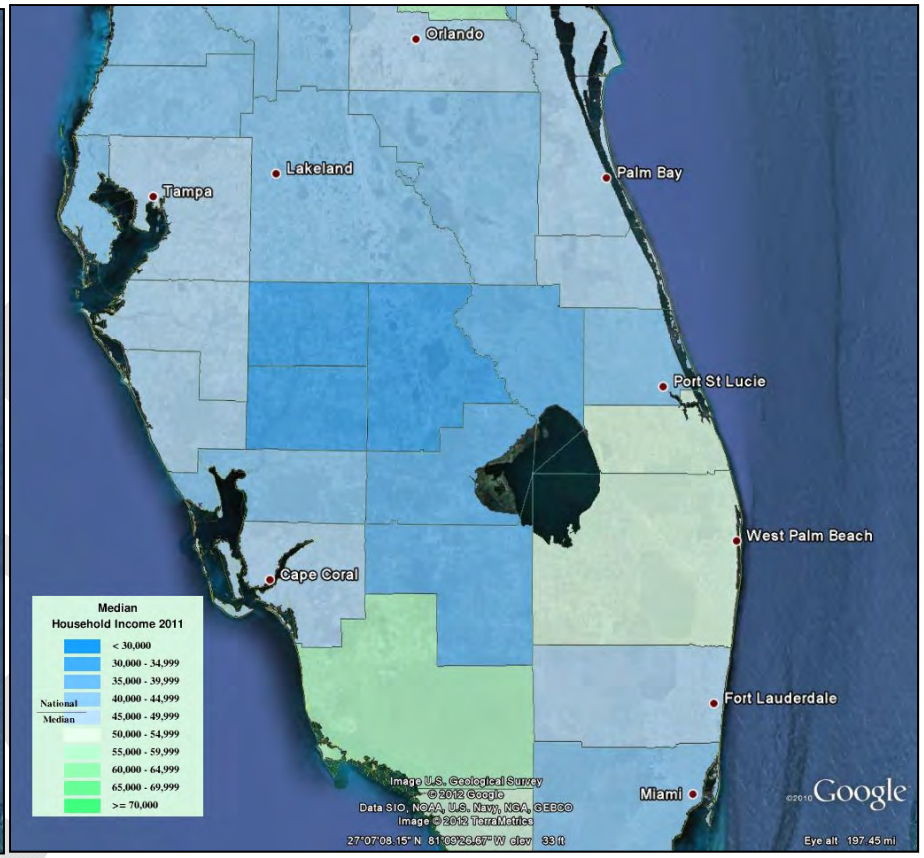


Figure 9. South Florida Median Household Income by County
Source: The Nielsen Company, 2011

2.1.2 Local Economy

Generally, tourism, strong wholesale and retail trade, government and service sectors characterize Florida's economy. Florida's warm weather and extensive coastline attracts vacationers and other visitors and helps make the state a significant retirement destination for people all over the country. Agricultural production is also an important sector of the state's economy, and is especially significant to portions of the study area. Compared to the national economy, the manufacturing sector has played less of a role in Florida, but high technology manufacturing has begun to emerge as a significant sector in the State over the last decade.

Of the nine counties shown in Table 5, the three largest, Broward, Miami-Dade and Palm Beach employ approximately 35% of Florida's work force and account for approximately 33% of state income. Table 6 indicates the importance of relatively low paying employment in the three counties of greatest economic impact. The results coincide with state averages across employment sectors and reflect the relative importance of industries related to tourism (retail, food service), the aged populations of South Florida (health care) and the growth experienced in Florida (construction).

Table 5. Employment as a Percentage of State Employment for Select South Florida Counties

County	Number of Wage & Salary Employees	Annual Wage & Salary Disbursements ($1,000)	Employee Percentage	Annual Salary Percentage
Florida	7,632,084	323,659,342	100%	100%
Glades	1,938	66,153	0.03%	0.02%
Hendry	14,224	418,654	0.19%	0.13%
Lee	208,538	8,238,828	2.73%	2.55%
Martin	59,631	2,378,068	0.78%	0.73%
Miami-Dade	1,038,010	48,445,712	13.60%	14.97%
Monroe	37,959	1,513,204	0.50%	0.47%
Okeechobee	11,016	364,625	0.14%	0.11%
Palm Beach	542,388	25,182,540	7.11%	7.78%
Broward	745,587	33,403,592	9.77%	10.32%
Select Counties Subtotal	2,659,291	120,011,376	35%	37%

Source: U.S. Bureau of Economic Analysis, 2010

DRAFT

Table 6. Employment by Industry for Three Major South Florida Counties

Industry	Broward County	Miami-Dade County	Palm Beach County	Three-County Total	Percentage of Employment by Industry
Health Care & Education	171,463	217,787	123,750	513,000	21%
Retail Trade	112,360	130,845	81,326	324,531	13%
Professional & Administration	108,344	134,619	81,209	324,172	13%
Food Service & Hospitality	86,607	112,057	63,721	262,385	11%
Construction	49,957	74,255	39,760	163,972	7%
Manufacturing	40,905	54,937	22,709	118,551	5%
Major Industry Sub-Total	398,173	506,713	288,725	1,193,611	48%
Total	826,452	1,075,625	577,572	2,479,649	100%

Source: 2010 U.S. Census Bureau American Community Survey.

2.1.3 Hinterland Demand for Specific Goods

The hinterland of the Port of Palm Beach for construction materials (cement and asphalt) includes undeveloped land north and west of the Port in Palm Beach and Martin counties. The proximity of the Port is also close to other high growth areas in Florida such as Indian River, Osceola, and Orange Counties, which are home to the cities of Vero Beach, Kissimmee, and Orlando, respectively. In 2010, the U.S. Census Bureau estimated the Orlando-Kissimmee Metropolitan Statistical Area to have over 2.1 million people. Future population projections for surrounding counties are shown in Table 14 in Section 4. One Port tenant that imports asphalt owns a subsidiary construction company that does business all over south Florida, and up to the Orlando metropolitan area. The Port is also in close proximity to highly-populated Broward and Miami-Dade counties. Figure 10, below, shows the spatial relationship of Palm Beach County to its neighboring hinterland counties.

DRAFT

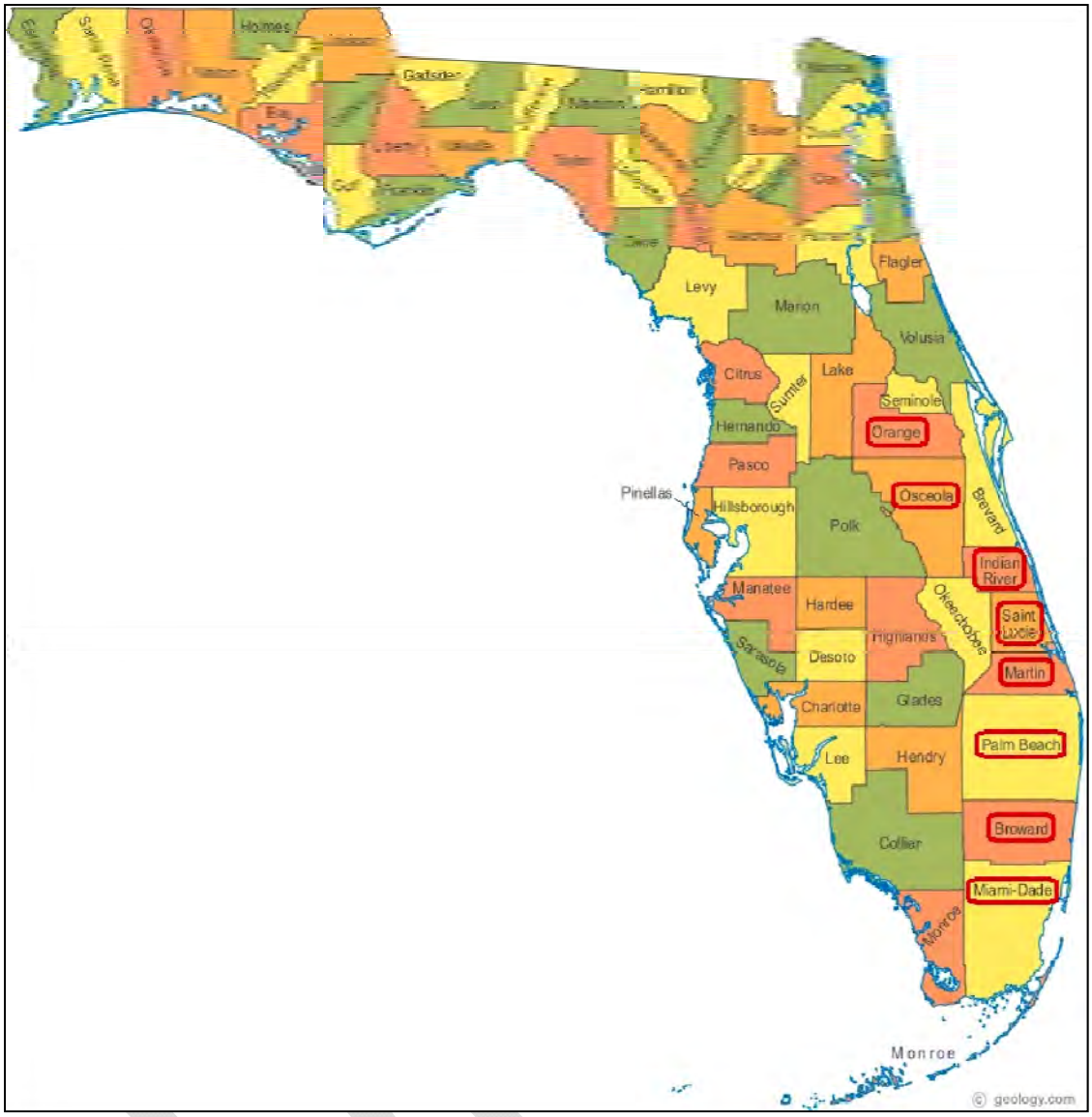


Figure 10. Florida Counties and Hinterland of Port of Palm Beach
Background Image Source: Geology.com; Note: Port of Palm Beach Hinterland County names are circled in red.

2.1.4 Hinterland Transit Connections

Compared to Port Everglades and Port of Miami the Port of Palm Beach has similar access to road connections. Major highway corridors of Interstate-95 and Florida's Turnpike run north and south through the county (Figure 11). Florida East Coast (FEC) and CSX rail lines both service the Port and immediate surrounding area, as well as other parts of Florida and link with the national rail network. The Port of Palm Beach is the only South Florida port to have on-dock rail access as of the writing of this report. However, both Port Everglades and Port of Miami have on-dock Intermodal Container Transfer Facility (ICTF) projects in development.

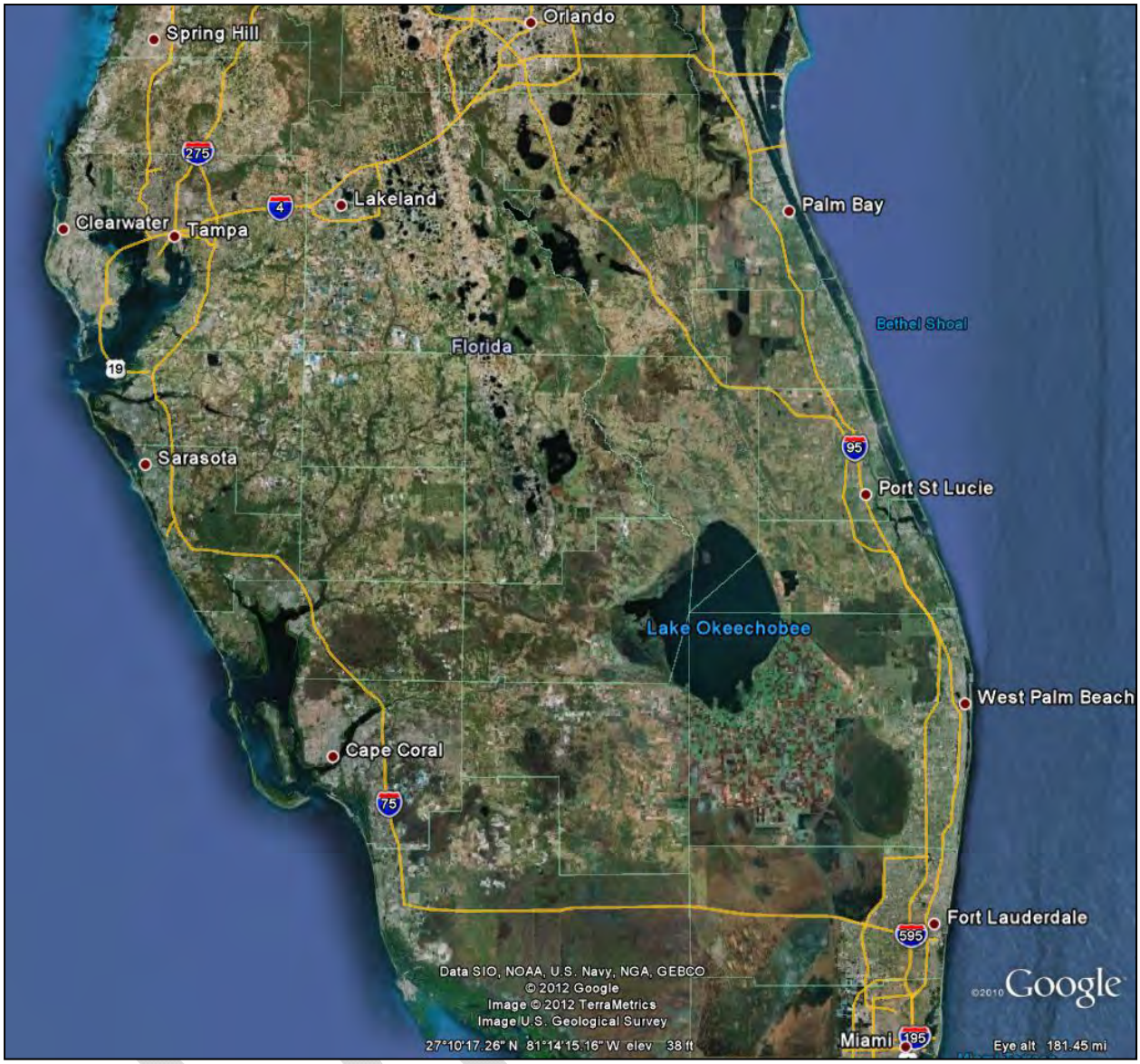


Figure 11. South Florida Major Roadways

Figure 12 shows an approximation of the inland movements of maritime cargo by truck through the Port of Palm Beach, Port Everglades, and Port of Miami. Tonnages shown are inbound and outbound, and were approximated by the Department of Transportation using a highway transportation network model. Most goods stay within, or originate from, the South Florida hinterland, followed by the rest of the State of Florida. Other states that send or receive the most goods to and from South Florida ports by truck are Georgia, Texas and New York, followed by North Carolina and Michigan to a lesser extent. Notice the arterial-looking nature of the highway system. Interstates 95, 75, 10, 77, and 24 are clearly visible as direct trucking routes with heavy annual cargo flows to and from South Florida ports. Even though this map is dated 1998, it still serves as a good representation of the movement of cargo by truck into and out of South Florida ports.

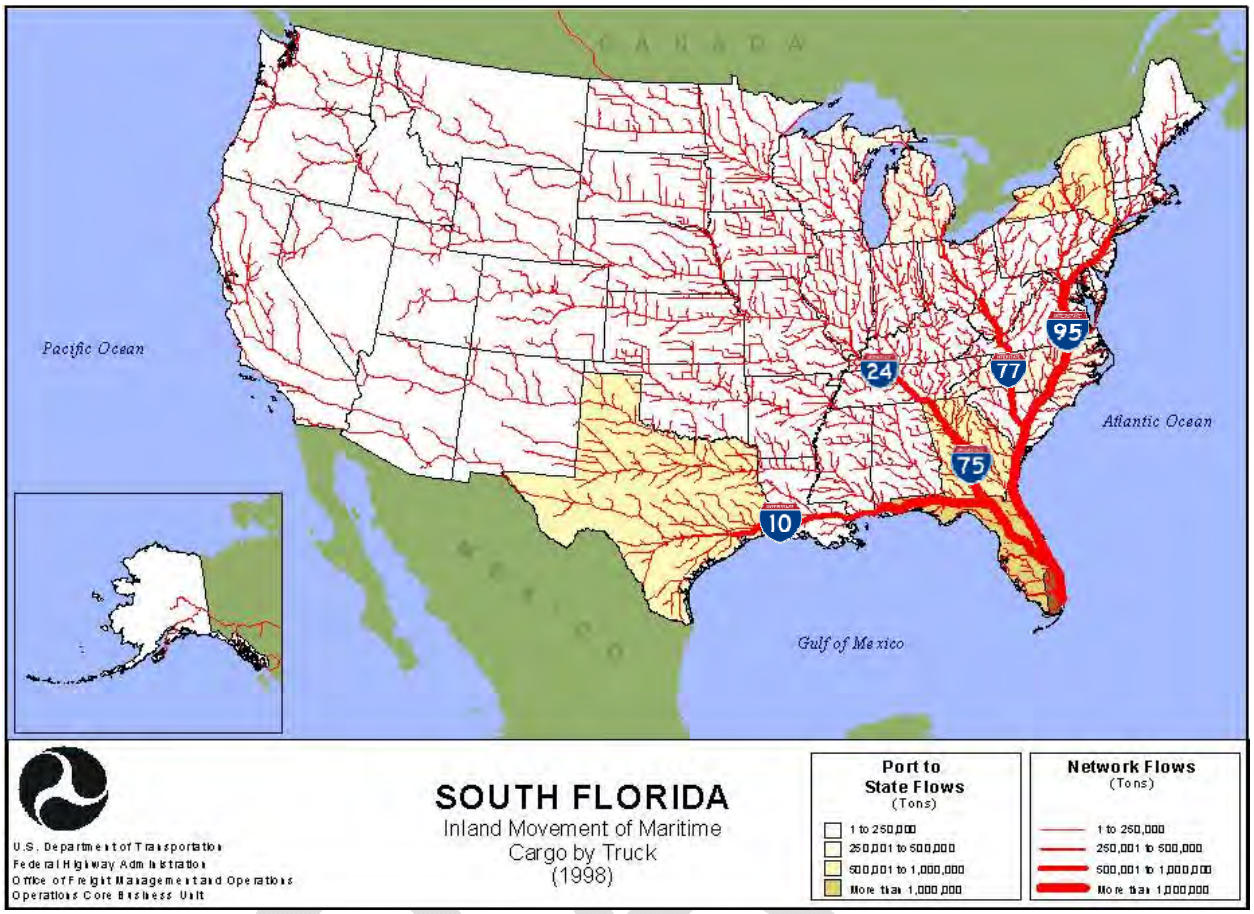


Figure 12. South Florida Inland Movement of Maritime Cargo by Truck

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management Operations

2.2 Existing Port Facilities

The Port of Palm Beach handles passengers, general cargo, containerized cargo and liquid and dry bulk cargo. The top commodities handled at the port include receipts of petroleum products (residual fuel oil, diesel, and asphalt) and cement, and out-bound shipments of food and farm products, including sugar and molasses. The existing berths and land-side port facilities are shown in Figure 13. The port facilities in Palm Beach Harbor consist of four wharves (North Marginal Wharf, Main Marginal Wharf, Mid Marginal Wharf and South Marginal Wharf), three slips (Slip 1, 2 and 3) and 17 berthing areas. The current site consists of approximately 156 total acres of land.

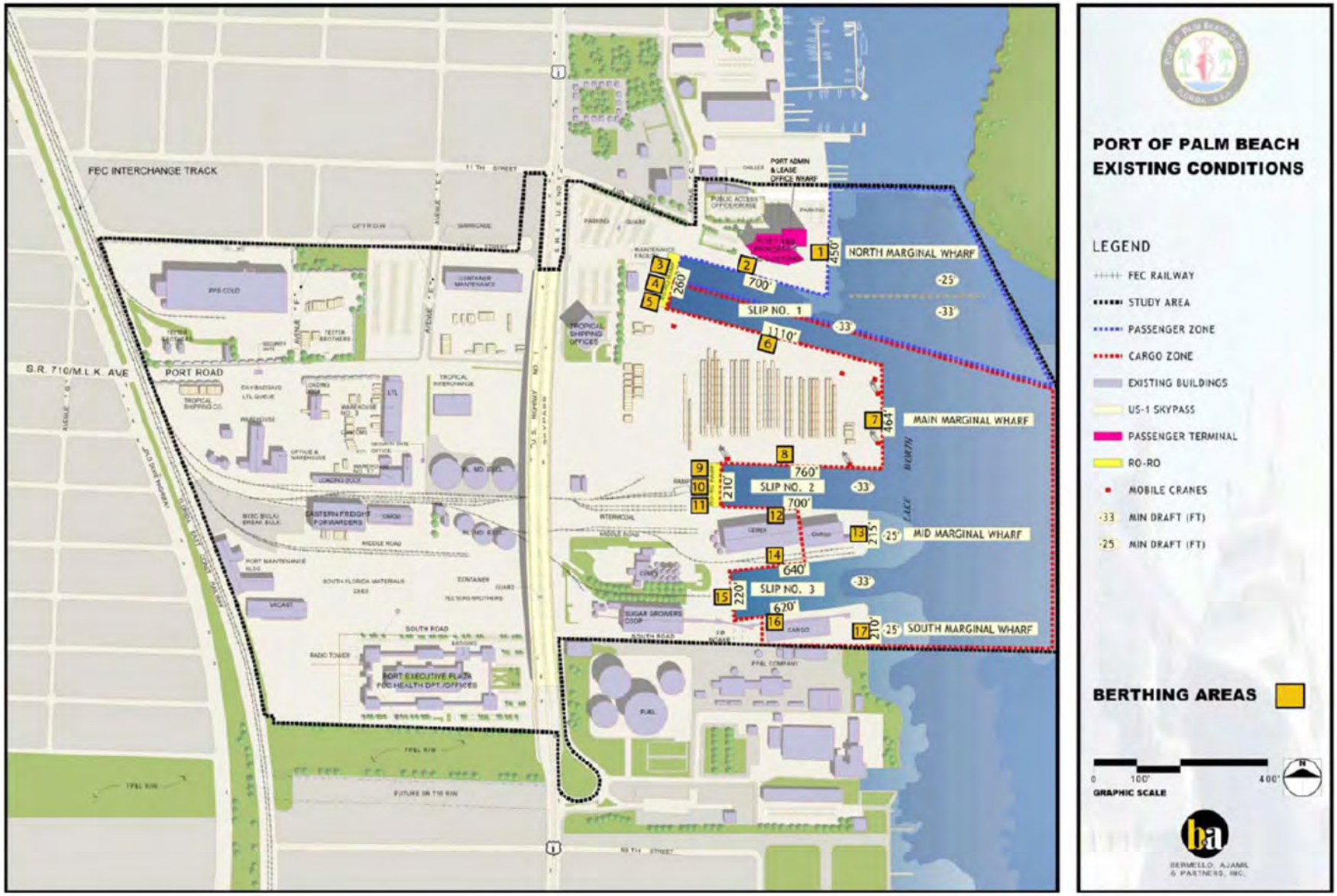


Figure 13. Port of Palm Beach Existing Facilities and Berth Configuration
Source: Port of Palm Beach Master Plan 2005-2015, February 2006.

Existing terminal facilities and berthing areas at Palm Beach Harbor and the types of cargo moved at each berth are described in the following list.

- North Marginal Wharf (Berth 1) – used exclusively for smaller day cruise vessels; it was previously occupied by the *Palm Beach Princess*, which had two scheduled off-shore sailings per day. The service catered primarily to the local gaming market. Another day cruise vessel has already begun operating and is assumed to be in place throughout the 50-year planning horizon.
- Slip 1 (Berths 2-6) – used by Tropical Shipping for container and Ro/Ro cargoes. The north side of the slip (Berth 2) is also used for the Bahamas Celebration, a cruise ship that transits to Freeport, Bahamas every other day from the Port of Palm Beach. Slip 1 is also used by small general cargo ships.
- Main Marginal Wharf (Berth 7) – used primarily by Tropical Shipping and small general cargo ships.
- Slip 2 (Berths 8-12) – generally an overflow slip for vessels that cannot be accommodated by slips 1 and 3. Slip 2 is primarily used by smaller Ro/Ro vessels as well as general cargo vessels. It is also used by Tropical Shipping, as needed.
- Mid Marginal Wharf (Berth 13) – used in conjunction with slips 2 and 3 by small general cargo ships.
- Slip 3 (Berths 14-16) – the major berth of the Port for all bulk cargoes, especially those on vessels with sailing drafts over 25 ft; primarily used for cement and fuel receipts and for shipments of sugar and molasses. Diesel and asphalt is also received at Slip 3. Large general cargo vessels carrying project cargo or other large break bulk will also use Slip 3.
- South Marginal Wharf (Berth 17) – primarily used by small general cargo ships.

The Port of Palm Beach has specialty equipment and storage areas for loading and storing the largest volume commodities that transit through the port. Residual fuel oil can be stored on-site in tanks at FPL's power generation facility, or transported via pipeline to a larger off-site holding facility where it can then be transferred via pipeline to FPL's Martin County power generation facility. Diesel fuel tanks at the port hold approximately 160,000 barrels (about 22,000 metric tons). Asphalt tanks at the port hold approximately 200,000 barrels (about 33,000 metric tons). Since the diesel and asphalt tanks are usually not completely empty when a petroleum tanker arrives at the port, the maximum amount of diesel or asphalt that a vessel is reasonably expected to unload in a single vessel call is between 130,000 barrels and 145,000 barrels (about 17,333 metric tons and 19,500 metric tons) for diesel, and from 150,000 barrels to 175,000 barrels (about 24,400 metric tons to 28,666 metric tons) for asphalt. Additionally, there is capacity for approximately 31,900 metric tons of cement in silos, 18,100 metric tons of cement in a warehouse facility, and storage for a large quantity of aggregate on the dock area between Slip 2 and Slip 3.

Other land-side facilities at the Port include specialty equipment for storing sugar and molasses and loading sugar and molasses onto vessels. Sugar and molasses are produced in the agricultural areas of Palm Beach County and central and southern Florida. The Port of Palm Beach is the only nearby port with equipment to load sugar and molasses onto ocean-going vessels. There are 6 steel molasses tanks

with 11.5 million gallons total capacity, with pipelines connecting them to the south side of Slip 3. There is about 20,865 metric tons of storage capacity for sugar with a conveyor to the south side of Slip 3.

2.3 Multi-port Analysis

The closest major ports to Palm Beach Harbor are Port Everglades and Miami Harbor to the south and Port Canaveral to the north. Figure 14, below, shows that the Port of Palm Beach is in close proximity to larger and deeper draft ports with much greater cargo throughput at Port Everglades and Miami to the south. To the north, the next major port after Port Canaveral is Jacksonville. Port of Palm Beach is a niche port with regard to vessels calls, cargo-types, and passengers, as explained in Section 2. This means that its cargo does not normally compete directly with other nearby ports, and therefore growth at the Port of Palm Beach will not affect growth in Port Everglades or Miami, which share the same hinterland.

The Port of Palm Beach has a niche containership cargo carrier with Caribbean trade routes. However, these vessel types are limited to feeder-size vessels, with the largest size of 1700 TEUs that have design drafts of 33 ft. Port Everglades and Port of Miami collectively serve longer international trade routes with Northern Europe, the Mediterranean, Asia, and Central and South America. Furthermore, the Port of Palm Beach is the only port in South Florida with facilities to move sugar and molasses.

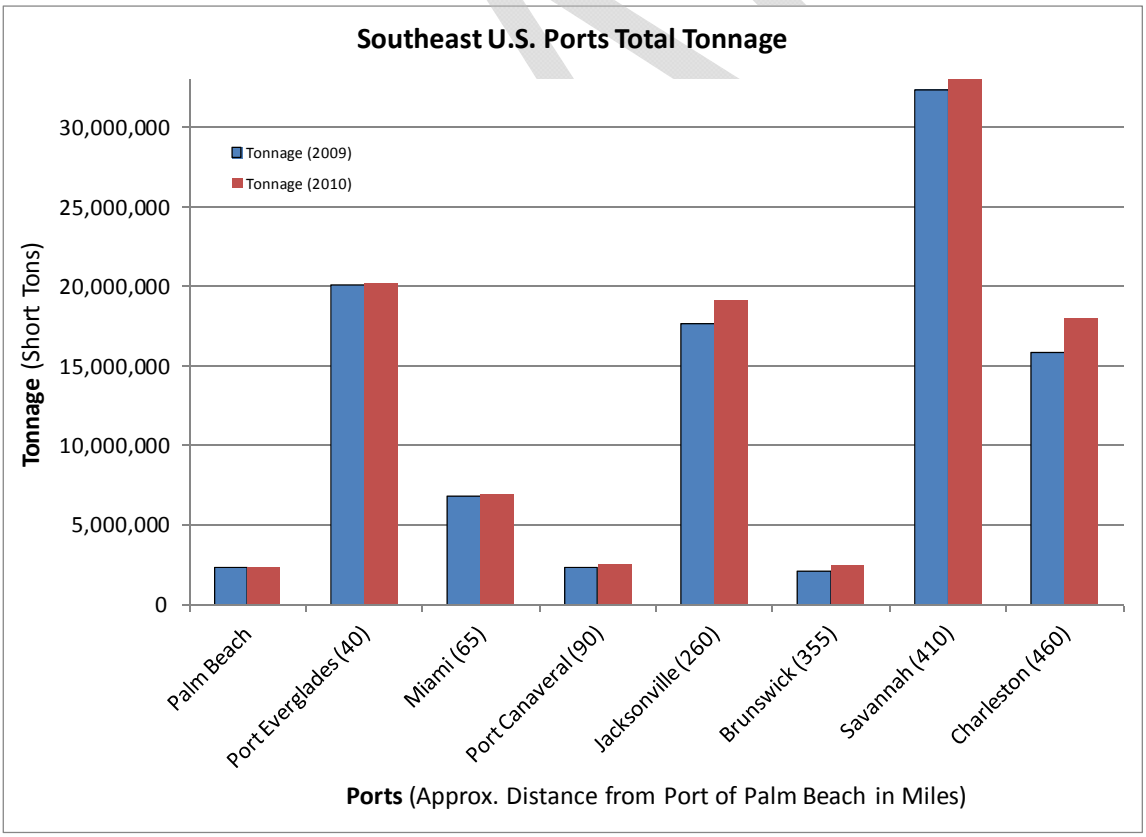


Figure 14. South Atlantic U.S. Ports Total Tonnage
Source: Waterborne Commerce Statistics Center

3 Existing Conditions

3.1 Historical and Existing Commodity Movements

Table 7 shows the total annual commodity tonnages at the Port for the period 1996 through 2010, and the associated annual growth rate for each year. The compound annual growth rate (CAGR) from 1996 to 2010 is also shown at 0.25 percent. Between 1996 and 2003 the Port's total annual tonnage rose from 2.29 million short tons to 4.36 million short tons, with a CAGR of 9.62 percent. Total commodity tonnage declined by 2008 to 2.38 million short tons, with a CAGR from 2004 to 2008 of -12.99 percent.

Table 7. Historical Total Tonnages for Port of Palm Beach and Annual Growth Rates

Port of Palm Beach Total Annual Cargo Tons (short tons)		
Year	Total Tons (in 1000s)	Annual Growth Rate (year-to-year)
1996	2294	
1997	2922	27.4%
1998	3149	7.8%
1999	3352	6.4%
2000	2950	-12.0%
2001	3518	19.3%
2002	4022	14.3%
2003	4362	8.5%
2004	4147	-4.9%
2005	3965	-4.4%
2006	2765	-30.3%
2007	3117	12.7%
2008	2377	-23.7%
2009	2341	-1.5%
2010	2374	1.4%
Compound Annual Growth Rate (1996-2010)		0.25%
Compound Annual Growth Rate (1996-2003)		9.62%

Source: Waterborne Commerce Statistics Center

Table 8 and Figure 15 depict the major bulk commodity tonnages for the period 1995 through 2010 that would be associated with the deepest draft vessels calling the Port. Total major bulk cargo grew from 1.71 million metric tons in 1996 to 2.42 million metric tons in 2004 for a CAGR of 4.42 percent. Bulk cargoes declined in 2005-2006 largely related to hurricane and storm disruptions, for example exports of molasses and receipts of fuel oil. Fuel oil has been declining recently due to the closure of the Riviera Beach power generation facility for renovations and modernization. Cement has declined due to the

DRAFT

recent housing market decline in demand. Not shown on this table is the recent substantial increase in diesel fuel and asphalt tonnage due to a new port tenant who is importing diesel and asphalt. More discussion on each of the major bulk commodities can be found in Section 4.

Table 8. Major Bulk Commodity Tonnages 1995-2010

(000 metric tons)																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cement	200	187	241	173	210	60	49	64	83	152	213	115	137	44	24	6
Fuel Oil	846	541	813	986	1,107	1,043	1,351	1,200	1,062	1,215	905	665	697	389	208	213
Molasses	154	180	146	157	278	259	239	331	215	265	91	77	161	105	150	155
Sugar	987	806	908	947	816	541	725	1,094	1,003	789	692	357	626	364	635	531
Subtotal	**2,188**	**1,714**	**2,108**	**2,263**	**2,409**	**1,902**	**2,364**	**2,690**	**2,363**	**2,421**	**1,901**	**1,215**	**1,621**	**902**	**1,017**	**905**
Other	508	367	542	593	631	774	827	959	1,595	1,341	1,696	1,294	1,207	1,255	1,108	1,248
Total	**2,696**	**2,081**	**2,651**	**2,857**	**3,041**	**2,676**	**3,191**	**3,649**	**3,958**	**3,762**	**3,597**	**2,508**	**2,828**	**2,156**	**2,125**	**2,154**

Source: Waterborne Commerce Statistics Center

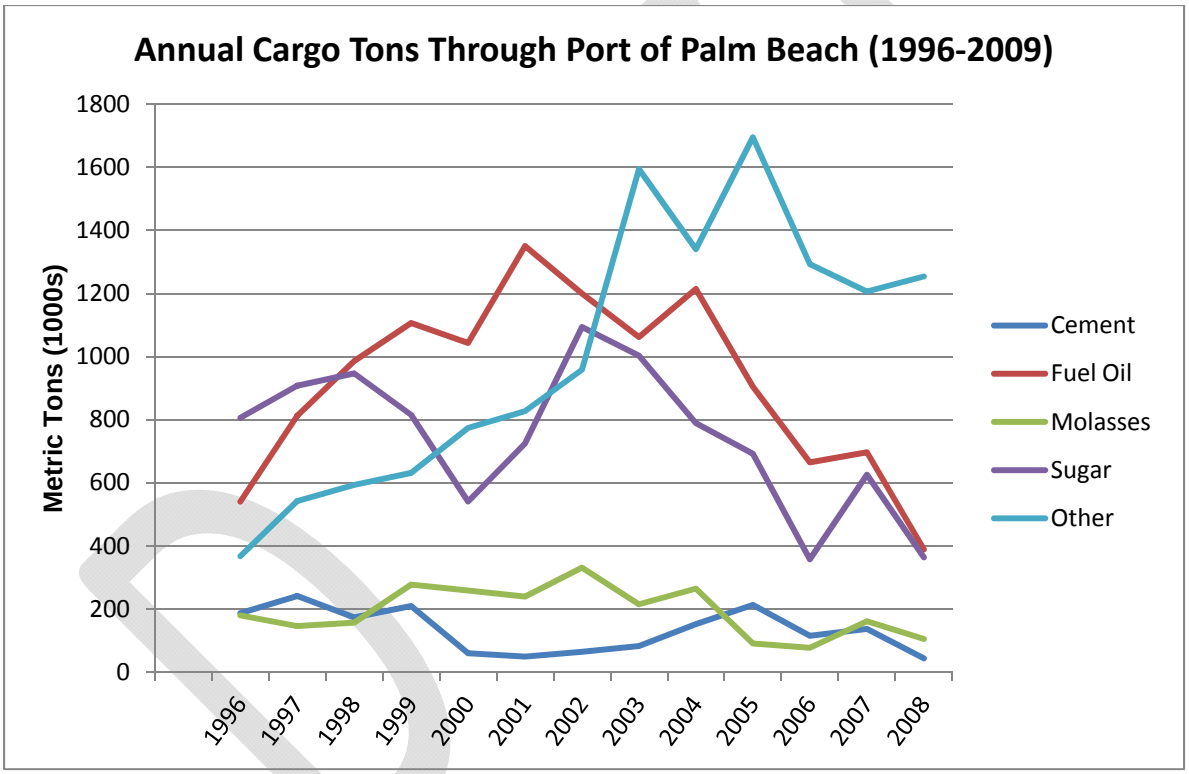


Figure 15. Annual Major Bulk Cargo Tons (1996-2009)

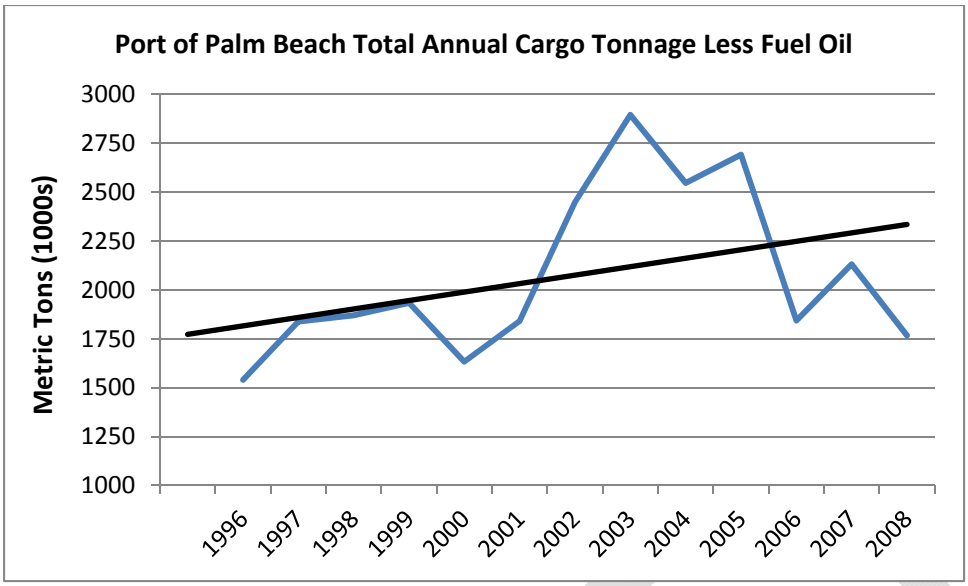


Figure 16. Annual Cargo Tonnage less Fuel Oil

Table 9. Long-term Growth Trends for Total Cargo and Total Cargo less Fuel Oil over 10 year and 14 year periods

Period	Description	Compound Annual Growth Rate
1996 – 2005	Total Cargo	6.27%
1996 – 2005	Total Cargo less Fuel Oil	6.40%
1996 – 2009	Total Cargo	0.16%
1996 – 2009	Total Cargo less Fuel Oil	1.70%

Table 9 above shows that annual cargo tonnage growth rates were very high over the 10-year period from 1996 to 2005. Fuel oil receipts began a trend of steady decline in 2005 when operations at the Riviera Beach power generation facility started to wane. Therefore, if fuel oil cargo tonnage is removed from the total cargo tonnage, the 14-year compound annual growth rate from 1996 to 2009 is 1.70% (Figure 16).

DRAFT

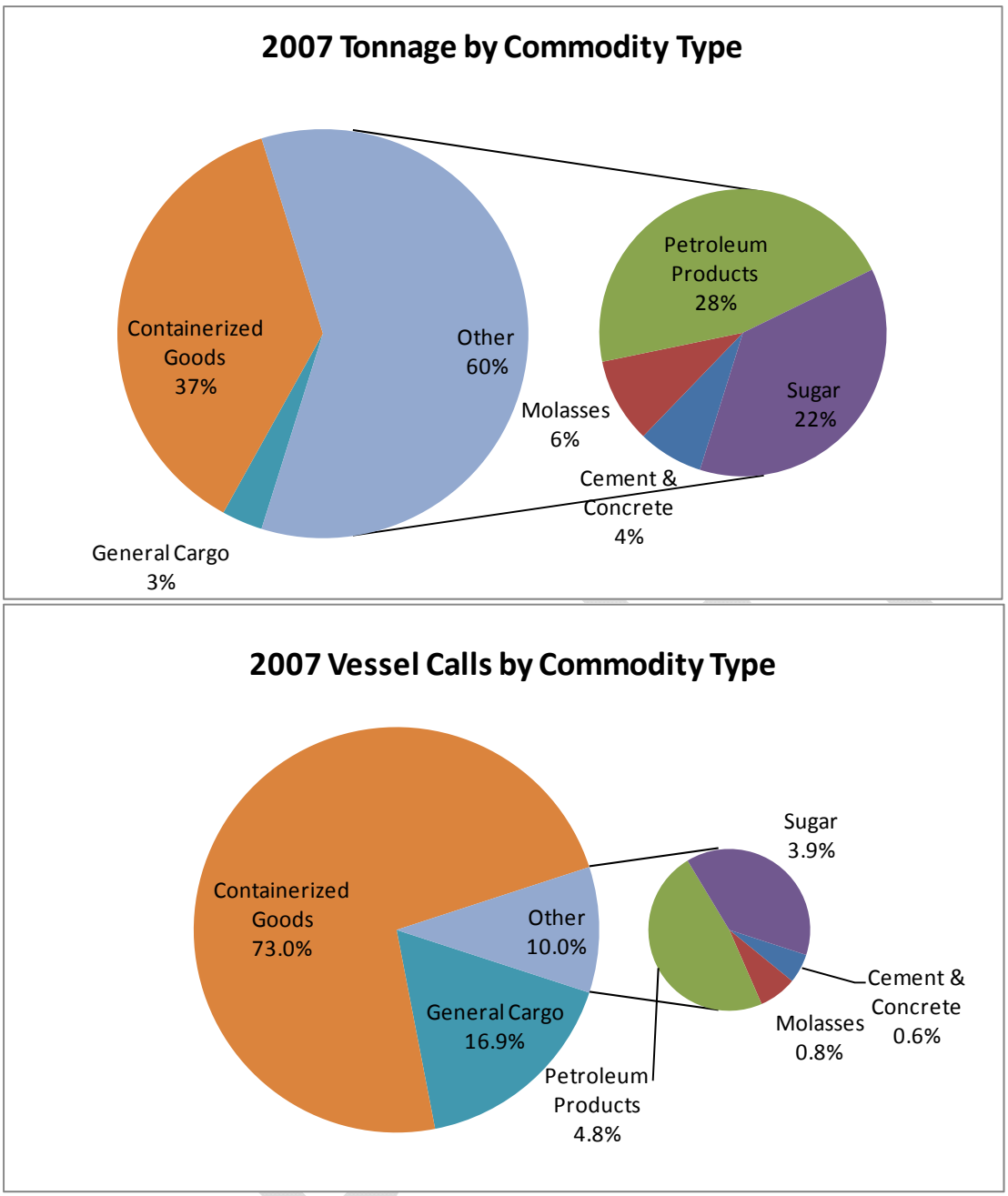


Figure 17. Comparison of Tonnage and Vessel Calls by Commodity Type
Source: Waterborne Commerce Statistics Center, and Port of Palm Beach Pilots' Log.
Notes: Petroleum Products includes: Residual Fuel Oil, Distillate Fuel Oil, Gasoline, Kerosene, and Asphalt.

Figure 17, above, shows the proportion of tonnage by commodity type compared to the number of vessel calls by commodity type, for the year 2007. The year 2007 was chosen for this example because it represented a typical level of historical commodity tonnage and vessel calls. It is clear that relative to the number of vessel calls, a small number of commodities make up a large portion of the total tonnage transiting through the Port of Palm Beach. Cement and concrete, molasses, sugar, and petroleum products represent only 10% of vessel calls in 2007. However, these same four commodity groups account for 60% of total tonnage in 2007.

3.2 Existing Vessel Fleet

Table 10 shows the total annual inbound and outbound vessel trips at the Port between 1996 and 2010. The sharp decline in total vessel trips, which occurred between 1996 and 1999, is primarily due to a reduction in small domestic vessel calls. This is also shown by the increase in annual cargo tons during the same period. From 2000 to 2005, annual vessel trips were steady, while cargo tonnage continued to increase from 2000 to 2003, suggesting more cargo was being loaded on the same or larger vessels. Since 2005, both annual cargo tonnage and annual vessel trips have steadily declined.

Table 10. Annual Vessel Movements

Port of Palm Beach Total Annual Vessel Trips		
Year	Inbound Trips (Receipts)	Outbound Trips (Shipments)
1996	4053	3425
1997	3415	2700
1998	2720	2514
1999	1793	1405
2000	1495	1467
2001	1536	1547
2002	1482	1476
2003	1482	1521
2004	1442	1503
2005	1536	1570
2006	1439	1473
2007	1334	1411
2008	1178	1246
2009	1101	1262
2010	1194	1413

Source: Waterborne Commerce Statistics Center
Note: Inbound and outbound trips will not match because domestic barge movements are only counted one way.

Table 11 shows the number of vessel movements by draft from 2004 to 2010. The existing authorized channel depth is 33 ft at MLLW. Generally, 2.5 ft of tide or greater is available about 32% of the time, and 3 ft of tide or greater is available about 15% of the time. Therefore, any calls with sailing drafts at 33 ft or greater are draft-constrained and tide-constrained. Note that the number of calls at 33 ft draft or deeper peaked in 2005, which corresponds to the highest throughput of cement since 1997 (Table 8). Since that time, total tonnage has declined due to reduced demand for some goods. As the total number of movements has declined, movements that are 27 feet of draft and deeper have remained steady from 2006 to 2009, and increased substantially in 2010. A number of vessels in this range of sailing drafts are likely draft-constrained, and could be subject to deeper loading with greater available channel depth.

DRAFT

Table 11. Vessel Movements by Draft

Number of Total Vessel Movements by Draft							
Draft	2004	2005	2006	2007	2008	2009	2010
0-9 ft.	524	407	814	895	737	583	427
10-14 ft.	1181	1117	908	698	651	781	793
15-20 ft.	728	950	791	715	648	525	558
21-26 ft.	331	374	246	316	249	343	658
27-32 ft.	158	200	130	116	136	127	166
33-38 ft.	23	58	23	5	3	4	5

Source: Waterborne Commerce Statistics Center

Table 12. Existing Fleet Vessel Characteristics by Vessel Type (2007-2009)

	Number of Calls			Average Vessel LOA (ft)			Average Vessel Beam (ft)			Average Design Draft (ft)		
Vessel Type	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Molasses	9	6	8	555.4	551.0	556.0	83.4	87.3	87.2	35.4	34.3	33.5
Sugar	46	29	42	360.7	345.6	377.9	72.8	70.4	75.7	N/A	N/A	N/A
Liquid Petroleum	50	40	25	467.4	506.4	487.1	78.0	80.5	82.0	27.5	29.3	30.1
Asphalt	7	3	5	463.0	438.8	449.5	67.3	79.3	74.8	24.3	26.5	24.5
Cement & Concrete	7	7	1	514.6	308.4	574.0	78.8	59.0	85.3	31.2	20.3	32.2
Container Ships	867	802	678	318.4	315.3	323.0	61.1	60.7	62.3	16.2	16.0	16.5
General Cargo	203	175	156	223.4	250.2	302.5	44.8	48.2	53.7	13.2	15.2	17.9

	Number of Calls			Max LOA (ft)			Max Beam (ft)			Max Design Draft (ft)		
Vessel Type	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Molasses	9	6	8	587.0	576.0	619.0	90.5	98.3	97.0	41.0	39.6	38.5
Sugar	46	29	42	366.0	430.0	430.0	75.0	82.0	80.0	N/A	N/A	N/A
Liquid Petroleum	50	40	25	638.0	640.0	640.0	85.5	93.0	93.0	29.5	36.0	36.0
Asphalt	7	3	5	490.0	446.0	485.0	80.0	80.0	80.0	30.6	26.5	26.5
Cement & Concrete	7	7	1	612.3	308.4	574.0	95.1	59.0	85.3	37.7	20.3	32.2
Container Ships	867	802	678	588.0	524.5	524.5	83.0	76.3	76.3	32.5	28.5	28.5
General Cargo	203	175	156	655.0	635.0	608.3	100.0	92.0	101.5	36.0	36.8	36.0

	Number of Calls			Average Arrival Draft (ft)			Average Departure Draft			Max Sailing Draft (ft)		
Vessel Type	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Molasses	9	6	8	24.5	22.7	24.2	30.6	29.8	29.2	32.2	32.5	30.0
Sugar	46	29	42	14.9	14.5	15.0	22.8	23.0	23.4	24.0	24.0	24.0
Liquid Petroleum	50	40	25	27.0	26.1	25.8	18.7	18.4	18.4	30.8	29.5	29.0
Asphalt	7	3	5	21.6	26.4	25.4	16.9	19.7	20.0	24.7	27.3	27.0
Cement & Concrete	7	7	1	25.7	20.3	27.0	21.9	12.0	21.7	27.3	20.7	27.0
Container Ships	867	802	678	13.1	13.1	13.5	14.3	14.3	14.6	28.6	28.3	29.2
General Cargo	203	175	156	13.3	14.6	15.3	12.1	13.4	15.2	28.0	30.5	32.5

	Number of Calls			Average Tugs Used Inbound			Average Tugs Used Outbound			Majority Propulsion Type	Primary Berth(s) Used
Vessel Type	2007	2008	2009	2007	2008	2009	2007	2008	2009		
Molasses	9	6	8	2.0	2.0	2.4	1.9	2.0	1.9	Motor	16C
Sugar	46	29	42	1.0	1.0	1.0	1.0	1.0	1.2	Tug & Barge	16C
Liquid Petroleum	50	40	25	1.5	1.4	1.7	1.2	1.2	1.5	Tug & Barge	14C
Asphalt	7	3	5	1.4	2.0	2.0	1.1	1.7	1.2	Tug & Barge	12C
Cement & Concrete	7	7	1	2.1	0.3	2.0	1.9	0.1	2.0	Motor	14C
Container Ships	867	802	678	0.2	0.1	0.1	0.1	0.1	0.1	Motor	5C/6C/6E/7C
General Cargo	203	175	156	0.8	0.7	0.8	0.2	0.2	0.3	Motor	11C

Notes: All measurements in feet. Erroneous data was excluded from averages. Liquid Petroleum includes residual fuel oil and distillate fuel oil (diesel). Source: Palm Beach Harbor Pilots' Logs

DRAFT

Table 13. Average Loaded Sailing Draft as a Percent of Design Draft by Vessel Type

Average Percent of Design Draft Used when Loaded				
Vessel Type	2007	2008	2009	Overall
Molasses	87%	87%	88%	87%
Sugar	90%	91%	92%	91%
Liquid Petroleum	96%	89%	86%	91%
Asphalt	88%	98%	97%	93%
Cement & Concrete	84%	99%	84%	91%
Container Ships	89%	90%	88%	89%
General Cargo	96%	95%	90%	94%

Notes: All measurements in feet. Erroneous data was excluded from averages. Liquid Petroleum includes residual fuel oil and distillate fuel oil (diesel). Source: Palm Beach Harbor Pilots' Logs

Table 12 shows the characteristics of vessels in the existing fleet, broken down by commodity type over three years (2007-2009). Table 13, above, shows the average loaded sailing draft as a percent of design draft by vessel type over three years (2007-2009). When compared with the average design drafts and maximum design drafts in Table 12, it is clear molasses product tankers, liquid petroleum tankers, and cement bulk carriers are currently the most draft-constrained vessels in the existing fleet calling the Port of Palm Beach.

4 Expected Future Conditions

The planning horizon for this project is 50-years, with a base-year of 2017[2]. An assessment into the future involves a review of past trends leading up to current situations and the likelihood of those conditions continuing into the future with or without change.

Within the study area there are economic, environmental, and technical changes underway that will likely impact future conditions. Changing demands of the population will greatly influence those conditions. Table 14 shows the historical and projected population for Palm Beach County, surrounding hinterland counties and the State of Florida. Palm Beach County population is projected to grow at an average annual rate of less than one percent between 2010 and 2030. This slow rate of growth will affect the demand for certain commodities such as construction materials and fuel oil, as explained in further detail in Section 4.2. Table 14 also shows population projections for nearby southern and central Florida counties of Broward, Miami-Dade, Martin, St. Lucie, Indian River, Osceola, and Orange.

[2] The base-year of 2017 was used throughout the economic evaluation process even though the final construction schedule is expected to complete in June 2018.

Table 14. Palm Beach County and Surrounding County Population Projections

County	1990	1995	2000	2005	2010	2015	2020	2025	2030	CAGR 1990-2010	CAGR 2010-2030	CAGR 1990-2030
Broward	1,255,531	1,428,708	1,623,018	1,740,987	1,745,570	1,787,228	1,834,967	1,880,047	1,921,172	1.66%	0.48%	1.07%
Indian River	90,208	100,375	112,947	130,043	142,303	154,988	169,319	183,403	196,916	2.31%	1.64%	1.97%
Martin	100,900	113,550	126,731	141,059	143,640	149,787	157,115	164,081	170,425	1.78%	0.86%	1.32%
Miami-Dade	1,937,194	2,076,171	2,253,779	2,422,075	2,480,757	2,561,276	2,653,957	2,742,987	2,825,874	1.24%	0.65%	0.95%
Orange	677,491	765,906	896,344	1,043,437	1,119,225	1,212,817	1,324,547	1,433,249	1,535,033	2.54%	1.59%	2.07%
Osceola	107,728	140,775	172,493	235,156	280,279	327,022	380,082	431,637	480,401	4.90%	2.73%	3.81%
Palm Beach	863,503	988,743	1,131,191	1,265,900	1,285,692	1,346,002	1,420,356	1,491,669	1,556,810	2.01%	0.96%	1.48%
St. Lucie	150,171	172,212	192,695	240,039	276,658	313,077	354,289	395,164	434,113	3.10%	2.28%	2.69%
Hinterland Sub-Total	5,182,726	5,786,440	6,509,198	7,218,696	7,474,124	7,852,197	8,294,632	8,722,237	9,120,744	1.85%	1.00%	1.42%
Florida	12,938,071	14,335,992	15,982,824	17,918,227	18,881,443	20,055,865	21,417,450	22,738,233	23,979,032	1.91%	1.20%	1.55%
Hinterland Percent of State Population	40.1%	40.4%	40.7%	40.3%	39.6%	39.2%	38.7%	38.4%	38.0%			

Note: CAGR = Compound Annual Growth Rate; Projections begin in 2010.

Source: Florida Demographic Estimating Conference, February 2009; Florida Demographic Database, August 2009

4.1 Caveats of Growth Estimates and Projections

No growth rate projection will ever be accurate, and the true ups and downs of business cycles cannot be accurately forecasted through a linear or exponential growth rate. Linear or steady compound growth rates (exponential growth) are meant only to be representative of projected tonnage that is expected to transit through the port over a longer period. Using smoother curves as estimates for actual tonnage acts to normalize peaks and valleys in future business cycles. In reality, future tonnage will likely exceed the forecast in some years, and fall short of the forecast in others. A "most-likely" steady growth rate will account for both of these occurrences over the long run because the positive and negative differences from the estimated to actual tonnage will eventually cancel each other out (Figure 18).

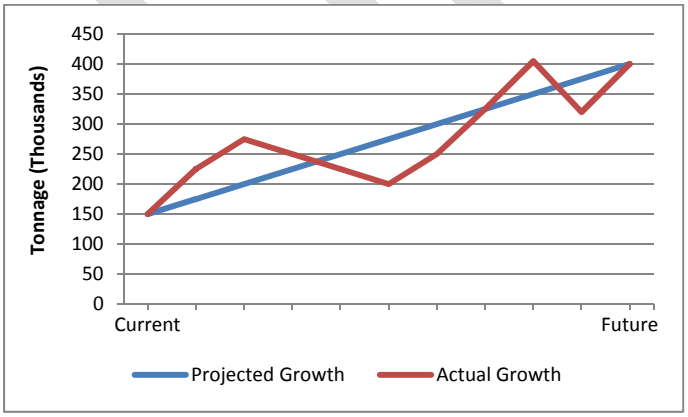


Figure 18. Example Graph of Differences between Estimated and Actual Growth

4.2 Future Commodity Movements

Historical tonnages were presented in Table 8, in Section 3.1. The future commodity growth for the 50-year planning horizon from the base year of 2017 to 2067 is summarized in Table 15 and shown graphically in Figure 19. The "Benefitting Commodity?" column displays whether or not the commodity movements will benefit from channel deepening. In the following subsections, the assumptions and caveats behind each of the predictions for each commodity are detailed.

Table 15. Future Commodity Movement Forecasts for Port of Palm Beach (2017-2067)

	2017	2027	2037	2047	2057	2067	CAGR (2017-2067)	Benefitting Commodity?
Sugar (Shipments)	790	790	790	790	790	790	0.00%	No
Molasses (Shipments)	265	265	265	265	265	265	0.00%	Yes
Liquid Petroleum Products (Receipts)	232	251	272	295	320	347	0.80%	Yes (only diesel)
Asphalt (Receipts)	76	95	119	149	186	186	1.81%	Yes
Cement & Concrete (Receipts)	97	122	154	194	244	308	2.35%	Yes
Containerized Cargo (Both Directions)	999	1,343	1,805	1,805	1,805	1,805	1.19%	No
Non-Containerized General Cargo (Both Directions)	122	135	148	163	179	197	0.96%	Yes (only for largest vessels)
Total	2,581	3,000	3,552	3,660	3,789	3,897	0.83%	

Notes: Values shown in thousands of metric tons. Liquid Petroleum includes residual fuel oil and distillate fuel oil (diesel). The seed values of current tonnages before applying a projected growth rate for containerized goods and non-containerized general cargo were estimated values. Other commodities used historic values for the base year projection that represented either current traffic or pre-recession traffic levels. Non-containerized general cargo includes break-bulk, project cargo, and Ro-Ro.

DRAFT

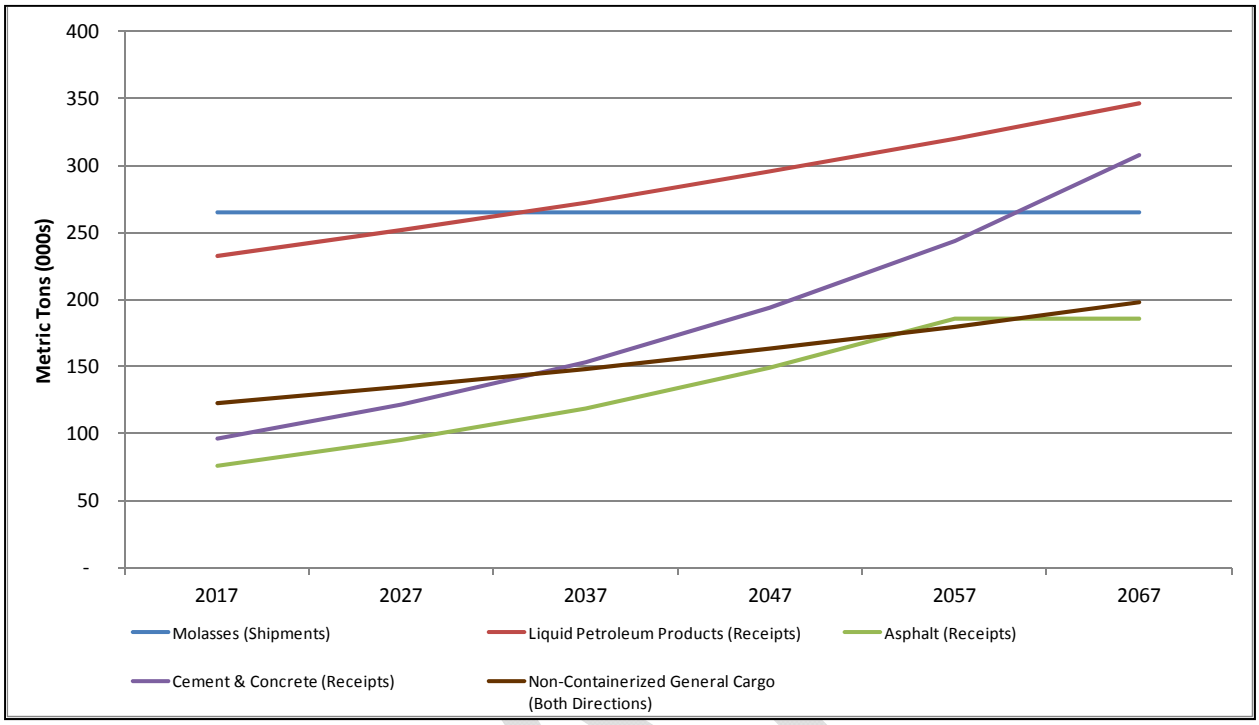
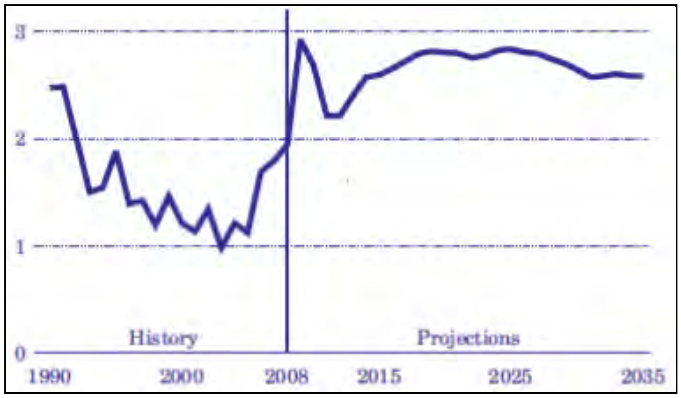


Figure 19. Port of Palm Beach Future Commodity Growth Projections

4.2.1 Fuel Oil and Diesel

Historically, residual fuel oil (also known as "No. 6" fuel oil) receipts were a large percentage of port cargo traffic because it was used by the Riviera Beach electricity generating facility, owned and operated by Florida Power & Light Company (FPL), which was adjacent to the Port of Palm Beach. Fuel oil is moved via domestic tug and barge, primarily from Gulf Coast ports. In order to meet future energy demands and potential emissions requirements, FPL has recently shut down the Riviera Beach plant with plans to replace it with a more efficient Combined Cycle plant, which will run primarily on natural gas. The natural gas will be transported to the facility exclusively via pipeline. The new Riviera Beach facility will be operational by 2014. During 2012-2014, there will likely be a small increase in bulk movements of heavy equipment form the imports and exports of the new and old parts of the Riviera Beach facility.

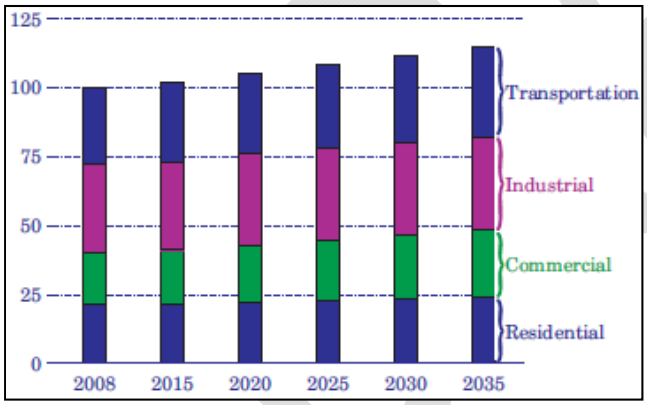
The rebuilt plant will have the capability to operate on diesel fuel, but this feature would only be used in an emergency that also caused a disruption in the supply of natural gas. The only other scenario that would cause the new power plant to run on diesel would be if the price of diesel were to drop below the price of natural gas. According to the U.S. Energy Information Administration (USEIA) Annual Energy Outlook 2010, "The ratio of low-sulfur light crude oil prices to Henry Hub natural gas prices on an energy equivalent basis remains high relative to the historical average throughout the projection [2009-2035]". The USEIA projection of natural gas prices is shown in Figure 20, below.



Source: USEIA, Annual Energy Outlook 2010

Figure 20. Ratio of low-sulfur light crude oil price to Henry Hub natural gas price on an energy equivalent basis, 1990-2035

The new Riviera Beach combined-cycle facility will have between 120,000 and 150,000 barrels of low-sulfur diesel fuel on-hand in case of emergencies. FPL will likely turn over this volume almost every year to test the backup capabilities of the new plant. However the volume is so low that it will likely be brought into the facility through truck rather than by barge. FPL's St. Lucie County power generation facility is expected to still require some residual fuel oil receipts through the Port for the period of analysis. Further FPL data, which supports the estimate of liquid petroleum in the base year of 2017, is considered sensitive and will be provided to reviewers upon request, if possible. Demand for energy is expected to increase (Figure 21). Specifically, demand for electricity is projected to grow at 1 percent per year from 2008 to 2035 (USEIA, 2010).



Source: USEIA, Annual Energy Outlook 2010

Figure 21. Primary energy use by end-use sector, 2008-2035 (quadrillion Btu)

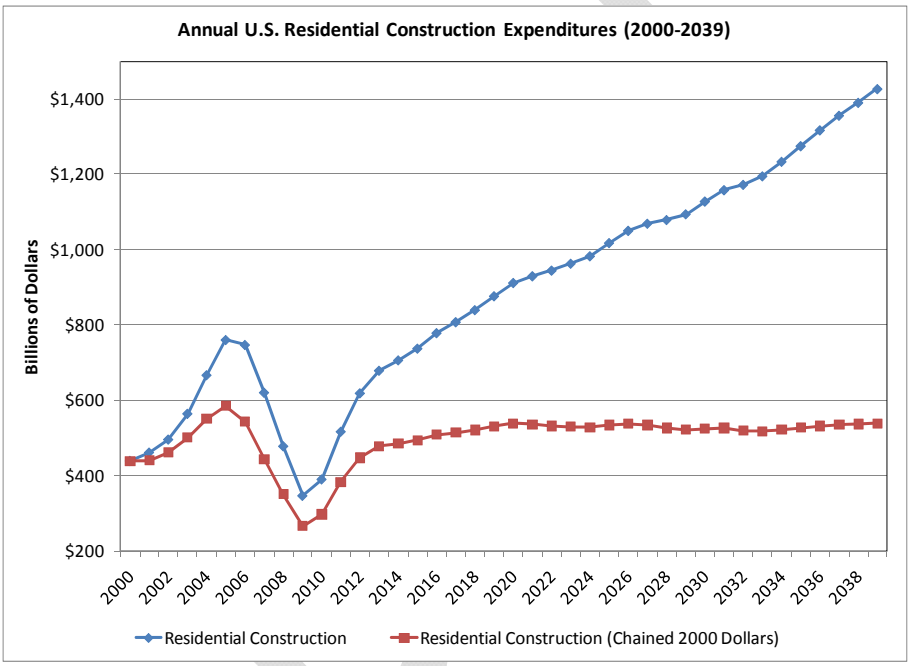
Diesel fuel, or distillate fuel oil, is another commodity that is received in substantial quantities through domestic barge movements from Gulf Coast ports. One tenant at the Port of Palm Beach currently imports diesel products for resale. This tenant has seen rapid growth in their diesel shipments since they began operations at the Port. This rapid growth is attributed to a ramping-up of a new business, and high growth rates for diesel are not expected over the entire period of analysis. Diesel receipts are expected to grow at moderate rates over the period of analysis.

Diesel fuel consumption is expected to grow at rates similar to the general national demand for energy in the transportation sector. The USEIA projects an average annual growth rate of 0.6 percent from 2008

to 2035 (USEIA, 2010) (Figure 21). Furthermore, with the addition of a new bio-fuel firm at the port, there may be a slight increase above the national rate in traffic of refined fuels.

4.2.2 Asphalt and Cement

Asphalt has historically moved through the Port of Palm Beach by domestic tug and barge from U.S. Gulf Coast ports. Demand for asphalt is primarily related to the demand for infrastructure construction and repairs (roadways), as well as for residential and commercial construction and repairs (roofs, driveways, and parking lots). Both of these factors are ultimately dependent upon population growth and subsequently, demand for residential and commercial construction. Nationwide, unadjusted growth in expenditures for residential construction remains slow but constant over the next 30 years after a rebound from recession levels (Figure 22). The projected post-recession compound annual growth rate in construction expenditures from 2012 to 2039 is 3.14 percent. However, the compound annual growth rate of expenditures on residential construction from 2012 to 2039 in Chained 2000 dollars is 0.68 percent.



Source: IHS Global Insight, "The 30-Year Focus", May 2009.

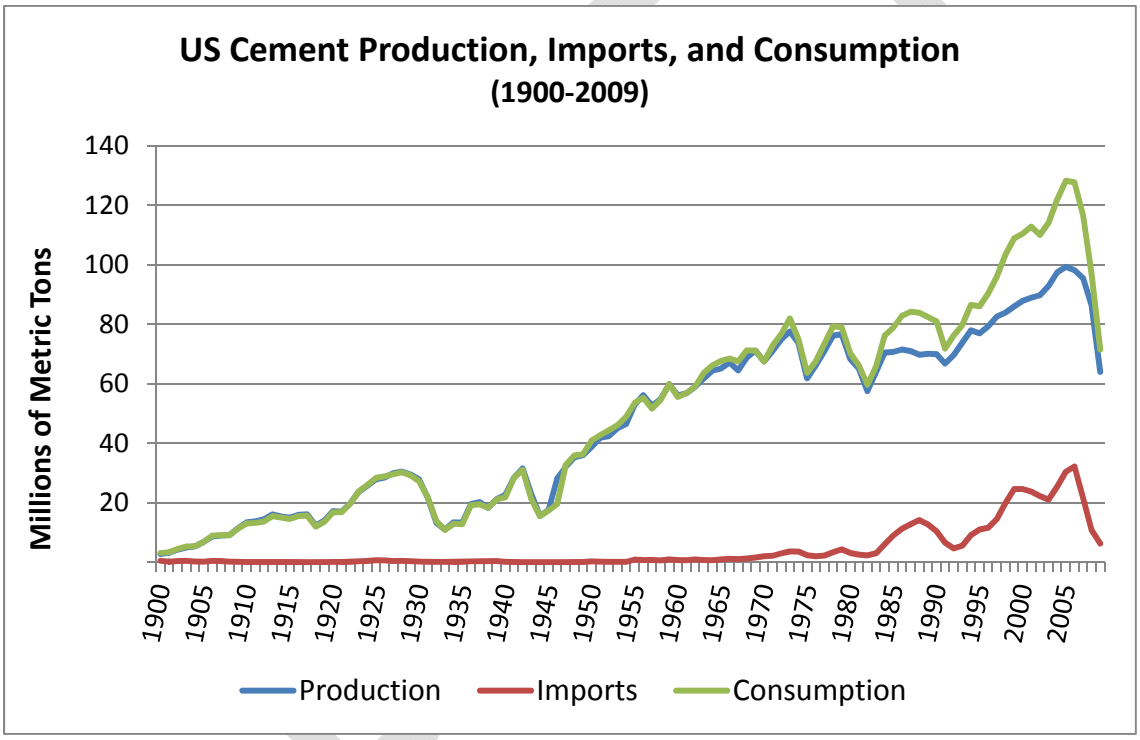
Figure 22. Residential Construction Expenditures: Historical and Projected

The Port of Palm Beach traditionally has moved a large amount of cement and other construction materials through its facilities, in the hundreds of thousands of tons since the 1990s. This volume has dropped off because of the decline in new construction, but it is expected to return to pre-recession levels by the base project year of 2017, as new construction rates return to normal. The historical building permits for Palm Beach and other southern and central Florida counties are shown in Table 19, below.

Cemex, a large cement company, has cement storage and processing facilities on-site at the Port, and Cemex is currently under a lease agreement with the Port until 2023. The facility is now idle but ready to return to service. This indicates that as soon as demand for cement rises, imports of cement will resume at normal rates, and should increase into the future along with the demand for new construction. Cement has traditionally been imported on foreign-flagged dry bulk carriers from various countries such as Mexico, Denmark, and Egypt.

4.2.2.1 Description of Cement Imports & Historical Rates

In the early 1970s, imports of cement began to steadily rise, up until the recent recession (Figure 23). Cement, aggregate, and cement input materials have historically been imported through the Port of Palm Beach to supplement local, domestic production. It is generally easier for cement producers to import cement to meet excess demand, and make adjustments to their import quantities, rather than constantly adjust their factory output.



Source: USGS Historical Statistics for Mineral and Material Commodities in the United States, Version 2010.
Figure 23. US Cement Production, Imports, and Consumption

Cement production also requires the input of other minerals that are not produced domestically, such as bauxite, alumina, and silica sands. These cement input materials must be imported in order to produce cement domestically. Furthermore, aggregate, or crushed stone is required as an addition to cement to produce "Ready-Mix" concrete, a primary building material. When demand for construction materials rises beyond the capacity of local production, aggregate is imported as well.

Since 1996, there have been two distinct peaks in cement imports through the Port of Palm Beach, in 1997 and in 2005. Table 16, below, shows the tonnage of cement imported through the Port of Palm

Beach. Table 17 shows the growth rate in imports and total tonnage moved over a 10-year period from 1996 to 2005, and over the 8-year period from 2000 to 2007. These two periods illustrate that the annual growth rates and annual throughput tonnages can be very sensitive to the period selected. Figure 24 emphasizes these trends graphically, and shows the cyclical nature of construction material demand.

Table 16. Annual Bulk Cement Cargo Tons through Port of Palm Beach

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Cement	187	241	173	210	60	49	64	83	152	213	115	137	44	24

Note: Values in 1000s of metric tons. Source: Waterborne Commerce Statistics Center.

Table 17. Cement Throughput and Growth Rates through Port of Palm Beach, FL

Period	Compound Annual Growth Rate	Total Tonnage Throughput (metric tons)	Average Annual Throughput over Period (metric tons)
1996 – 2005	1.47%	1,432,000 tons	143,200 tons
2000 – 2007	12.55%	874,000 tons	109,250 tons

Source: Waterborne Commerce Statistics Center.

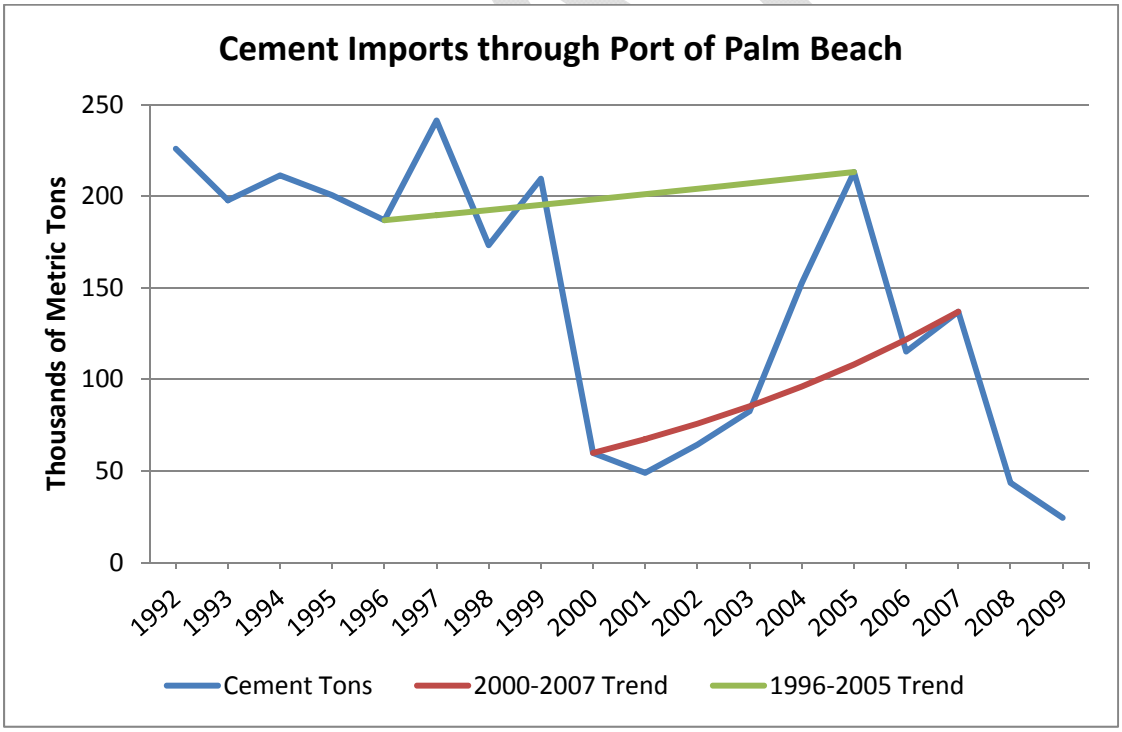


Figure 24. Cement Imports through Port of Palm Beach, with Trend Lines
Source: Waterborne Commerce Statistics Center.

4.2.2.2 Description of Market & Drivers of Demand

Demand for cement and asphalt is primarily related to the demand for infrastructure construction and repairs (roadways), as well as for residential and commercial construction and repairs. Long-run demand for these types of construction is ultimately dependent upon population growth (Table 14). During the 10-year period from 1996-2005, Palm Beach County's population growth rates slightly exceeded the growth rates of the South Florida Hinterland Counties and the entire State of Florida (Table 18). Another key indicator of demand for cement is residential building permits (Table 19 and Table 20).

Table 18. Historical Population Growth Rates

Area	Period	Compound Annual Growth Rate
Palm Beach County	1996-2005	2.50%
South Florida Hinterland	1996-2005	2.23%
State of Florida	1996-2005	2.28%
Palm Beach County	2000-2007	1.95%
South Florida Hinterland	2000-2007	1.95%
State of Florida	2000-2007	2.25%

Source: Florida Demographic Estimating Conference, February 2009; and Florida Demographic Database, August 2009.

Table 19. Historical Residential Building Permits in South Florida Hinterland

County	1990	1995	2000	2005	2009	CAGR (1990-2005)	CAGR (1996-2005)
Broward	5808	8489	9362	3826	607	-2.7%	-10.0%
Indian River	1068	836	1278	3702	285	8.6%	16.6%
Martin	904	947	1072	1235	109	2.1%	1.7%
Miami-Dade	5416	7794	6465	10500	683	4.5%	11.2%
Orange	6352	5500	6474	11303	1837	3.9%	7.3%
Osceola	2633	1570	3215	6002	650	5.6%	13.5%
Palm Beach	6199	7672	7016	8960	1128	2.5%	0.6%
St. Lucie	2335	1286	1752	8095	256	8.6%	20.3%
South Florida Hinterland Total	**30715**	**34094**	**36634**	**53623**	**5555**	**3.8%**	**5.2%**

Note: CAGR = Compound Annual Growth Rate. Source: US Census Bureau

DRAFT

Table 20. Historical Privately-owned Residential Building Permits for Select South Florida Counties by Year (1990-2009)

County	1990	1991	1992	1993	1994	CAGR
Broward	5808	4984	6840	9999	10961	17.2%
Indian River	1068	855	763	886	1089	0.5%
Martin	904	648	786	978	912	0.2%
Miami-Dade	5416	4496	5825	5982	6506	4.7%
Orange	6352	5546	5927	6034	6355	0.0%
Osceola	2633	1728	2037	1986	1690	-10.5%
Palm Beach	6199	5502	6669	7341	8860	9.3%
St. Lucie	2335	1518	1472	1515	1562	-9.6%

County	1995	1996	1997	1998	1999	CAGR
Broward	8489	9904	7860	9137	8810	0.9%
Indian River	836	927	938	1092	1129	7.8%
Martin	947	1057	1018	1062	1074	3.2%
Orange	5500	6020	6187	7234	7560	8.3%
Osceola	1570	1915	3068	2720	3163	19.1%
Palm Beach	7672	8506	6477	6583	6696	-3.3%
St. Lucie	1286	1532	1402	1469	1688	7.0%

County	2000	2001	2002	2003	2004	CAGR
Broward	9362	8476	6003	4133	5021	-14.4%
Indian River	1278	1271	1512	1841	3740	30.8%
Martin	1072	972	1458	1443	1287	4.7%
Miami-Dade	6465	7387	6741	9252	10079	11.7%
Orange	6474	7585	8442	10210	11925	16.5%
Osceola	3215	3614	3669	4742	6443	19.0%
Palm Beach	7016	7722	9707	11150	10581	10.8%
St. Lucie	1752	2201	3391	6902	7739	45.0%

County	2005	2006	2007	2008	2009	CAGR
Broward	3826	3740	1910	991	607	-36.9%
Indian River	3702	2882	1149	626	285	-47.3%
Martin	1235	941	326	185	109	-45.5%
Miami-Dade	10500	7193	3540	1213	683	-49.5%
Orange	11303	9817	4292	2539	1837	-36.5%
Osceola	6002	5916	2434	1068	650	-42.6%
Palm Beach	8960	4874	2182	1358	1128	-40.4%
St. Lucie	8095	4713	1727	710	256	-57.8%

Note: CAGR = Compound Annual Growth Rate over 5 year period shown in each sub-table.
Source: U.S. Census Bureau

4.2.2.3 Cement Tonnage Projections

Cement tonnage in these projections is used as proxy for all cement and cement input materials. Total "cement" tonnage represents cement, aggregate, and other bulk minerals used in the production of cement, such as bauxite, alumina, and silica sands. Some of these other input minerals must be imported as they are not produced domestically. Therefore, there will always be a demand to import some input minerals, even if demand for cement is relatively low.

In order to project the tonnages of cement and cement input products that will transit through the Port of Palm Beach in the future with- and without-project conditions, historical data and future projections of related factors such as population growth and residential construction expenditures were all examined. Since the Port of Palm Beach is not the only South Florida port to import cement, it is

DRAFT

necessary to include the import tonnages through Port Everglades to show a clear historical relationship between residential building permits and cement import tonnages (Figure 25).

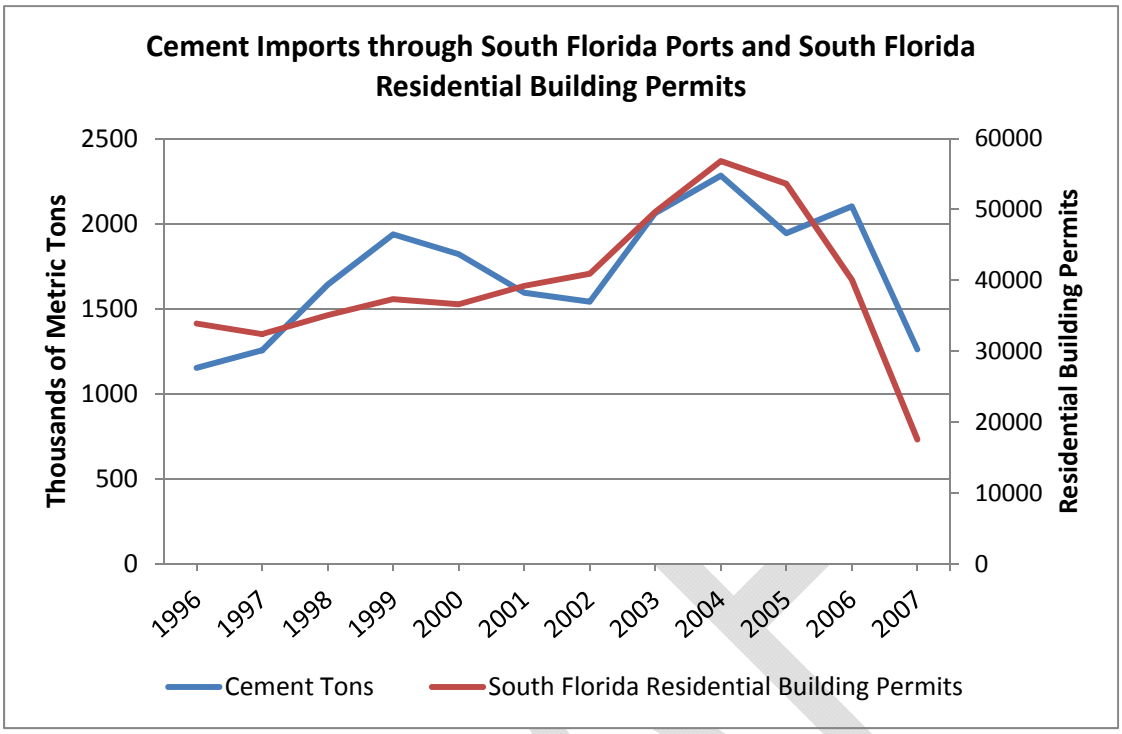


Figure 25. Cement Imports through South Florida Ports and South Florida Residential Building Permits (1996-2007)
Note: Includes tonnages through Port of Palm Beach and Port Everglades.
Sources: U.S. Census Bureau and Waterborne Commerce Statistics Center.

A growth scenario that was used to calculate primary project benefits, Scenario 2, and several alternative growth scenarios were developed based on this information. A summary of the projections is shown below in Figure 26, Table 22, and Table 21. Detailed description of how the projection was developed for Scenario 2 is contained in the following section. More detailed discussion on these other growth scenarios for cement can be found in the sensitivity analysis section, Section 6.

Table 21. Summary Description of Projection Methods for Cement

Projection	Summary of Method	Base-year Tonnage	Growth Rate / Equation
Scenario 2	Ratio of 96-05 residential construction permits to population growth	40% of 1997 peak cement import tonnage at Port	2.35%
Scenario 3	Linear regression of scaled long-term U.S. cement imports	Projected using linear regression equation	Linear Regression equation: *y=3.6461(x-1969)*
Scenario 1	Ratio of 96-05 cement imports at Port of Palm Beach to population growth	40% of 1997 peak cement import tonnage at Port	0.66%
Scenario 4	Based on input from interview with industry representative who currently imports cement products at Port of Palm Beach	120k short tons (from industry input)	double in 10 years; then 0% growth for remaining period of analysis

Table 22. Detailed Projected Import Tonnage of Cement Products through Port of Palm Beach

Projection	2017	2022	2027	2032	2037	2042	2047	2052	2057	2062	2067
Scenario 2	96.5	108.4	121.7	136.7	153.5	172.4	193.6	217.4	244.1	274.2	307.9
Scenario 3	175.0	193.2	211.5	229.7	247.9	266.2	284.4	302.6	320.9	339.1	357.3
Scenario 1	96.5	99.8	103.1	106.6	110.1	113.8	117.6	121.6	125.7	129.9	134.2
Scenario 4	108.9	163.3	217.8	217.8	217.8	217.8	217.8	217.8	217.8	217.8	217.8

Note: Values shown in 000 metric tons

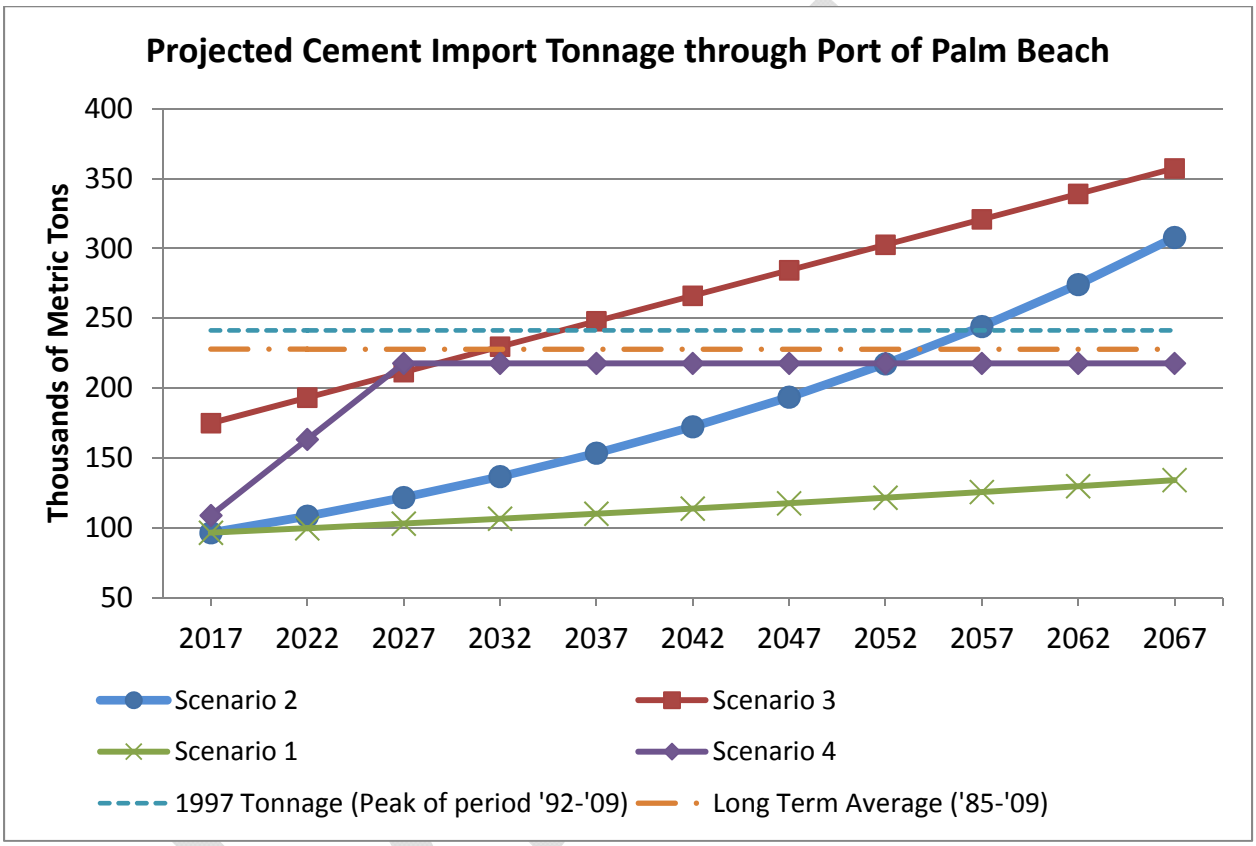


Figure 26. Graph of Projected Import Tonnage of Cement Products through Port of Palm Beach

4.2.2.4 Scenario 2 Projected Cement Import Tonnage Growth Rate and Assumptions

The Scenario 2 growth scenario was used for primary benefits calculations for the project. Its growth rate was derived from the ratio of compound annual growth in South Florida residential construction permits to compound annual growth rate in South Florida population over a 10-year period, 1996 to 2005 (Figure 27). This ratio was then applied to future population compound annual growth projections in South Florida from 2010-2030 (1%) to get a projected growth rate for import tonnage of cement and cement input products through the Port of Palm Beach over the entire period of analysis. The base project-year (2017) tonnage is based on 40% of the 14-year peak (1997) import tonnage through the Port (241,300 tons * 40% = 96,500 tons).

$$\frac{5.23\%}{2.23\%} = 2.35\ ratio\ of\ historical\ residential\ construction\ to\ population\ growth$$

$$2.35 * 1.00\% = 2.35\%\ projected\ growth\ rate\ for\ cement\ import\ tonnage$$

Figure 27. Calculations for Projected Cement Growth based on Historical Ratio of Residential Construction to Population Growth

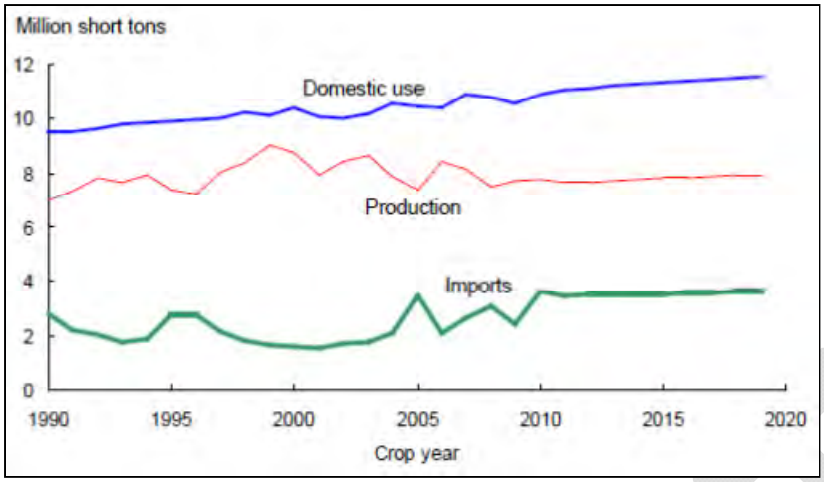
Assumptions behind using the ratio of residential construction permits to population growth over a 10-year period were that the demand for cement would be highly correlated to residential construction, which is a direct function of residential building permits. Along with residential construction comes an increased demand for infrastructure and related commercial and industrial buildings. All of these factors will play a role in riving the demand for cement. The assumption behind using 40% of the peak tonnage as the base-year tonnage was that this would represent a rebound in the construction industry, but still not a full return to historical mean import tonnage (126,000 metric tons on average from 1996-2009). It is not until 2029, over 10 years into the project, are annual tonnages expected to surpass the long-term historical average tonnage. By 2057, 40 years into the project, annual tonnages are expected to surpass the historical peak import tonnage. This growth scenario is a conservative estimate compared to the Scenario 4 estimate from industry input, and the Scenario 3 growth scenario which is based on national long-term growth trends. More detailed discussion on these other growth scenarios for cement can be found in Section 6.

4.2.3 Sugar and Molasses

Sugar and molasses are both major commodities that are shipped from the Port of Palm Beach through the Florida Sugar & Molasses Exchange, Inc. In 2007-2008, Florida cane sugar made up an estimated 48 percent of the cane sugar and 24.3 percent of the total sugar produced in the U.S. (from sugarcane and beets, combined) (UF/IFAS, Florida Sugarcane Handbook, SS-AGR-232, August 2009). About half of that amount was shipped out via domestic barge through the Port of Palm Beach. Domestic sugar refineries that typically receive Florida sugar via ocean-going barge are located in Yonkers, NY, Baltimore, MD, Savannah, GA, Chalmette, LA, and Gramercy, LA.

Molasses production is a direct by-product of sugar production and therefore its growth is inherently related to growth in production of sugar. These commodities will likely experience very slow but steady growth in the future up until the limit of production capacity in Florida is reached, at which point growth in production will remain constant. On a national level, the USDA expects sugar for human consumption to grow at approximately 0.6 percent per year (Figure 28). This level of growth is less than the projected growth rate of the population of the U.S. Therefore, this projection leads to a scenario in which per capita sugar consumption will decline slightly by 2019. Molasses is generally used as an additive in feed for livestock. Molasses is shipped through the port of Palm Beach via foreign-flagged products tankers to ports in Northern Europe.

This analysis assumes that sugar and molasses tonnage movements will likely return to 2004 levels by 2017 and then experience no growth over the period of analysis.



Source: USDA Agricultural Projections to 2019 (OCE-2010-1), February 2010.

Figure 28. U.S. Sugar Production, Use and Imports (1990-2019)

4.2.4 Containerized Cargo

The container traffic through the Port of Palm Beach is primarily moved by Tropical Shipping, who services the Caribbean islands with consumer goods, food, and retail products from the United States and Canada. For goods being exported in containers, their hinterland encompasses the entire U.S., parts of Canada, and some international goods for re-export.

Tropical Shipping has experienced steady historical growth up to the recession of 2008-2009. The post-recession number of container shipments is expected to continue to grow into the future at a rate of about 3 percent per year, according to Tropical's own estimate (personal communication on July 21, 2010). The rate of growth attributed to containerized cargo exports from the Port of Palm Beach is directly related to demand for goods in the Caribbean islands, which is primarily influenced by growth of travel and tourism in the area. Real growth of demand for the travel and tourism industry in the Caribbean is projected to increase by 3.9% per year to $107 billion by 2020 (World Travel and Tourism Council, 2010). Therefore, a growth estimate of 3 percent per year is reasonable, and it was applied to the 2011 PIERS' forecast, through 2037, at which point the Port will likely approach its throughput capacity.

4.2.5 Non-Containerized General Cargo, Break Bulk and Specialty Shipments

Although general cargo movements have historically made up a smaller portion of commodity traffic at the Port of Palm Beach, a relatively new tenant, Port Contractors, Inc., has been handling various types of break bulk, project cargo and specialty goods since the fourth quarter of 2008. They move many different goods, such as heavy equipment, wire rod, linerboard paper, telephone poles, and equipment for FPL, from many different markets, such as Europe, the Mediterranean, Central America, and the Caribbean. Additionally, they specialize in large yacht relocation services. The yachts shipped are typically up to 200 feet long and placed on the deck of a loaded general cargo ship.

DRAFT

Port Contractors have grown their commodity movement tonnages exponentially in the first two years of operations at the Port and expect to continue to move a greater quantity of miscellaneous break bulk goods, specialty cargo, and yachts each year. The rate of growth estimated for all non-containerized general cargo is the same as the compound annual growth rate projection for South Florida population growth, 0.96 percent.

4.2.6 Cruise Passengers

From 1997 to 2010, the *Palm Beach Princess* operated as a day-cruise out of the Port of Palm Beach. Day-cruises offer dining and gambling, once the ship has reached international waters. The *Princess* sailed twice daily throughout its time at the Port. In late 2009, the *Princess* suffered mechanical and financial troubles, which were compounded by decreased attendance because of unfavorable economic conditions nationwide. The operators of the Princess filed for bankruptcy and have relocated the ship as of April 7, 2010.

As of March, 2010, a new overnight cruise ship has been operating out of the Port of Palm Beach, the *Bahamas Celebration*. The *Bahamas Celebration* can accommodate up to 1311 passengers at maximum capacity (not including crew), on approximately 178 vessel calls per year. They run a two-day route to Freeport, Bahamas and back, every other day. The Celebration Cruise Line has been operating at an average of 67% of maximum capacity from their first voyage throughout the remainder of calendar year 2010, as shown in Table 23, below. The only way for Celebration Cruise Lines to expand their current service would be to add a second vessel to their route, which would effectively double their current passenger capacity. This scenario is a best-case future growth scenario. Since the cruise line has only been operating from March, 2010, and the industry exhibits high seasonality, it is not possible to determine a likely future growth estimate.

Table 23. Bahamas Celebration Cruise Passenger Statistics by Month in 2010

Month	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Total Passengers	8,245	15,222	13,841	15,968	17,831	15,651	8,892	10,057	10,239	10,867	126,813
Number of Voyages	8	15	15	15	16	15	15	16	15	15	145
Avg. Passengers Per Voyage	1,031	1,015	923	1,065	1,114	1,043	593	629	683	724	882
Avg. Percent of Full Capacity	79%	77%	70%	81%	85%	80%	45%	48%	52%	55%	67%

Note: First record is March 17, 2010.
Source: U.S. Customs and Border Protection

Before the *Bahamas Celebration* began to sail out of the Port of Palm Beach, the Port renovated its current cruise passenger terminal to accommodate the larger vessel and greater number of passengers. The Port also left the smaller day-cruise passenger terminal intact and ready to service another day-cruise. Because of the general success of the *Palm Beach Princess* during its 13-year life at the Port of Palm Beach, another day-cruise vessel, the *Black Diamond*, has already begun operating. The Port has accepted a contract from a new operator of the vessel *Black Diamond*, a 160 ft cruise vessel with a capacity of 600 passengers and 150 crew members. The *Black Diamond* began service in November 2012

and operates on a twice-daily schedule similar to the schedule of the *Palm Beach Princess*. The *Black Diamond* will also provide regional economic development benefits because it is a U.S. flagged vessel and it will employ 150 local workers. The Port of Palm Beach will realize increased revenues from parking and passenger fees as well.

4.3 Future With- and Without-Project Vessel Movements

The future without-project vessel fleet will be similar to the composition of the existing fleet, particularly in the fact that it will be draft-constrained by the existing project depth minus under-keel clearance; and length-constrained by the sharp turn in the entrance channel. Under without-project conditions the future fleet will call at 30 foot drafts maximum for (non-petroleum) liquid bulk and dry bulk (33 foot project depth minus 3 foot under-keel clearance requirements). Compared to the existing condition, one main difference will be the number of vessel calls. The future without-project vessel calls were projected by applying the forecasted commodity tonnage for each commodity type to a vessel fleet distribution that is similar to the existing condition fleet mix. The future without-project vessel movements are summarized in Table 24, below.

The future-with project vessel calls were projected by applying the forecasted commodity tonnage for each commodity type to a fleet distribution that minimizes total transportation costs by utilizing the most efficient mix of vessel sizes that take full advantage of increased channel width and depth in the future with-project conditions. The future with-project vessel movements are shown for the 39 ft project in Table 25, below. In these tables you can clearly see the shift from smaller to larger vessels for the primary benefitting bulk commodities. In the following subsections, the assumptions and caveats behind each of the vessel fleet predictions are detailed.

DRAFT

Table 24. Vessel Movements by Vessel Type and Class for Without Project

Project Condition:	Without Project	Calls by Project Year		
Vessel Type	Vessel Class	2017	2037	2067
Container	Container - 300 TEU	714	1093	1093
Container	Container - 600 TEU	8	28	28
Container	Container - 1000 TEU	52	93	93
Container	Container - 1200 TEU	50	90	90
Container	Container - 1400 TEU	2	16	16
Barge	Dry Barge - Sugar	46	46	46
Barge	Tanker Barge - Petroleum	30	37	52
Tanker	Tanker Molasses - 20k DWT	3	3	3
Tanker	Tanker Molasses - 25k DWT	9	9	9
Tanker	Tanker Molasses - 35k DWT	1	1	1
Tanker	Tanker Molasses - 50k DWT	0	0	0
Tanker	Tanker Molasses - 60k DWT	0	0	0
Tanker	Tanker Petroleum - 10k DWT	3	4	6
Tanker	Tanker Petroleum - 35k DWT	0	0	0
Tanker	Tanker Petroleum - 50k DWT	0	0	0
Tanker	Tanker Petroleum - 60k DWT	0	0	0
Bulker	Bulker Cement - 15k DWT	3	4	9
Bulker	Bulker Cement - 25k DWT	0	0	0
Bulker	Bulker Cement - 35k DWT	1	2	3
Bulker	Bulker Cement - 40k DWT	2	3	6
Bulker	Bulker Cement - 50k DWT	0	0	0
Bulker	Bulker Cement - 60k DWT	0	0	0
Gen Cargo	Gen Cargo - Small	94	114	127
Gen Cargo	Gen Cargo - 20k DWT	6	8	12
Gen Cargo	Gen Cargo - 24k DWT	1	1	3
Gen Cargo	Gen Cargo - 30k DWT	1	1	3
Gen Cargo	Gen Cargo - 37.5k DWT	0	0	0
Cruise	Cruise - Bahamas Celebration	182	182	182
Cruise	Cruise - Day Cruise	703	703	703
Total		1911	2438	2485

DRAFT

Table 25. Vessel Movements by Vessel Type and Class for 39FT Project

Project Condition:	39' + Widening	Calls by Project Year		
Vessel Type	Vessel Class	2017	2037	2067
Container	Container - 300 TEU	714	1093	1093
Container	Container - 600 TEU	8	28	28
Container	Container - 1000 TEU	52	93	93
Container	Container - 1200 TEU	50	90	90
Container	Container - 1400 TEU	2	16	16
Barge	Dry Barge - Sugar	46	46	46
Barge	Tanker Barge - Petroleum	11	14	22
Tanker	Tanker Molasses - 20k DWT	0	0	0
Tanker	Tanker Molasses - 25k DWT	0	0	0
Tanker	Tanker Molasses - 35k DWT	0	0	0
Tanker	Tanker Molasses - 50k DWT	3	3	3
Tanker	Tanker Molasses - 60k DWT	3	3	3
Tanker	Tanker Petroleum - 10k DWT	0	0	0
Tanker	Tanker Petroleum - 35k DWT	9	10	13
Tanker	Tanker Petroleum - 50k DWT	1	2	3
Tanker	Tanker Petroleum - 60k DWT	0	0	0
Bulker	Bulker Cement - 15k DWT	0	0	0
Bulker	Bulker Cement - 25k DWT	0	0	0
Bulker	Bulker Cement - 35k DWT	1	0	0
Bulker	Bulker Cement - 40k DWT	1	2	3
Bulker	Bulker Cement - 50k DWT	1	1	3
Bulker	Bulker Cement - 60k DWT	0	1	2
Gen Cargo	Gen Cargo - Small	94	114	127
Gen Cargo	Gen Cargo - 20k DWT	0	1	2
Gen Cargo	Gen Cargo - 24k DWT	2	1	4
Gen Cargo	Gen Cargo - 30k DWT	2	2	4
Gen Cargo	Gen Cargo - 37.5k DWT	1	2	2
Cruise	Cruise - Bahamas Celebration	182	182	182
Cruise	Cruise - Day Cruise	703	703	703
Total		1886	2407	2442

4.3.1 Design Vessel

The Institute for Water Resources (IWR) National Economic Development Deep Draft Navigation Manual defines a design vessel as the largest existing or future vessel call that is expected to use the harbor in on a recurring basis, but may be in insignificant numbers. The economic analysis should be able to show

DRAFT

that the fleet and commodity forecast support the size of the design vessel. If not, then a smaller design vessel should be used.

Three design vessels were identified for the ship simulation. The dimensions of the design vessels are shown in Table 26, below. The *Palm Beach Brewer* and *Black Rose* are both single-screw Panamax bulkers, which represent the largest vessels with least-capable handling that are expected to call in the with-project condition. These vessel sizes coincide with the largest vessel sizes used in the HarborSym modeling analysis (see Table 25 and Section 4.3.8). The *Norwegian Sea* is a larger cruise ship that could possibly call in the with-project condition when the existing cruise vessel reaches the end of its useful life, but it is not assumed to call in the future for the purposes of this study's economic analysis.

Table 26. Design Vessels Used for Ship Simulation

Ship Name	Palm Beach Brewer	Black Rose	Norwegian Sea
Condition	Loaded	Loaded	Design
Tonnage	62,820	65,085	19,810
LOA (ft)	656	707	710
Beam (ft)	106	105	93.2
Draft Fwd (ft)	40.02	40.02	22.3
Draft Aft (ft)	40.02	40.02	22.3
Propulsion	Diesel	Diesel	Diesel
Bow Thruster hp	none	none	2,682
Stern Thruster hp	none	none	2,682
Shaft HP	13,357	13,512	14,161
Propeller	1 Fixed	1 Fixed	2 Variable
Propeller Direction	CW	CW	Inward
Max Rudder	35	35	35

4.3.2 Residual Fuel Oil and Diesel

The 2017 base year for liquid petroleum projections assumes that growth will continue from 2010 on, as the local demand returns to normal from recession levels. The 2017 level of liquid petroleum products was determined by first calculating the 2011 tonnage of imports for diesel fuel and residual fuel oil, as self-reported by port tenants. Then growth rates were applied to these commodities using the projected national rates of growth of demand for electricity and transportation energy, respectively (USEIA, Annual Energy Outlook 2010).

In the without project condition, receipts of fuel oil continue to move primarily by domestic tug and barge. With the large reduction in fuel oil receipts because of the Riviera Beach power plant conversion to natural gas, it is less likely that the fleet of tanker vessels carrying fuel oil will transition to self-propelled vessels in the without-project condition. Diesel fuel will continue to be brought in by domestic tug and barge in the without-project condition as well. However, in the with-project condition, a

transition to self-propelled tankers would be likely because of the economies of scale offered by bringing in larger vessels, as well as the benefits of reduced sailing restrictions and less tugs used.

4.3.3 Asphalt and Cement

Asphalt would continue to by domestic tug barge in the future without-project condition. As asphalt receipts are expected to rise steadily, in the future with-project condition a transition of fleet to larger self-propelled tanker vessels would be likely because of economies of scale and benefits from fewer vessel movements, and less tugs used. However, the amount of asphalt that can be moved through the Port is not only constrained by demand from the hinterland, but also from the available storage facilities at the Port.

Cement receipts are already moved via self-propelled bulk ships, which are currently draft-constrained given the evidence that the largest cement vessels calling in recent years have had up to 37.7 foot design drafts. Cement ships also use tug assistance the most frequently. In the future with-project scenario, cement carriers would likely be larger vessels approaching 50,000 DWT, which would draw deeper drafts, and, if the channel were wider, they might use tug assistance less frequently. The main advantage of using larger vessels would be a transportation cost savings in the form of fewer shipments to move a similar amount of goods. In addition, the larger channel dimensions would relieve some of the sailing restrictions to which large bulk vessels must currently adhere.

4.3.4 Sugar and Molasses

Sugar and molasses have traditionally been two of the Port of Palm Beach's major domestic shipment and foreign export commodities. In the future without-project scenario, sugar and molasses tonnage movements will likely return to 2004 levels by 2017 and then experience no growth over the period of analysis because of how close the production level will be to the limit of sugar production in Florida, which is constrained by land available for production. Without capacity restrictions the growth rate of sugar production in Florida would follow the U.S. growth rate, which is forecasted to be 0.6 percent (USDA, 2010). Sugar would continue to move by domestic tug and barge in both the without-project and with-project conditions because of national price supports for US sugar production.

Molasses is generally exported to Europe for use in animal feed and other food products. The molasses products tankers are currently draft constrained, as the largest vessels that have called in recent years have design drafts up to 41 feet. Molasses products tankers (like cement vessels) also use the greatest number of tug assistance. In a future with-project condition, molasses tanker size would generally increase with a deeper channel, and their use of tugs would likely decrease with a wider channel.

4.3.5 Containerized Cargo

Tropical currently offers at least 6 different liner services, which visit nearly 30 Caribbean ports. Their total average capacity is 3000 TEUs per week through the Port of Palm Beach for all of their liner services combined, using mainly feeder-type vessels with capacities of less than 1000 TEUs. Extrapolated over the entire year, the total annual capacity for all Tropical Shipping services through the Port of Palm

Beach is approximately 156,000 TEUs per year. According to Tropical, an estimated 135,000 loaded TEUs moved in 2010, which means they were operating at about 86.5% of their total capacity. Through chartering vessels to meet excess demand, Tropical can expand their liner services accordingly in a relatively short time period compared to building or purchasing a new vessel. However, once demand reaches a certain threshold it is more economical for Tropical to build or purchase a new vessel for their fleet.

The rate of growth attributed to containerized cargo exports from the Port of Palm Beach is directly related to demand for goods in the Caribbean islands that are serviced by Tropical Shipping. The demand for goods in the Caribbean islands is primarily influenced by growth of travel and tourism in the area. Travel and tourism direct industry's real GDP in the Caribbean has been estimated to grow at rates up to 4.2 percent from 2010 to 2020 (World Travel and Tourism Council, 2010). Therefore, the tenant's own growth estimate of 3 percent per year was applied to the 2009 number of loaded and empty TEUs as recorded by the Port, and extrapolated through 2037, at which point the Port will likely approach its throughput capacity.

4.3.6 Non-Containerized General Cargo and Specialty Shipments

Even with relatively low commodity tonnages and growth rates, the vessels calling the Port of Palm Beach in the future for general cargo shipments will likely be some of the largest vessels. This is primarily because the largest of these vessels are calling already fully loaded in order to pick up or deliver specialty shipments, such as yachts or project cargo. The existing fleet of the largest general cargo ships is already draft-constrained by the current channel depth, and it is length constrained by channel width. In the future without-project scenario, these limits will continue to be hardships for the port tenants that move these types of goods. Project cargo and yachts generally are placed on the top deck of a loaded general cargo ship. If the channel depth is limited, then the ships must light load in order to be able to call the Port of Palm Beach as the first stop or last stop in their route with the specialty goods on the top deck.

The largest general cargo vessels that have called in recent years have had lengths up to 655 feet, and design drafts up to 36.75 feet (Table 12). In the future without project, these vessels will continue to be draft and length constrained. With a deeper and wider channel in the with-project condition, vessels of this type will be larger and more able to more fully load to their design drafts with other types of cargo before calling Palm Beach to load or unload specialty cargo.

4.3.7 Cruise Passengers

Currently, the Bahamas Celebration, at 673.4 feet long, is the largest cruise vessel that will fit through the turn in the entrance channel of Lake Worth Inlet. In the future without-project condition, the overnight cruise vessels will remain length constrained because of the sharp turn in the entrance channel. So, if Celebration Cruise Line were to add a second vessel to their fleet, it would be of a similar length. The overnight cruise vessel is only subject to current constraints under high wind conditions in the without-project condition (Table 1). Under with-project conditions, this restriction would be lifted.

Under with-project conditions, a longer cruise vessel may be likely to call as well. The day-cruise vessel would be the same in the with- and without-project conditions.

4.3.8 Future Without- and With-Project Vessel Size Comparison Summary

Currently, the largest self-propelled vessels will be limited to the 30,000 to 35,000 DWT range. With a deeper channel, larger vessels upwards of 50,000 DWT could operate into the Port with the result of carrying additional cargo on fewer dry bulk and general cargo vessels. A deeper channel would also result in more self-propelled tanker vessels for imports of diesel and asphalt (shifting from domestic barge).

Under with-project conditions there will likely be a decrease in the number of vessel calls because of a replacement of smaller vessels and some barges with larger vessels. Depending on future with-project channel depth, Panamax-beam dry bulk vessels are expected to call between approximately 50,000 and 60,000 DWT. Under with-project conditions there will be a shift from domestic tug and barge to self-propelled tankers for liquid petroleum bulk movements.

5 National Economic Development Benefits

The Planning Guidance Notebook, Engineer Regulation 1105-2-100, gives specific details of what can be considered a NED benefit for deep-draft navigation improvement projects. The NED benefits for the Lake Worth Inlet project were determined using the transportation cost reduction method. Transportation cost reductions, in the most basic terms, are calculated by subtracting the total cost of moving all of the goods through the port over the period of analysis in the with-project condition from the total cost in the without-project condition. Total transportation costs were calculated using the Corps-certified HarborSym simulation model.

5.1 Economic Model Setup and Inputs

5.1.1 Methods and Key Assumptions

Transportation cost savings benefits in the study were derived from increased efficiencies in the movement of cargo. For the purposes of this study, all benefits from reductions in transportation costs were assumed to have the same destination, and harbor with and without the project. For the sake of simplification of the analysis, it was assumed that increased efficiencies would reduce transportation costs without affecting the demand for import and export of goods through the harbor. This means that the commodity tonnages forecast to be transited through Palm Beach Harbor are expected to move with or without the proposed improvements. There will be no expected shift in destination, mode of transportation, or any induced movement of cargo due to the proposed navigation improvements. However, for some petroleum products there will be a shift in origin from the U.S. Gulf Coast to East Coast of South America and the Caribbean. Transportation cost savings will result primarily from the use of larger, more efficient vessels, more efficient use of large vessels that are currently transiting the harbor, and reduced congestion in the harbor.

Other primary assumptions include: that the rest of origin to destination and land-side costs remain the same in with-and without project; changes in additional fees (such as dockage, wharfage, tug-assist, etc.) were minimal and therefore were not included in the analysis.

The Corps-developed HarborSym model (version 1.4.8) was used to calculate transportation costs for entire routes and time in port for all vessel calls projected throughout the period of analysis. HarborSym was created by CDM-Smith (under contract) to serve as the primary Corps'-certified economic model for Deep Draft Navigation projects. For this study HarborSym version 1.4.8 was used for all final production modeling, and benefit calculations. The HarborSym Model has been certified for use on all deep draft navigation studies in accordance with Engineering Circular 1105-2-412, Assuring Quality of Planning Models.

HarborSym performs data-driven Monte Carlo simulations of vessel transits through harbors, based on user input. The model incorporates uncertainty through randomizing parameters over multiple model iterations, based on a user-inputted range for parameters such as vessel speed through a specified area (reach), loading and unloading times at docks, docking and undocking times, at-sea distances, etc.

The simulations are based upon vessels moving through reaches from the harbor entrance to their destination dock. At each time increment (step) the model determines if each vessel can move from one node to the next, without violating transit rules. If a transit rule would be violated by a vessel entering a reach, such as passing another vessel when the channel width is too narrow, then the vessel waits until the next time step. This waiting continues until the rule is no longer violated and the vessel resumes its journey.

HarborSym records and accumulates the total time and cost of vessel transits through the harbor and at sea. Since many variations of events can occur over a total voyage, many iterations of the simulation were run to obtain the average values for time in the harbor, time waiting, and total operating costs of vessels in the harbor and at sea.

Assumptions that were included in the development of the HarborSym model or are limitations of using the model are described in the following lists. The limitations of the model were not considered significant for the purposes of this study.

HarborSym Model limitations:

- Tug use and tug costs are not included.
- Wind is not simulated.
- Loading/unloading costs at the port of origin/destination (for imports/exports respectively) are not included.
- Additional handling fees at the study port or foreign port are not included.
- Pilotage costs and other terminal fees for the study port are not included.
- Hinterland transportation costs are not included.
- Ability to account for other fixed costs is not included.

Assumptions in model:

- HarborSym predefined assumptions:
    - All vessels can be classified into classes of similar vessels which exhibit similar operating costs and other characteristics.
    - All vessels of a similar type will have a similar commodity transfer rate for a specific commodity.
    - Arrival times for non-priority vessels will vary randomly within a 24 hour window of the originally designated arrival time.
    - Costs external to the port are the same for all conditions.
- Study-specific assumptions:
    - All vessels are foreign flagged except barges, which are all U.S. flagged.
    - Underkeel clearance for all non-petroleum carrying vessels is a minimum of 3 FT.
    - Underkeel clearance for all petroleum-carrying vessels is a minimum of 4 FT.
    - Vessel sailing draft distribution only differs within a vessel type.
    - Vessels in a vessel class for a specific commodity have the same commodity loads transferred and sailing drafts for a specific project alternative and year.
    - For simplification purposes, container vessels export goods only.
    - For simplification purposes, large cruise vessels export passengers only.
    - For simplification purposes and to utilize separate loading rates, smallest general cargo ships (<20,000 DWT) export goods only, while largest general cargo ships import goods only (>=20,000 DWT).
    - For simplification purposes, all containers were assumed to be 5 metric tons per TEU in the model.
    - Vessels will wait up to 4 days to berth before turning away (deleted from system).
    - For draft-constrained vessels, as project depths increase, vessel fleet will transition to the most optimal combination, while observing other constraints such as land-side capacity.

Additional information on the use of HarborSym for this study can be found in the Economic Model Documentation appendix (Appendix H).

5.1.2 Vessel Operating Costs

The primary component of total transportation costs is vessel operating costs (VOCs). Vessel operating costs from VOC EGM 11-05 tables (dated 15 July 2011) were used for this study. Some ships were outside of the range of vessel sizes in the VOC tables; the costs for these vessels were interpolated or extrapolated using DWT or TEU capacity to proportion costs.

In HarborSym, at-sea costs were used while vessels were maneuvering within the harbor. There was not a separate entry available in the model to differentiate between sailing at-sea costs and maneuvering in-harbor costs. These costs were slightly overstated compared to actual maneuvering costs. However,

since Palm Beach Harbor has such a short entrance channel, it was determined that this lesser overstatement of costs in-harbor was better than a larger understatement of at-sea costs.

5.1.3 Routes

HarborSym refers to the routes that vessels travel as "route groups." Route groups represent the distances that vessels travel outside the study port to other ports along their respective routes. For this study, most of the route groups that were included apply to cargoes and vessel types that will benefit from channel deepening. Other vessel types and commodities that will not benefit from channel deepening were assigned to the "Default Route Group," which only has a placeholder distance of 1 nautical mile for each leg of the journey. Route group distances are summarized in Table 27.

Table 27. Route Groups with Distances from HarborSym Inputs

		Prior Port			
Name	Description	Min Distance	Most Likely	Max Distance	Limiting Depth
Default RtGrp	Default route group	1	1	1	85
Sugar	Sugar Route to Baltimore and NewYork	821	860	898	85
USTankBrg-Gulf	Gulf Coast US Tanker Barge Route with Split Shipment	23	70	131	85
Molasses	Molasses Tanker Route to Northern Europe	4004	4039	4073	85
Petrol-Split	Petroleum Imports with Split Shipment	23	70	131	85
Petrol-Direct	Petroleum Imports with Direct Shipment	74	832	1233	85
Cement-Split	Cement imports with split shipment	56	265.5	499.5	85
Cement-Direct	Cement imports with direct shipment	1188	1483	4253	85
GenCargo	General Cargo world-wide routes	262	1795	4004	85

	Next Port				Additional Sea Distance		
Name	Min Distance	Most Likely	Max Distance	Limiting Depth	Min	Most Likely	Max
Default RtGrp	1	1	1	85	1	1	1
Sugar	821	860	898	85	1	1	1
USTankBrg-Gulf	409.5	459	508.5	85	389.5	511	634.5
Molasses	4004	4039	4073	85	1	1	1
Petrol-Split	37	416	616.5	85	39	460.5	721
Petrol-Direct	74	832	1233	85	1	1	1
Cement-Split	594	741.5	2126.5	85	638.5	989	2366.5
Cement-Direct	1188	1483	4253	85	1	1	1
GenCargo	262	1100	6664	85	1	1	1

Notes: Distances are in nautical miles and depths are in feet. 85 ft limiting depth indicates no limitations at other ports on route.

Route groups were determined based on Waterborne Commerce Statistics Center data, interviews with port tenants, and port-to-port distance estimates from http://sea-distances.com/. The basis for each route group is detailed in the paragraphs below.

The "Sugar" route group is based on a combination of the destinations of most sugar barges departing from the Port of Palm Beach. These primary destinations are Baltimore and New York. Since barges will go to either destination with equal probability, the two distances were averaged to create the most likely distance, while Baltimore was used for the minimum distance, and New York was used for the maximum distance. These min-most likely-max distances were used for both the prior port and next port distances because the barges will operate in a simple back and forth service.

The “USTankBrg-Gulf” route group is based on a combination of the origins and destinations of most US-flagged petroleum tanker barges that call the Port of Palm Beach. Tanker barges will originate from the Gulf Coast, usually from either New Orleans or Houston area petroleum refineries. The barges split their shipment between Florida ports, usually with a first port of call at Port Everglades, Port Canaveral or Jacksonville. Then Palm Beach is the second port of call before returning to the Gulf Coast. In the case of a split shipment, costs are also split between the shippers at each receiving port. To simulate this in the model, distances were halved for each of the distances on the route. Therefore, the “Prior Port” distances reflect half of the distances from other Florida ports to the Port of Palm Beach, the “Next Port” distances reflect half of the distances from the Port of Palm Beach to the Gulf Coast, and the “Additional Sea Distances” reflect half of the distances from the Gulf Coast to other Florida ports.

The “Molasses” route group is based on a combination of the destinations of foreign-flagged molasses tankers, departing from the Port of Palm Beach. These primary destinations are Dagenham on the Thames River near London, U.K. and Amsterdam, Netherlands. Since tankers will go to either destination with equal probability, the two distances were averaged to create the most likely distance, while London was used for the minimum distance, and Amsterdam was used for the maximum distance. These min-most likely-max distances were used for both the prior port and next port distances because the tankers will operate in a simple back and forth service.

The “Petrol-Split” route group is based on a combination of origins and destinations of petroleum tankers that operate in a split-shipment service with other Florida ports. The concept of this route is similar to the “USTankBrg-Gulf” route, except the origin is a foreign port instead of a domestic port. Tankers originate from either the Caribbean (Freeport, Bahamas and Willemstad, Curacao) or the East Coast of South America (Maracaibo, Venezuela). The tankers split their shipments between other Florida Ports and Port of Palm Beach, and then return to their origin after calling the Port of Palm Beach. In the case of a split shipment, costs are also split between the shippers at each receiving port. To simulate this in the model, distances were halved for each of the distances on the route. The “Petrol-Direct” route is similar to the Petrol-Split route, except that it excludes the distances to other Florida ports, and distances are not halved.

The “Cement-Split” route is based on a combination of origins and destinations of cement bulkers that operate in a split-shipment service with other U.S. ports. Cement bulkers will originate from the Caribbean (Netherlands Antilles), East Coast South America (Maracaibo, Venezuela), or Northern Europe (Aalborg, Denmark). They will stop at another U.S. East Coast or U.S. Gulf Coast port (Tampa, Jacksonville, New York, Port Canaveral, Providence, or Mobile), and then stop at the Port of Palm Beach before returning to the port of origin. In the case of a split shipment, costs are also split between the shippers at each receiving port. To simulate this in the model, distances were halved for each of the distances on the route. The most likely distances for each leg of the route are based on weighted averages of distances for that leg derived from Waterborne Commerce Statistics Center data. The “Cement-Direct” route is similar to the Cement-Split route, except that it excludes the distances to other U.S. ports, and distances are not halved.

The “GenCargo” route is based on a combination of origins and destinations for large general cargo vessels (sailing draft greater than or equal to 30 FT) that called the Port of Palm Beach. The most likely distances for each leg of the route are based on weighted averages of distances for that leg derived from Waterborne Commerce Statistics Center data. For modeling purposes, it was assumed that large general cargo vessels operate similar to bulkers in a back-and-forth pattern, and therefore no additional at-sea distance was included. In reality, large general cargo ships will often visit more than one port on a route, however, the large number of possible combinations of ports, limited available data, and relatively low project benefits made this reality not as valuable to include in the model in greater detail. Therefore, it was assumed that the large distribution between minimum and maximum distances for both prior and next ports will also cover the possibility of additional at-sea distances. This route group is only applied to the largest classes of general cargo ships; those that are greater than or equal to 20,000 DWT.

5.2 Economic Modeling Results and Plan Selection

Plan formulation started before any economic modeling took place. The first phase of screening used the ship simulation results to narrow down the widening alternatives to a single widening plan footprint that was used throughout all of the alternatives (Figure 29). In general, the entrance channel will be widened from 400’ to 440’ and 460’ (width varies), the inner channel (Cut-1 and Cut-2) will be widened from 300’ to 450’ minimum, and the south end of the main turning basin will be extended by 150’.

The widening footprint was refined and reduced over several iterations as environmental concerns were raised and addressed, costs were identified and refined, and as the widening plan was evaluated further by the harbor pilots with respect to the ship simulation results. Only a single widening footprint was modeled because the widening features had already been reduced to their smallest practicable dimensions, while still guaranteeing the necessary level of safety for larger vessels and rule changes according to the harbor pilots. Any greater widening measures would have increased the project costs without increasing the benefits, and therefore were not modeled.

The design vessels that were identified as the largest vessels that will call on a recurring basis were used in the ship simulation. The vessel tracks assisted in determination of the widening footprint. These vessels also determined the maximum inner channel depth to evaluate for deepening, 43 ft. A 43 ft inner channel project depth would allow the design vessels to transit the harbor fully-laden, without tide restrictions. All project depths in this appendix refer to the inner channel and main turning basin at mean lower-low water (MLLW).

The outer entrance channel will be several feet deeper than the inner channel and include widening features to account for wave action in the with-project condition. According to Engineer Manual (EM) 1110-2-1613, safe navigation will usually require a wider and deeper entrance channel than the port interior channel because navigation in entrance channels is often affected adversely by strong and variable (in space and time) tidal currents, rough seas and swell, breaking waves, and wind. See the Engineering Appendix (Appendix A) for more info on specific depths in areas of the project.

The existing project depth is 33 ft MLLW in the inner channel and turning basin. It was determined through interviews with port users and harbor pilots that some shipping and vessel-transit practices

would be changed to realize transportation cost savings if the channel were widened only, without deepening. Accordingly, a widening-only project alternative was evaluated for the 33 ft existing depth. Furthermore, the harbor pilots and port users maintained that widening would be required for any benefits to be recognized from deepening. Therefore, the intermediate array of project alternatives was identified for economic modeling as widening only, and for each 1 ft incremental depth, deepening from 34 ft to 43 ft with widening.

DRAFT

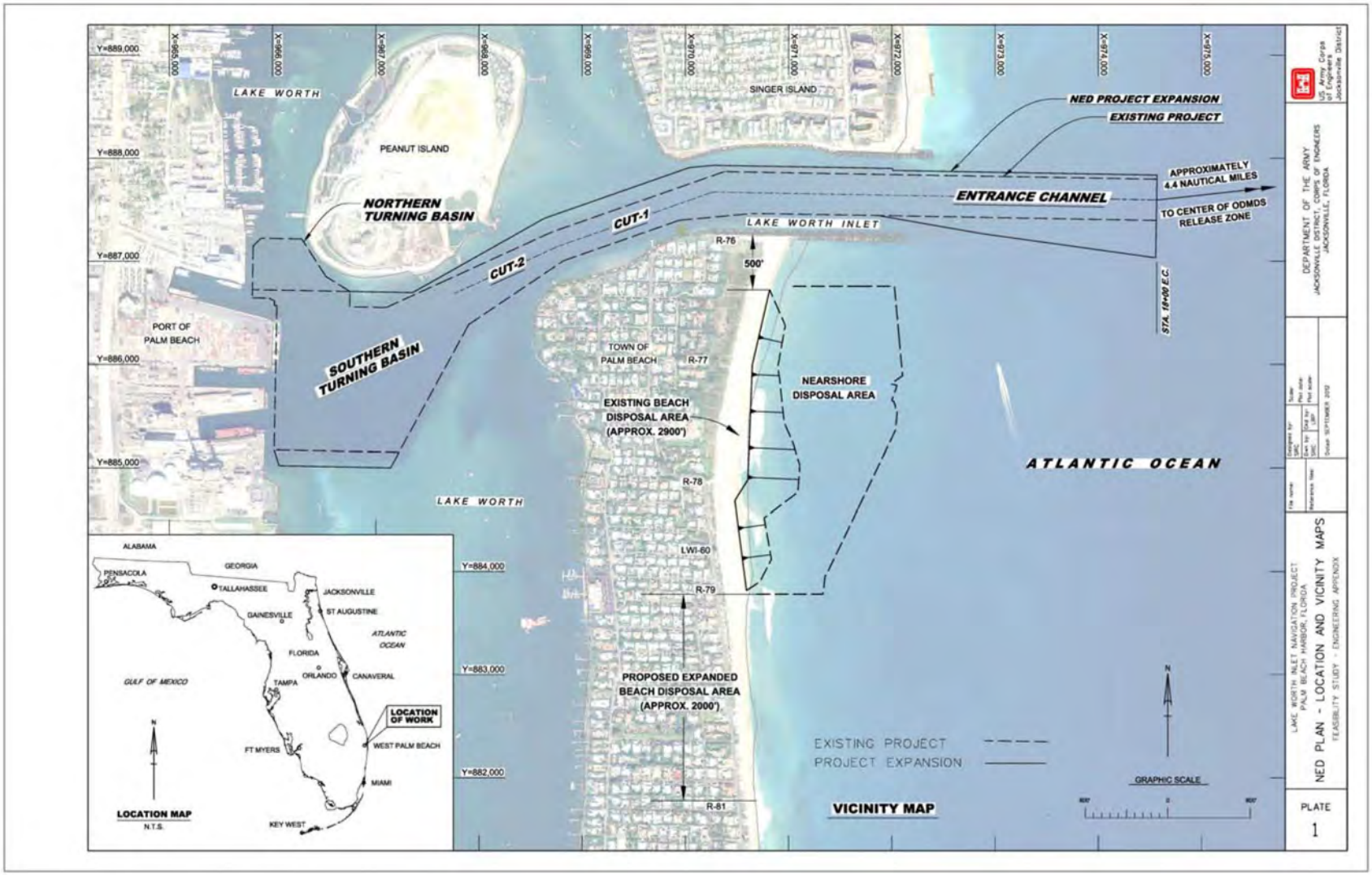


Figure 29. Recommended Plan Widening Features
Note: Figure is shown for reference purposes only.

5.2.1 Annual Cost Savings for Intermediate Array of Alternatives

Once the widening alternatives were screened down to one single set of widening features, the HarborSym model was used to analyze the "intermediate array" of alternatives. This first round of modeling was at a lower level of detail than subsequent modeling of the final array. One major difference is that the split-shipment route groups and distanced were not yet defined at this stage of the modeling effort. Also, to save time and study costs, only every other depth increment was modeled, and then benefits were interpolated between depths to compare the full array of alternatives. Finally, for the initial and intermediate screening, the costs shown were calculated at a lower level of detail, and interest during construction (IDC) was estimated based on uniform monthly payments instead of the actual construction schedule. The first level of modeling results and intermediate screening-level costs are shown in Table 28, Table 29, and Table 30, below.

Table 30 shows a summary of the net NED benefits and benefit-cost ratios for the intermediate array of alternatives. The alternative with the highest net NED benefits is the 40 ft project depth with widening. Both the 39 ft and 41 ft depth alternatives showed net NED benefits very close to the 40 ft depth.

Table 28. Intermediate Array of Alternatives Total Present-Value and Average Annual Benefits

Project (Depth)	Sum of Present-Value Total Transportation Cost Savings	Average Annual Transportation Cost Savings
Widening-Only	$ 92,360,668	$ 4,116,905
34'+Widening	$ 140,105,583	$ 6,245,097
35'+Widening	$ 154,813,739	$ 6,900,701
36'+Widening	$ 169,521,895	$ 7,556,306
37'+Widening	$ 184,230,051	$ 8,211,911
38'+Widening	$ 196,953,886	$ 8,779,066
39'+Widening	$ 209,677,721	$ 9,346,221
40'+Widening	$ 219,161,213	$ 9,768,940
41'+Widening	$ 228,644,705	$ 10,191,659
42'+Widening	$ 236,256,816	$ 10,530,963
43'+Widening	$ 243,868,926	$ 10,870,267

Notes: Annualized at 3.75% over 50 years. Linear interpolation was used for benefits of even-numbered depths. Benefits are based on 10-iteration model runs. Results based on preliminary version of model that did not account for practice of split-shipments of petroleum products and cement.

DRAFT

Table 29. Intermediate Array of Alternatives Total and Average Annual Project Cost

Project Depth +Widening (Feet)	Project Cost	Construction Duration (days)	Construction Duration (months)	Interest During Construction	Total Cost Including IDC	Average Annual Cost
33	$ 48,000,000	321	10.7	$ 723,144	$ 48,723,144	$ 2,171,796
34	$ 48,000,000	322	10.7	$ 725,546	$ 48,725,546	$ 2,171,903
35	$ 49,000,000	327	10.9	$ 752,700	$ 49,752,700	$ 2,217,688
36	$ 50,000,000	337	11.2	$ 794,760	$ 50,794,760	$ 2,264,137
37	$ 53,000,000	355	11.8	$ 891,974	$ 53,891,974	$ 2,402,193
38	$ 58,000,000	404	13.5	$ 1,125,621	$ 59,125,621	$ 2,635,478
39	$ 65,000,000	462	15.4	$ 1,459,427	$ 66,459,427	$ 2,962,377
40	$ 71,000,000	514	17.1	$ 1,788,055	$ 72,788,055	$ 3,244,471
41	$ 85,000,000	676	22.5	$ 2,873,359	$ 87,873,359	$ 3,916,886
42	$ 94,000,000	750	25.0	$ 3,548,866	$ 97,548,866	$ 4,348,164
43	$ 101,000,000	811	27.0	$ 4,145,108	$ 105,145,108	$ 4,686,761

Notes: Annualized at 3.75% over 50 years. Interest during construction estimated based on mid-month uniform payments. Jetty stabilization costs were only included from 41-43 ft project depths. Advanced maintenance costs not included. Construction duration months were calculated as construction duration days / 30.

Table 30. Summary of Intermediate Array of Alternatives Net Benefits and Benefit-Cost Ratios

Project (Depth)	Widening-Only	34'+ Widening	35'+ Widening	36'+ Widening	37'+ Widening	38'+ Widening	39'+ Widening	**40'+ Widening**	41'+ Widening	42'+ Widening	43'+ Widening
Average Annual Benefits	$ 4,116,905	$ 6,245,097	$ 6,900,701	$ 7,556,306	$ 8,211,911	$ 8,779,066	$ 9,346,221	**$ 9,768,940**	$10,191,659	$10,530,963	$10,870,267
Average Annual Costs	$ 2,171,796	$ 2,171,903	$ 2,217,688	$ 2,264,137	$ 2,402,193	$ 2,635,478	$ 2,962,377	**$ 3,244,471**	$ 3,916,886	$ 4,348,164	$ 4,686,761
Net Benefits	$ 1,945,109	$ 4,073,194	$ 4,683,014	$ 5,292,169	$ 5,809,718	$ 6,143,587	$ 6,383,844	**$ 6,524,469**	$ 6,274,773	$ 6,182,798	$ 6,183,506
BCR	1.90	2.88	3.11	3.34	3.42	3.33	3.15	**3.01**	2.60	2.42	2.32

Notes: Annualized at 3.75% over 50 years. Yellow shaded and bolded column represents highest net benefits (40'). Orange shaded columns are within 5% of highest net benefits (39' and 41').

5.2.2 Annual Cost Savings for Final Array of Alternatives

Based on the net benefit results of the intermediate array of alternatives, the final array of alternatives was identified as project depths from 38 ft to 41 ft, with widening for each. For the final array of alternatives, both the model and costs were refined to a higher level of detail. The model results now included the accounting for split-shipment practices for petroleum and cement. Also, each of these four depths was modeled, and none of the alternative's results were interpolated. The costs and benefits for the final array of alternatives are shown in Table 31, Table 32, and Table 33.

DRAFT

Table 33 shows a summary of the net NED benefits and benefit-cost ratios for the final array of alternatives. In the final array, the 40 ft depth alternative still shows the highest net NED benefits, but 39 ft is even closer compared to the intermediate array results, and 41 ft net benefits have fallen due to an increase in jetty stabilization feature costs, which are required at the 41 ft depth (when not considering advanced maintenance).

Table 31. Final Array of Alternatives Total Present-Value and Average Annual Benefits

Project (Depth)	38'+Widening	39'+Widening	40'+Widening	41'+Widening
Sum of Present-Value Benefits	$ 143,950,872	$ 164,350,855	$ 173,791,403	$ 174,849,043
Annualized Cost Savings	$ 6,416,498	$ 7,325,811	$ 7,746,616	$ 7,793,759

Notes: Annualized at 3.75% over 50 years. Benefits are based on 10-iteration model runs.

Table 32. Final Array of Alternatives Total and Average Annual Project Cost

Project Depth +Widening (Feet)	Project Cost	Construction Duration (days)	Construction Duration (months)	IDC Est. based on mid-month uniform payments	Total Cost Including IDC	Average Annual Cost
38	$ 66,000,000	299	10.0	$ 916,951	$ 66,916,951	$ 2,982,771
39	$ 73,000,000	369	12.3	$ 1,282,646	$ 74,282,646	$ 3,311,091
40	$ 79,000,000	459	15.3	$ 1,761,054	$ 80,761,054	$ 3,599,861
41	$ 94,000,000	521	17.4	$ 2,403,041	$ 96,403,041	$ 4,297,090

Notes: Annualized at 3.75% over 50 years. Interest during construction estimated based on mid-month uniform payments. 600 linear foot jetty stabilization costs were included for 41 ft project depth. Advanced maintenance costs were not included.

Table 33. Summary of Final Array of Alternatives Net Benefits and Benefit-Cost Ratios

Project (Depth)	38'+Widening	39'+Widening	**40'+Widening**	41'+Widening
Average Annual Benefits	$ 6,416,498	$ 7,325,811	**$ 7,746,616**	$ 7,793,759
Average Annual Costs	$ 2,982,771	$ 3,311,091	**$ 3,599,861**	$ 4,297,090
AA Net Benefits	$ 3,433,727	$ 4,014,720	**$ 4,146,755**	$ 3,496,669
BCR	2.15	2.21	**2.15**	1.81

Notes: Annualized at 3.75% over 50 years.

5.2.3 Annual Cost Savings for the Recommended Plan

Finally, the final array of plans was scrutinized more closely with respect to NED benefits including advanced maintenance and the required costs of jetty stabilization using planning-level costs (Table 34).

DRAFT

Table 34. Summary of Final Array of Alternatives Net Benefits and Benefit-Cost Ratios including Advanced Maintenance

Project (Depth)	38'+Widening	**39'+Widening**	40'+Widening	41'+Widening
Average Annual Transportation Cost Savings Benefits	$ 6,416,498	**$ 7,325,811**	$ 7,746,616	$ 7,793,759
Average Annual Advanced Maintenance Benefits	$ 250,588	**$ 250,588**	$ 250,588	$ 250,588
Total Average Annual Benefits	$ 6,667,086	**$ 7,576,399**	$ 7,997,204	$ 8,044,347
Average Annual Costs	$ 3,448,595	**$ 3,870,829**	$ 4,392,087	$ 4,773,324
AA Net Benefits	$ 3,218,490	**$ 3,705,570**	$ 3,605,117	$ 3,271,024
BCR	1.93	**1.96**	1.82	1.69

Notes: Annualized at 3.75% over 50 years. Interest during construction estimated based on mid-month uniform payments. 600 linear foot jetty stabilization costs were included for 40 ft and 41 ft project depths. 200 linear foot jetty stabilization costs were included for 39 ft project depth. Advanced maintenance costs were included.

In the previous section, Table 33 shows that the 40-foot alternative has the highest net benefits. The 39-foot alternative's net benefits were within 1% of the 40-foot alternative, but the net benefits for the 38-foot and 41-foot alternatives, respectively, are each more significantly lower than both the 39-foot and 41 foot alternatives. Additionally, Table 34 shows that the 39 ft plan returned the highest net benefits once the costs of advanced maintenance and jetty stabilization were included (see Section 6 for full advanced maintenance discussion).

ER 1105-2-100 states the following: "Identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost effective plans produce no significantly different levels of net benefits, the less costly plan is to be the NED plan, even though the level of outputs may be less." Therefore, the 39 ft plan was selected as the recommended plan. So, the 39 ft plan HarborSym model was re-run for 100 iterations to achieve a higher level of certainty surrounding the benefits. Results of the 100-iteration benefits model are shown in Table 35.

Table 35. Summary of Recommended Plan Net Benefits and Benefit-cost Ratio without Advanced Maintenance

Project (Depth)	39'+Widening
Sum of Present-Value Benefits	$ 158,380,000
Total Costs with IDC	$ 74,280,000
Annualized Cost Savings (Benefits)	$ 7,060,000
Annualized Costs	$ 3,310,000
AA Net NED Benefits	$ 3,750,000
BCR	2.13

Notes: Annualized at 3.75% over 50 years. Numbers rounded to nearest $10,000. Benefits are based on 100-iteration model runs. Interest during construction estimated based on mid-month uniform payments. Advanced maintenance costs were not included. Jetty stabilization at the 39ft depth is not necessary without advanced maintenance and therefore these costs were not included.

DRAFT

Table 36. Summary of Recommended Plan Net Benefits and Benefit-cost Ratio including Advanced Maintenance

Project (Depth)	39'+Widening
Sum of Present-Value Benefits	$ 158,380,000
Total Costs with IDC	$ 96,000,000
Annualized Transportation Cost Savings (Benefits)	$ 7,060,000
Annualized Advanced Maintenance Cost Savings (Benefits)	$ 250,000
Total Average Annual Benefits	$ 7,310,000
Total Average Annual Costs	$ 4,280,000
AA Net NED Benefits	$ 3,030,000
BCR	1.71

Notes: Annualized at 3.75% over 50 years. Numbers rounded to nearest $10,000. Benefits are based on 100-iteration model runs. Interest during construction estimated based on mid-month uniform payments. Jetty stabilization costs and advanced maintenance costs were included.

5.2.4 Cost Savings by Commodity

A breakdown of cost savings by commodity is shown in Table 37. This table shows that the largest portion of the NED benefits can be attributed to petroleum products (diesel and asphalt) at 43% of total benefits. These benefits are derived partly from the shift in vessels from barges to self-propelled tankers. Molasses benefits account for 27% of total benefits, and are derived from the more efficient use of existing vessels and utilization of larger vessels. Cement and general cargo together account for the remaining 30% of total NED benefits.

DRAFT

Table 37. Summary of Benefits by Commodity

Commodity	Tonnage	Total Cost WOP	Total Cost for 39' project	Total Cost Savings	Cost Savings per Ton	Percent of Total
Cement	307,869	$ 4,702,533	$ 3,387,215	$ 1,315,318	$ 4.27	13%
Molasses	264,628	$ 7,935,092	$ 5,301,442	$ 2,633,650	$ 9.95	27%
Petroleum	532,702	$ 9,585,851	$ 5,335,448	$ 4,250,404	$ 7.98	43%
General Cargo	197,425	$ 6,991,197	$ 5,346,582	$ 1,644,616	$ 8.33	17%
Total	1,302,624	$ 29,214,674	$ 19,370,687	$ 9,843,987		100%

Notes: Benefits are based on 100-iteration model runs. Commodity forecasts are based on "Scenario 2" cement growth for project year 2067. "Petroleum" includes asphalt, diesel, and fuel oil.

6 Advanced Maintenance and Life-cycle Cost Analysis

Analysis on advanced maintenance and total life-cycle costs:

The project area has a high rate of shoaling, which has historically often led to multiple maintenance events in a single year. The advanced maintenance plan for the existing project has recently been changed to reduce the frequency and magnitude of annual maintenance. This advanced maintenance plan was further improved upon during the course of this feasibility study to completely eliminate the need for annual maintenance in favor of a biennial cycle. The estimate of these maintenance cycles over the period of analysis are detailed in Table 38.

DRAFT

Table 38. Cost Comparison for Additional Advanced Maintenance Features

Period	Present Value Factor	Maintenance Costs without Advanced Maintenance		Maintenance Costs with Advanced Maintenance	
		Avg Costs/yr	Present Value	Avg Costs/yr	Present Value
1	0.96386	$5,200,000	$5,012,048	$9,500,000	$9,156,627
2	0.92902	$800,000	$743,214	$0	$0
3	0.89544	$5,200,000	$4,656,279	$0	$0
4	0.86307	$800,000	$690,458	$5,300,000	$4,574,287
5	0.83188	$5,200,000	$4,325,764	$0	$0
6	0.80181	$800,000	$641,448	$5,300,000	$4,249,592
7	0.77283	$5,200,000	$4,018,709	$0	$0
8	0.74490	$800,000	$595,916	$5,300,000	$3,947,944
9	0.71797	$5,200,000	$3,733,450	$0	$0
10	0.69202	$800,000	$553,616	$5,300,000	$3,667,709
11	0.66701	$5,200,000	$3,468,440	$0	$0
12	0.64290	$800,000	$514,319	$5,300,000	$3,407,365
13	0.61966	$5,200,000	$3,222,241	$0	$0
14	0.59726	$800,000	$477,811	$5,300,000	$3,165,501
15	0.57568	$5,200,000	$2,993,517	$0	$0
16	0.55487	$800,000	$443,895	$5,300,000	$2,940,805
17	0.53481	$5,200,000	$2,781,029	$0	$0
18	0.51548	$800,000	$412,386	$5,300,000	$2,732,058
19	0.49685	$5,200,000	$2,583,624	$0	$0
20	0.47889	$800,000	$383,114	$5,300,000	$2,538,129
21	0.46158	$5,200,000	$2,400,231	$0	$0
22	0.44490	$800,000	$355,919	$5,300,000	$2,357,966
23	0.42882	$5,200,000	$2,229,857	$0	$0
24	0.41332	$800,000	$330,655	$5,300,000	$2,190,591
25	0.39838	$5,200,000	$2,071,575	$0	$0
26	0.38398	$800,000	$307,184	$5,300,000	$2,035,097
27	0.37010	$5,200,000	$1,924,529	$0	$0
28	0.35672	$800,000	$285,380	$5,300,000	$1,890,640
29	0.34383	$5,200,000	$1,787,921	$0	$0
30	0.33140	$800,000	$265,123	$5,300,000	$1,756,438
31	0.31942	$5,200,000	$1,661,009	$0	$0
32	0.30788	$800,000	$246,304	$5,300,000	$1,631,761
33	0.29675	$5,200,000	$1,543,106	$0	$0
34	0.28603	$800,000	$228,820	$5,300,000	$1,515,934
35	0.27569	$5,200,000	$1,433,572	$0	$0
36	0.26572	$800,000	$212,578	$5,300,000	$1,408,329
37	0.25612	$5,200,000	$1,331,814	$0	$0
38	0.24686	$800,000	$197,489	$5,300,000	$1,308,362
39	0.23794	$5,200,000	$1,237,278	$0	$0
40	0.22934	$800,000	$183,470	$5,300,000	$1,215,491
41	0.22105	$5,200,000	$1,149,452	$0	$0
42	0.21306	$800,000	$170,447	$5,300,000	$1,129,212
43	0.20536	$5,200,000	$1,067,861	$0	$0
44	0.19794	$800,000	$158,348	$5,300,000	$1,049,057
45	0.19078	$5,200,000	$992,062	$0	$0
46	0.18389	$800,000	$147,108	$5,300,000	$974,592
47	0.17724	$5,200,000	$921,642	$0	$0
48	0.17083	$800,000	$136,666	$5,300,000	$905,413
49	0.16466	$5,200,000	$856,222	$0	$0
50	0.15871	$800,000	$126,965	$5,300,000	$841,144

Notes: Cost estimates are in FY 13 price level; present value factor used 3.75% discount rate.

DRAFT

Table 39. Summary of Additional Advanced Maintenance Cost Savings

Total Present Value Maintenance without additional Advanced Maintenance	$68,211,870
Total Present Value Maintenance with additional Advanced Maintenance	$62,590,044
Total Present Value Savings with Additional Advanced Maintenance	$5,621,826
Average Annual Equivalent Savings with additional Advanced Maintenance	$250,588

Notes: Cost estimates are in FY 13 price level; amortized at 3.75%.

7 Sensitivity Analysis

Sensitivity analyses were performed to determine how robust the recommended plan would be with different commodity growth scenarios.

7.1 Alternative Cement Growth Scenarios

Several alternative growth scenarios were then developed for comparison to the most-likely scenario.

First, the "Scenario 1" growth scenario uses the same base project-year tonnage as the Most-Likely scenario, but then a different growth rate is applied throughout the period of analysis. The 10-year compound annual growth rate of cement imports through the Port of Palm Beach was divided by the compound annual growth rate in South Florida population over a 10-year period, 1996 to 2005, (1.46% / 2.23% = 0.66). This ratio was then applied to future population compound annual growth projections in South Florida from 2010-2030 (1%) to get a projected growth rate for import tonnage of cement and cement input products through the Port of Palm Beach over the entire period of analysis (1.00% * 0.66 = 0.66%). Assumptions behind using the ratio of historical import tonnage at the Port related to population growth over a 10-year period are that the actual tonnage imported should be related directly to population growth. However, there are many other factors that contribute to demand for cement that may not be captured by using population growth and import tonnage alone. This is especially true when the period selected can greatly skew the growth rates, depending on if construction was on an up-turn or a down-turn. The period from 1996 to 2005 starts before a peak in tonnage in 1997, and it ends at the next peak tonnage in 2005. If the period from 2000 to 2007 were selected instead, then the growth rate using this method would have been high at 6.4%. The import tonnages vary too much in a short period to be tied directly to something as steady as population growth. Therefore, while the "Scenario 1" growth estimate in this application is an extremely conservative estimate, it is not recommended as the primary growth scenario because it has a much greater probability of underestimating import tonnage in the future.

"Scenario 2" growth was selected as the primary growth rate used for the analysis. This growth scenario was described in Section 4.2.2.4.

Next, the "Scenario 3" growth scenario was developed from the linear regression of long-term US imports, scaled to average proportion of Palm Beach imports level from 1996-2009, including economic downturn.

The largest historical dataset available was the U.S. Geological Survey's Cement Statistics from the Statistics for Mineral and Material Commodities in the United States, Version 2010. This dataset includes the total metric tonnage of cement for domestic production, imports, exports, stocks, and apparent consumption in the United States for years from 1900 through 2009. The data showed a clear upward trend in U.S. imports of cement from the early 1970s onward (Figure 23).

The total import tonnage of cement through the Port of Palm Beach was then compared to the U.S. import tonnage over the available period of record for the Port (1996-2009). An average percent of total annual U.S. import tonnage that was transited through the Port of Palm Beach was then identified as 0.66%. Then this percentage was derived by dividing the cement import tonnage through the Port of Palm Beach by the total U.S. import tonnage for each year from 1996-2009, and then averaging these percentages. The average percent of U.S. import tonnage that transited through the Port of Palm Beach was applied to the record of U.S. imports from 1970 through 2009 to determine a "theoretical historical trend" of U.S. imports, scaled to the level of imports for the Port of Palm Beach. A linear regression equation then found the growth trend in U.S. cement imports, scaled to the level of the Port of Palm Beach, from 1970 through 2009 to be:

$Y = 3.6461(x-1969)$, where Y = thousands of metric tons, and X = projection year.

The assumption in applying this percentage and regression line is that growth trends in Palm Beach will follow the trends at the national level. The base-year (2017) projected tonnage for the High estimate was predicted using the regression equation. However, the "Scenario 3" estimate is not recommended as the primary growth scenario, because it bases the growth rate on national-level data, and does not reflect regional or local trends, and therefore this estimate has a greater probability of not representing future import tonnage to the Port's hinterland. It could also under-estimate growth if the local area had historical growth above the national average.

Finally, an alternative mid-range projection was created based on industry input. The "Scenario 4" projection estimates that 120,000 short tons of cement and cement input products will transit through the Port in the base-year (2017). That amount was predicted to have a quicker rebound time than other projections, and it doubles within ten years to 240,000 short tons, but then falls to zero growth for the remainder of the period of analysis. Assumptions behind the "Scenario 4" are that the actual importers of cement at the Port have the most knowledge of the local industry, market conditions, and other factors related to drivers of demand for their products. The industry representatives also have the most historical knowledge of the cement industry, and past trends on which to base their future projections. However, the industry estimate is not recommended as the primary growth projection because it may have a greater probability of containing bias toward higher growth rates in the near-term.

DRAFT

Scenario 1 sensitivity analysis results are shown in Table 40 and Table 41, below. Compared to the final array net benefits shown in Table 33 and Table 34, the Scenario 1 benefits are within 0.5% at the 39 ft project depth and 1.0% at the 40 ft project depth.

Table 40. Summary of Scenario 1 Cement Growth Sensitivity Analysis Net Benefits without Advanced Maintenance

Project (Depth)	38'+Widening	39'+Widening	**40'+Widening**
Average Annual Benefits	$ 6,447,358	$ 7,308,151	**$ 7,668,318**
Average Annual Costs	$ 2,982,771	$ 3,311,091	**$ 3,599,861**
AA Net Benefits	$ 3,464,587	$ 3,997,060	**$ 4,068,457**
BCR	2.16	2.21	**2.13**

Notes: Annualized at 3.75% over 50 years. 600 linear foot jetty stabilization costs were included for 41 ft project depth. Advanced maintenance costs were not included.

Table 41. Summary of Scenario 1 Cement Growth Sensitivity Analysis Net Benefits including Advanced Maintenance

Project (Depth)	38'+Widening	**39'+Widening**	40'+Widening
Average Annual Transportation Cost Savings Benefits	$ 6,447,358	**$ 7,308,151**	$ 7,668,318
Average Annual Advanced Maintenance Benefits	$ 250,588	**$ 250,588**	$ 250,588
Total Average Annual Benefits	$ 6,697,946	**$ 7,558,739**	$ 7,918,906
Average Annual Costs	$ 3,448,595	**$ 3,870,829**	$ 4,392,087
AA Net Benefits	$ 3,249,351	**$ 3,687,910**	$ 3,526,819
BCR	1.94	**1.95**	1.80

Notes: Annualized at 3.75% over 50 years. 600 linear foot jetty stabilization costs were included for 40 ft and 41 ft project depths. 200 linear foot jetty stabilization costs were included for 39 ft project depth. Advanced maintenance costs were included.

7.2 Reduced Overall Growth Sensitivity Scenarios

In addition to the reduced forecasts for cement growth, sensitivity analyses were conducted with reduced overall commodity growth in various scenarios.

7.2.1 No Growth after 20 Years

In the “No Growth after 20 years” scenario, all commodity tonnages were held constant after 20 years into the period of analysis. Results from this scenario are shown in Table 42 and Table 43.

DRAFT

Table 42. Summary of No Growth after 20 Years Sensitivity Analysis Net Benefits without Advanced Maintenance

Project (Depth)	38'+Widening	39'+Widening	**40'+Widening**	41'+Widening
Average Annual Benefits	$ 6,081,747	$ 6,918,637	**$ 7,344,016**	$ 7,368,413
Average Annual Costs	$ 2,982,771	$ 3,311,091	**$ 3,599,861**	$ 4,297,090
AA Net Benefits	$ 3,098,976	$ 3,607,546	**$ 3,744,155**	$ 3,071,323
BCR	2.04	2.09	**2.04**	1.71

Notes: Annualized at 3.75% over 50 years. 600 linear foot jetty stabilization costs were included for 41 ft project depth. Advanced maintenance costs were not included.

Table 43. Summary of No Growth after 20 Years Sensitivity Analysis Net Benefits including Advanced Maintenance

Project (Depth)	38'+Widening	**39'+Widening**	40'+Widening	41'+Widening
Average Annual Transportation Cost Savings Benefits	$ 6,081,747	**$ 6,918,637**	$ 7,344,016	$ 7,368,413
Average Annual Advanced Maintenance Benefits	$ 250,588	**$ 250,588**	$ 250,588	$ 250,588
Total Average Annual Benefits	$ 6,332,335	**$ 7,169,225**	$ 7,594,604	$ 7,619,001
Average Annual Costs	$ 3,448,595	**$ 3,870,829**	$ 4,392,087	$ 4,773,324
AA Net Benefits	$ 2,883,740	**$ 3,298,396**	$ 3,202,517	$ 2,845,677
BCR	1.84	**1.85**	1.73	1.60

Notes: Annualized at 3.75% over 50 years. 600 linear foot jetty stabilization costs were included for 40 ft and 41 ft project depths. 200 linear foot jetty stabilization costs were included for 39 ft project depth. Advanced maintenance costs were included.

7.2.2 No Growth after Base Year

In the "No Growth after Base Year" scenario, commodity tonnages were increased from the existing levels to the base year and then held constant from the base project year throughout the period of analysis. Results are shown in Table 44 and Table 45.

Table 44. Summary of No Growth after Base Year Sensitivity Analysis Net Benefits without Advanced Maintenance

Project (Depth)	38'+Widening	39'+Widening	**40'+Widening**	41'+Widening
Average Annual Benefits	$ 5,703,293	$ 6,171,926	**$ 6,739,391**	$ 6,790,789
Average Annual Costs	$ 2,982,771	$ 3,311,091	**$ 3,599,861**	$ 4,297,090
AA Net Benefits	$ 2,720,522	$ 2,860,835	**$ 3,139,531**	$ 2,493,699
BCR	1.91	1.86	**1.87**	1.58

Notes: Annualized at 3.75% over 50 years. 600 linear foot jetty stabilization costs were included for 41 ft project depth. Advanced maintenance costs were not included.

DRAFT

Table 45. Summary of No Growth after Base Year Sensitivity Analysis Net Benefits including Advance Maintenance

Project (Depth)	38'+Widening	39'+Widening	**40'+Widening**	41'+Widening
Average Annual Transportation Cost Savings Benefits	$ 5,703,293	$ 6,171,926	**$ 6,739,391**	$ 6,790,789
Average Annual Advanced Maintenance Benefits	$ 250,588	$ 250,588	**$ 250,588**	$ 250,588
Total Average Annual Benefits	$ 5,953,881	$ 6,422,514	**$ 6,989,979**	$ 7,041,377
Average Annual Costs	$ 3,448,595	$ 3,870,829	**$ 4,392,087**	$ 4,773,324
AA Net Benefits	$ 2,505,286	$ 2,551,685	**$ 2,597,892**	$ 2,268,053
BCR	1.73	1.66	**1.59**	1.48

Notes: Annualized at 3.75% over 50 years. 600 linear foot jetty stabilization costs were included for 40 ft and 41 ft project depths. 200 linear foot jetty stabilization costs were included for 39 ft project depth. Advanced maintenance costs were included.

7.2.3 Existing Traffic with No Growth

In the "Existing Traffic with No Growth" scenario, all commodity tonnages were set to the existing level of traffic and then held constant throughout the period of analysis. Results from this scenario are shown in Table 46, below. This sensitivity scenario was not modeled for other alternatives because it was considered to be the absolute lowest and most conservative growth scenario. It is shown for information only to demonstrate that even with conservative growth assumptions (i.e. no growth from today's level of traffic), the 39 ft alternative is still economically feasible.

Table 46. Summary of Existing Traffic with No Growth Sensitivity Analysis Net Benefits

Project (Depth)	39'+Widening
Average Annual Benefits	$ 3,318,965
Average Annual Costs	$ 3,311,091
AA Net Benefits	$ 7,874
BCR	1.00

Notes: Annualized at 3.75% over 50 years. Advanced maintenance and jetty stabilization costs were not included.

7.2.4 7% Discount Rate

In the "7% Discount Rate" scenario, all benefits and costs were annualized at the 7% discount rate, which is required by the Office of Management and Budget (OMB) to be displayed for comparison. Results from this scenario are shown in Table 47. This sensitivity scenario is shown for information only to demonstrate the responsiveness in annualized project costs and benefits to changes in the Federal discount rate.

DRAFT

Table 47. Benefit Cost Ratio and Net Benefits at 7% Discount Rate

Project (Depth)	39'+Widening
Sum of Present-Value Benefits	$ 93,410,000
Total Costs with IDC	$ 100,520,000
Annualized Transportation Cost Savings (Benefits)	$ 6,770,000
Annualized Advanced Maintenance Cost Savings (Benefits)	$ 210,000
Total Average Annual Benefits	$ 6,980,000
Total Average Annual Costs	$ 7,280,000
AA Net NED Benefits	($ 310,000)
BCR	0.96

Notes: Annualized at 7% over 50 years. Numbers rounded to nearest $10,000. Benefits are based on 100-iteration model runs. Interest during construction estimated based on mid-month uniform payments. Jetty stabilization costs and advanced maintenance costs were included.

8 Regional Economic Development Benefits

IMPLAN is an input-output model, developed by the company MIG, which is widely used for economic impact analysis. The job-creation estimates for this project were developed using most recent version of the model, Version 3.0. These estimates use the 2010 dataset for the entire State of Florida, which is the most recent data available. The dataset includes employment and impact multipliers for specific areas and industries. All multipliers were developed by MIG using empirical data, including wage, salary, and income data as well as information about the number of firms in various sectors of the economy and sector size classes (as defined by number of employees).

Once the IMPLAN model was set up, it was used to calculate employment creation effects in different industries or sectors of the economy based on the input of additional expenditures in a specific industry or sector. For this analysis, the "non-residential construction" sector was used to account for all input expenditures. This sector is the most applicable to Corps of Engineers' civil works projects.

A "job created" is defined as the employment of one person for one year that would not have otherwise been employed. The estimates produced by IMPLAN include three categories of employment impacts: direct, indirect, and induced.

- **Direct Impacts:** The jobs directly generated by a project. This category typically consists of workers hired by the contractors who are building USACE projects.

- **Indirect Impacts:** Employment changes occurring in other businesses/industries in the community that supply inputs to the project industry. For example, if the project requires a contractor to purchase new equipment or materials from another company, any new employment created as a result of that purchase would be considered an indirect impact.

- **Induced Impacts:** The jobs created when employees who are working for the project spend their new income in the community. For example, construction workers may spend their wages at local restaurants, grocery stores, and apartments. Any job created as result of these expenditures is considered induced.

The jobs-created estimates include both full-time and part-time jobs. MIG also provides adjustment factors to account for the part-time employment to convert "jobs-created" to full-time equivalency (FTE) jobs. The job creation estimates for this project are not FTE estimates.

Table 48. Regional Economic Development Job Impact Multipliers

Direct Jobs Created per $1 million expenditure	7.1
Indirect and induced jobs created per $1 million expenditure	8.2
Total Jobs Created per $1 million expenditure	15.3

Table 49. Regional Economic Development Job Impacts from Project Construction Expenditures

Total Construction Costs	$ 93,499,664
Direct Job Impacts	663.8
Indirect and Induced Job Impacts	766.7
Total Job Impacts	1430.5

DRAFT

APPENDIX D

LAKE WORTH INLET

Palm Beach Harbor

SECTION 404(b) EVALUATION

I. Project Description

a. Location. Lake Worth Inlet and Palm Beach Harbor are on the Atlantic Coast of Florida, approximately 53 miles south of Ft. Pierce Harbor, and 71 miles north of Miami Harbor.

b. General Description. The U.S. Army Corps of Engineers (Corps), Jacksonville District, is proposing to widen and deepen the current Federal navigation channel at Lake Worth Inlet / Palm Beach Harbor. The proposed plan includes the following: addition of a new channel flare on the south side of the Entrance Channel, a widening of the Entrance Channel by either 40' or 60' to the north, widening of the Inner Harbor Cuts 1 and 2 to provide for a minimum channel width of 450', a 150' expansion of the Southern (Main) Turning Basin to the south, and an expansion of the Southern (Main) Turning Basin on the north side to remove a notch currently encroaching into the basin. The channel would be deepened to a project depth of 39 feet Mean Lower Low Water (MLLW) for the Inner Harbor and 41 feet MLLW for the Entrance Channel plus applicable allowances and overdepths discussed in the Engineering Appendix included in the integrated Feasibility Report and Environmental Impact Statement (FR/EIS).

In addition to the project improvements described above that are necessary to facilitate the safe and efficient navigation of the design vessel, there are other features needed to support the project. These features include North Jetty stabilization, reconfiguration of the advanced maintenance zones, reconfiguration of the settling basin, seagrass mitigation construction, and hardbottom mitigation construction as detailed in the integrated FR/EIS.

c. Authority and Purpose. See **Chapter 1** of the integrated FR/EIS.

d. General Description of Dredged Material

(1) General Characteristics of Material: Please see **Chapter 4.2** of the integrated FR/EIS for additional detail as well as **Figure 4-1** and **Table 4-1** in the integrated FR/EIS for a listing of material by location. Generally, the following material is expected within the project limits: sands, silty sands, and interfingering rock layers.

(2) Quantity of Material: The tentatively selected plan would dredge a total of approximately two million cubic yards of material. Please see **Chapter 4.2** of the integrated FR/EIS for additional detail.

(3) Source of Material: Dredged material would come from the Federal navigation channel for Lake Worth Inlet as well as the proposed widening and deeping locations shown in the reference map in **Chapter 4** of the integrated FR/EIS.

e. Description of the Proposed Discharge Site(s)

(1) Location. It is anticipated that all of the material to be excavated from the entrance channel up to Station 45+00 would be placed in nearshore placement area, located below mean high water line, with the exception of the amount which would be used to mitigate for seagrasses. The remainder of the material would be placed at the Palm

Beach Ocean Dredged Material Disposal Site (ODMDS). Please see also **Chapter 4.8** of the integrated FR/EIS.

(2) Size. Near shore quality sand would be placed in the near shore (below the MHW line) between DEP range monuments R-76 to R-79, used for mitigation, or placed in the designated ODMDS.

(3) Type of Site. Nearshore, ODMDS, or proposed mitigation site.

(4) Type(s) of Habitat. Nearshore consists of bare sand with no exposed hard bottom or resources within the footprint. ODMDS site is bare sand/silty substrate with no exposed hard bottom. Proposed mitigation sites consist of sandy/silty substrate within the inlet for seagrass mitigation, and nearshore sand substrate for hard bottom mitigation.

(5) Timing and Duration of Discharge. The exact timing of dredging operations is not known, although dredging activities are expected to occur in the winter months.

f. Description of Disposal Method. Disposal could be either from a pipeline via hydraulic dredging or clamshell dredge and transport barge.

II. Factual Determinations

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope: The material would be placed below mean low water to elevation -16.

(2) Sediment Type. The material to be disposed in the nearshore would be silty sand in nature. Rock and material not suitable for nearshore placement would be disposed of at the ODMDS.

(3) Dredged Material Movement: Material would settle and be moved to downdrift beaches by wave action if placed in nearshore. It is expected the material would remain in place if used for mitigation. Material deposited in the ODMDS would remain within the confines of the ODMDS.

(4) Physical Effects on Benthos: Some benthic organisms that are not mobile may be may be covered by the nearshore placement and/or the mitigation site material. Recolonization soon after project completion is expected to replace those organisms that do not survive project construction. It is anticipated that no long-term adverse impacts would occur.

(5) Other Effects: NA

(6) Actions Taken to Minimize Impacts: BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts

b. Water Circulation. Fluctuation and Salinity Determinations

(1) Water column: During nearshore disposal operations, turbidity would increase temporarily in the water column adjacent to the project. The increased turbidity would be short-term; therefore nearshore placement would have no long-term or significant impacts, if any, on salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients or eutrophication

(2) Current Patterns and Circulation : Net movement of water is from the north to the south. The project would have no significant effect on existing current patterns, current flow, velocity, stratification, or the hydrologic regime in the area.

(3) Normal Water Level Fluctuations: Mean tidal range in the project area is 3.5 feet with a spring tide range of approximately 4.1 feet.

(4) Salinity Gradients: Salinity is that of oceanic water. Dredged material placement would not affect normal tide fluctuations or salinity.

(5) Actions That Will Be Taken to Minimize Impacts: BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts.

c. Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site: There may be a temporary increase in turbidity levels in the project area along the disposal site during discharge. Turbidity would be short-term and localized and no significant adverse impacts are expected. State water quality standards for turbidity outside an allowable mixing zone would not be exceeded.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column: The sea floor, at this location, is characterized by a sandy substrate nearshore and sand/silt substrate at the ODMDS. There would be little, if any, adverse effects to chemical and physical properties of the water as a result of placing sandy material in the nearshore and sand/silt/rock material at the ODMDS.

(a) Light Penetration: Some decrease in light penetration may occur in the immediate vicinity of the disposal area. This effect would be temporary, limited to the immediate area of construction, and would have no adverse impact on the environment.

(b) Dissolved Oxygen: Dissolved oxygen levels would not be altered by this project due to the high energy wave environment and associated adequate reaeriation rates.

(b) Toxic Metals and Organics: No toxic metals or organics are expected to be released by the project.

(d) Pathogens: No pathogens are expected to be released by the project.

(e) Aesthetics: The aesthetic quality of the water in the immediate area of the project would be reduced during construction due to increased turbidity. This would be a short-term and localized condition. Material placed in the nearshore would likely provide improved beach width down drift of placement location.

(f) Others as Appropriate: None.

(3) Effects on Biota

(a) Primary Production, Photosynthesis: Primary productivity is not a recognized, significant phenomenon in the surf zone, where a temporarily increased level of suspended particulates would occur. There would be no effect on the nearshore productivity as a result of the proposed disposal area.

(b) Suspension/Filter Feeders: An increase in turbidity could adversely impact burrowing invertebrate filter feeders within and adjacent to the immediate construction area. It is not expected that a short-term, temporary increase in turbidity would have any long-term negative impact on these highly fecund organisms.

(c) Sight Feeders: No significant impacts on these organisms are expected as the majority of sight feeders are highly motile and can move outside the project area.

(4) Actions taken to Minimize Impacts: BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts.

d. Contaminant Determinations: The material that would be disposed would not introduce, relocate, or increase contaminants at the area. The material would consist of sandy material with some silt in the nearshore and material with higher concentrations of rock in the ODMDS.

e. Aquatic Ecosystem and Organism Determinations: The material that would be placed in the nearshore would be similar enough to the existing substrate so that no impacts are expected. The materials meet the exclusion criteria, therefore, no additional chemical-biological interactive testing would be required.

(1) Effects on Plankton: No adverse impacts on autotrophic or heterotrophic organisms are anticipated.

(2) Effects on Benthos: The material would bury some benthic organisms. Benthic organisms found in the intertidal areas along the project disposal area are adapted for existence in an area with considerable substrate movement, thus most would be able to burrow up through the disposed material. Recolonization is expected to occur within a year after construction activities cease. No adverse long-term impacts to non-motile or motile benthic invertebrates are anticipated.

(3) Effects on Nekton: No adverse impacts to nektonic species are anticipated.

(4) Effects on Aquatic Food Web: No adverse long-term impact to any trophic group in the food web is anticipated.

(5) Effects on Special Aquatic Sites: There are no hardground or coral reef communities located in the immediate nearshore area that would be impacted by disposal activities. **Chapter 5** of the integrated FR/EIS offers a more detailed discussion on impacts.

(6) Threatened and Endangered Species: Appropriate measures to avoid, minimize, and mitigate for impacts to listed species have been fully coordinated with NMFS and USFWS.

(7) Other Wildlife: No adverse impacts to small foraging mammals, reptiles, or wading birds, or wildlife in general are expected.

(8) Actions to Minimize Impacts: BMPs along with terms and conditions associated with ESA Biological Opinions would be followed.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination: Material placed in the nearshore would meet requirements outlined in the Water Quality Certificate. Placement would not cause unacceptable changes in the mixing zone water quality requirements as specified by the State of Florida's Water Quality Certification permit procedures. No adverse impacts related to depth, current velocity, direction and variability, degree of turbulence, stratification, or ambient concentrations of constituents are expected from implementation of the project.

(2) Determination of Compliance with Applicable Water Quality Standards: Because of the inert nature of the material to be to be disposed, Class III water quality standards would not be violated.

(3) Potential Effects on Human Use Characteristic

(a) Municipal and Private Water Supply: No municipal or private water supplies would be impacted by the implementation of the project.

(b) Recreational and Commercial Fisheries: Fishing in the immediate construction area would be prohibited during construction. Otherwise, recreational and commercial fisheries would not be impacted by the implementation of the project.

(c) Water Related Recreation: Beach/water related recreation in the immediate vicinity of construction would be prohibited during construction activities. This would be a short-term impact.

(d) Aesthetics: The existing environmental setting would not be adversely impacted. Construction activities would cause a temporary increase in noise and air pollution caused by equipment as well as some temporary increase in turbidity. These impacts are not expected to adversely affect the aesthetic resources over the long term and once construction ends, conditions would return to pre-project levels.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves: No such designated sites are located within the project area.

g. Determination of Cumulative Effects on the Aquatic Ecosystem: There would be no cumulative impacts that result in a major impairment in water quality of the existing aquatic ecosystem resulting from the placement of material at the project site.

h. Determination of Secondary Effects on the Aquatic Ecosystem: There would be no secondary impacts on the aquatic ecosystem as a result of the dredging.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. Adaptation of the Section 404(b)(l) Guidelines to this Evaluation: No significant adaptations of the guidelines were made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem : No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States. Further, no less environmentally damaging practical alternatives to the proposed actions exist. To test the suitability upland sand sources the borrow areas proposed by the contractor would be used for this project. In addition, the impacts of using other sources on cultural resources, protected species, and other environmental factors would likely be equal to or greater than the impacts of the proposed action. The no action alternative would allow the present condition of the channel to need dredging at increased frequency compared to the preferred alternative.

c. Compliance with Applicable State Water Quality Standards: After consideration of disposal site dilution and dispersion, the discharge of dredged materials would not cause or contribute to, violations of any applicable State water quality standards for Class III waters.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 Of the Clean Water Act: The discharge operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. Compliance with Endangered Species Act of 1973: The disposal of dredged material would not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended. Standard conditions for monitoring and relocating turtle nests would be employed.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection. Research, and Sanctuaries Act of 1972: No marine sanctuaries are located within the project area.

g. Evaluation of Extent of Degradation of the Waters of the United States: The placement of dredged material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values would not occur.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem: Appropriate steps have been taken to minimize the adverse environmental impact of the proposed action. Turbidity would be monitored so that if levels exceed State water quality standards of 29 NTU's above background, the contractor would be required to cease work until conditions return to normal. In the vicinity of reef and other hard grounds, measures would be taken to minimize sediment deposition on sensitive reef organisms.

i. On the basis of the guidelines, the proposed dredging and disposal sites are specified as complying with the requirements of these guidelines.

COASTAL ZONE MANAGEMENT ACT AND FLORIDA COASTAL MANAGEMENT PROGRAM FEDERAL CONSISTENCY DETERMINATION

LAKE WORTH INLET FEASIBILITY STUDY

Enforceable Policy. Florida State Statues considered "enforceable policy" under the Coastal Zone Management Act (www.dep.state.fl.us/cmp/federal/24_statutes.htm).
Applicability of the Coastal Zone Management Act. The following summarizes the process and procedures under the Coastal Zone Management Act for Federal Actions and for non-Federal Applicants*.

Item	Non-Federal Applicant (15 CFR 930, subpart D)	Federal Action (15 CFR 930, subpart C)
Enforceable Policies	Reviewed and approved by NOAA (in FL www.dep.state.fl.us/cmp/federal/24_statutes.htm)	Same
Effects Test	Direct, indirect (cumulative, secondary), adverse, or beneficial	Same
Review Time	Six (6) months from state receipt of Consistency Certification (30-days for completeness notice). Can be altered by written agreement between State and applicant	60 days, extendable (or contractible) by mutual agreement
Consistency	Must be fully consistent	To maximum extent practicable**
Procedure Initiation	Applicant provides Consistency Certification to State	Federal agency provides "Consistency Statement" to State
Appealable	Yes, applicant can appeal to Secretary (NOAA)	No (NOAA can "mediate")
Activities	Listed activities with their geographic location (State can request additional listing within 30 days)	Listed or unlisted activities in State program
Activities in Another State	Must have approval for interstate reviews from NOAA	Interstate review approval NOT required
Activities in Federal Waters	Yes, if activity affects State waters	Same

* There are separate requirements for activities on the Outer Continental Shelf (subpart E) and for "assistance to an applicant agency" (subpart F).
** Must be fully consistent except for items prohibited by applicable law (generally does not count lack of funding as prohibited by law, 15 CFR 930.32).

1. Chapter 161, Beach and Shore Protection. The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

Consistency Statement: The purpose of the proposed action is to improve and maintain safe navigation depths in Palm Beach Harbor/Lake Worth Inlet, Palm Beach County, Florida. Information will be submitted to the State for a permit in compliance with this chapter.

2. Chapters 186 and 187, State and Regional Planning. These chapters establish the State Comprehensive Plan, which sets goals that articulate a strategic vision of the State's future. Its purpose is to define in a broad sense, goals and policies that provide decision-makers directions for the future and long-range guidance for orderly social, economic and physical growth.

Consistency Statement: The project meets the primary goal of the State Comprehensive Plan. The proposed work will be coordinated with the State through review of this document.

3. Chapter 252, Disaster Preparation, Response and Mitigation. This chapter creates a State Emergency Management Agency, with authority to provide for the common defense; to protect the public peace, health and safety; and to preserve and protect the lives and property of the people of Florida.

Consistency Statement: This chapter does not apply.

4. Chapter 253, State Lands. This chapter governs the management of submerged State lands and resources within State lands. This includes archeological and historic resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; spoil islands; and artificial reefs.

Consistency Statement: The proposed activity will be coordinated with the State and appropriate State permits will be obtained. The proposed action will be consistent with the intent of this chapter.

5. Chapters 253, 259, 260 and 375, Land Acquisition. These chapters authorize the State to acquire land to protect environmentally sensitive areas.

Consistency Statement: The proposed action is being coordinated with the State of Florida. The project is consistent with this chapter.

6. Chapter 258, State Parks and Aquatic Preserves. This chapter authorizes the State to manage State parks and preserves. Consistency with this chapter would include consideration of projects that would directly or indirectly adversely impact park property, natural resources, park programs or management or operations.

Consistency Statement: The proposed action will not impact any State parks or preserves. This chapter is not applicable.

7. Chapter 267, Historic Preservation. This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.

Consistency Statement: The proposed action has been coordinated with the State Historic Preservation Officer (SHPO) and is consistent with the intent of this chapter.

8. Chapter 288, Economic Development and Tourism. This chapter directs the State to provide guidance and promotion of beneficial development through the encouragement of economic diversification and promotion of tourism.

Consistency Statement: The proposed improvements and maintenance thereof are consistent with the goals of this chapter.

9. Chapter 334 and 339, Public Transportation. This chapter authorizes the planning and development of a safe and efficient transportation system.

Consistency Statement: The proposed action will not adversely affect public transportation and therefore would be consistent with the goals of this chapter.

10. Chapter 370, Living Saltwater Resources. This chapter directs the State to preserve, manage and protect the marine crustacean, shell and anadromous fishery resources in State waters; to protect and enhance the marine and estuarine environment; to regulate fishermen and vessels of the state engaged in the taking of such resources within or without State waters; to issue licenses for the taking and processing of fisheries products; to secure and maintain statistical records of the catch of each such species; and to conduct scientific, economic and other studies and research.

Consistency Statement: Marine crustacean, shell, and andromous fishery resources will be temporarily impacted. Temporary and permanent impacts will occur within the marine and estuarine environment. These impacts will be mitigated.

11. Chapter 372, Living Land and Freshwater Resources. This chapter establishes the Game and Freshwater Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, educational, aesthetic and economic benefits.

Consistency Statement: The work in Lake Worth Inlet and Palm Beach Harbor will be consistent with the goals of this chapter.

12. Chapter 373, Water Resources. This chapter provides the authority to regulate the withdrawal, diversion, storage and consumption of water.

Consistency Statement: This work does not involve water resources as described in this chapter.

13. Chapter 376, Pollutant Spill Prevention and Control. This chapter regulates the transfer, storage and transportation of pollutants and the cleanup of pollutant discharges.

Consistency Statement: This work does not involve the transportation or discharge of pollutants. Conditions will be placed in the contract to handle inadvertent spills of pollutants such as vehicle fuels. The proposed action will comply with this chapter.

14. Chapter 377, Oil and Gas Exploration and Production. This chapter authorizes the regulation of all phases of exploration, drilling and production of oil, gas and other petroleum resources.

Consistency Statement: The proposed action does not involve the exploration, drilling, or production of oil, gas, or other petroleum products; therefore this chapter does not apply.

15. Chapter 380, Environmental Land and Water Management. This chapter establishes criteria and procedures to assure that local land development decisions consider the regional impact of large-scale development.

Consistency Statement: The proposed action is consistent with the intent of this chapter.

16. Chapter 388, Arthropod Control. This chapter provides for a comprehensive approach for abatement or suppression of mosquitoes and other arthropod pests within the State.

Consistency Statement: The work will not further the propagation of mosquitoes or other pest arthropods. The proposed action will be consistent with the goals of this chapter.

17. Chapter 403, Environmental Control. This chapter authorizes the regulation of pollution of the air and waters of the State by the Department of Environmental Protection.

Consistency Statement: Appropriate State permits will be obtained for this project.

18. Chapter 582, Soil and Water Conservation. This chapter establishes policy for the conservation of State soils and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop and utilize soil and water resources both on-site and on adjoining properties affected by the work. Particular attention will be given to work on or near agricultural lands.

Consistency Statement: The proposed action is not located near agricultural lands; therefore, this chapter does not apply.

APPENDIX D – MITIGATION PLAN

This report outlines compensatory mitigation for unavoidable impacts to seagrass and hardbottom habitats impacted by implementation of the Recommended Plan considered in the Draft Environmental Impact Statement (DEIS). Impacts to the total project include 4.5 acres of seagrass habitat and 4.9 acres of hardbottom habitat outside of or deeper than the present authorized channel width and depth. Of these impacts, mitigation will be required for seagrass and hardbottom habitats where new construction dredging is proposed. The South Atlantic Fishery Management Council (SAFMC) and National Marine Fisheries Service (NMFS) (SAFMC 1998) consider all of these habitat types Essential Fish Habitat (EFH). For dredging the rock/rubble and silt/sand/rubble bottom within the channel, mitigation is not proposed since dredging was previously performed in the channel and temporal impacts are minimal.

The following mitigation plan complies with the requirements of Section 2036 of the Water Resources Development Act of 2007 (WRDA 2007) and "complies with the mitigation standards and policies established pursuant to the regulatory programs".

Mitigation Options

A total of 10 options have been identified that could serve as full or partial mitigation for impacts to seagrasses and hardbottoms within Lake Worth Lagoon (Table 1, Figure 1). The amount of site specific information known at this time varies among projects listed below. Table 1 summarizes the mitigation potential of each site identified to date.

Submerged aquatic seagrass colonies occur within federal channels of the proposed project area where dredging will occur and on the immediately adjacent buffer. The search for available candidate sites was researched by contacting Palm Beach County Department of Environmental Resource Management, which has a proven success record with comparable restoration and mitigation. The site has significant need of restoration; thus, the US Army Corps of Engineers has the opportunity to contribute to the community as well as compensate for impact to seagrass within the Lake Worth Lagoon Watershed.

Based on previous coordination with Federal, state, and local resource agencies, in-kind restoration of seagrass and hardbottom habitat is the agency-preferred option for mitigating for said impacts.

Figure 1. Locations of proposed mitigation sites.

Project #	Project Name	Project Type	Site Conditions	Habitat Created
1	Little Lake Worth	Dredged Hole Capping/Filling	30 ac (-30'NGVD) ; contains muck sediments 900,000 cy3 capacity to -12' NGVD	Limited potential for seagrass Art hardbottom <10 ac
2	Turtle Cove	Dredged Hole Capping/Filling	+42 ac (-18'NGVD); contains muck sediments. 660,000 cy3 capacity to -4.5' NGVD	<10 ac seagrass 6-10 ac art hardbottom
3	Singer Island Seagrasses	Acquisition Conservation	147 ac of privately held submerged lands w/ healthiest seagrass bed in LWL	Purchase & Preservation by adjoining to J.D. MacArthur Beach State Park
4	Kelsey Park Hardbottom	Artificial Hardbottom	6 ac permitted site contains 2 ac art hardbottom 4 ac remain for new hardbottom creation	4 ac art hardbottom
5	Sugar Sands Hardbottom	Artificial Hardbottom	10 ac permitted site contains 7ac art hardbottom 3 ac remain for new hardbottom creation	3 ac art hardbottom
6	Singer Island Hardbottom Pods	Artificial Hardbottom	Permitted nearshore site 4ac art hardbottom built & under 5yr monitoring plan. 2 ac remain for new hardbottom creation	2 ac art hardbottom

Project #	Project Name	Project Type	Site Conditions	Habitat Created
7	Peanut Island shoal	-Dredging -Artificial Hardbottom	30 ac shoal >100,000 cy3 sand to be dredged	10 ac seagrass (temporary-may accrete) 1 ac art hardbottom
8	Peanut Island Breakwaters	Artificial Hardbottom	SE Peanut has existing breakwaters 3 ac remain for new hardbottom creation	3 ac area for additional breakwaters
9	Rybovich Hardbottom	Artificial Hardbottom	5 ac permitted site contains 3 ac art hardbottom 2 ac remain for new hardbottom creation	2 ac art hardbottom
10	Ibis Isle	-Filling/Capping	41 ac dredged hole, muck sediments Located 8.5 mi south of LW inlet >600,000 cy3 capacity	<20 ac seagrass
Note	All sites		Require verification of resources & conditions	

Table 1. Mitigation options and estimated available acres

3.0 Mitigation Requirements

3.1 Seagrass

Direct impacts to seagrass communities are restricted to the widening of Palm Beach Harbor entrance channel and widening of the existing turning basin to the north and south. Impacts include the permanent loss (removal) of 4.5 acres of mixed seagrass beds. Losses will occur from both the widening footprint and the natural equilibration of the side slopes as described in the EIS. Coordination with the Federal and state resource agencies will determine the final mitigation needed to compensate for these 4.5 acres of impacts to seagrasses within Lake Worth Inlet. Mitigation needs from impacts to seagrasses were calculated using the State of Florida Department of Environmental Protection (FDEP) model named UMAM. This model is the only accepted model by the FDEP to calculate mitigation requirements for seagrass impacts. Results from the Corps UMAM model run showed 8.25 acres of seagrass mitigation were needed to offset the impacts. The Corps used a larger mitigation number when estimating costs to represent worst case of 11.25 acres of mitigation. A final mitigation compensation between 8.25 – 11.25 acres for seagrass impacts will be determined during the public review of the document as the Corps and Federal/state agencies discuss the model results.

In order to replace local seagrass functions and values, restoration will be implemented within Lake Worth, preferably in areas where seagrass once occurred and is now absent due to past anthropogenic activities such as dredging. Seagrass habitat will be restored by filling old borrow areas located within Lake Worth to result in a minimum surface area of 8.25 acres of new seagrass beds. Based on a discussions with the Palm Beach County Department of Environmental Resource Management (ERM) in August of 21012, there are several old borrow areas which were considered suitable for filling with dredged material, capping with sand, and restoring seagrass habitat to an elevation consistent with the depths where adjacent seagrass beds are present (Table 2).

Restoration of seagrass communities, while still considered experimental by some resource agencies, can enhance habitat heterogeneity and the diversity of invertebrate and fish communities, if carefully implemented. The recent treatise on seagrass restoration entitled "Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters" by Fonseca et al. (1998) discusses the benefits, risks, and successful approaches associated with seagrass restoration. Given the documented success of more recent efforts to restore seagrass communities including those in South Florida, restoration is quickly becoming a proven resource management tool in some areas where conditions are appropriate.

Table 1 Dredging Impacts by Habitat Type

Habitat Type and Current Dredge Status	**Component**				
	B-2	**C**	**D**	**G**	**Total**
Seagrass- new impacts with project footprint and side slope equilibration (acres)	0.0	0.4	**2.0**	2.1	**4.5**

3.2 Hardbottom

To calculate the acreage of creation of artificial hardbottom required for compensation, the Corps performed a Visual Habitat Equivalency Analyses (HEA) (see NOAA 2000). The method used was designed to take into account both projected impact acreages for various habitats and recovery times to calculate the overall loss of habitat function that occurs from the time a new impact occurs to the time of full functional recovery. HEA is usually applied to situations where previously non-impacted habitats are damaged and was used, in this case, to calculate compensatory mitigation acreages for removal of habitat in previously undredged areas. Projected impact acreages were classified according to the method that would be applied to calculate functional loss. This was necessary because the proposed mitigation will be type-for-type, to reflect the need to mitigate for similar habitat types and expected species within the impacted area and the mitigation location.

Several assumptions are involved in the HEA method. These assumptions include (1) the relative functionality (usually expressed as a percentage) of both impact and mitigation areas at "time-0" (time zero) (i.e., at the initiation of mitigation operations or at the time the impact occurs to the habitat), (2) the relative functionality of both the impact and mitigation area at the completion of recovery of each area, (3) the form of the recovery function (e.g., linear, exponential, hyperbolic, etc.), and (4) the recovery/completion time for the impact area and mitigation area to reach full functionality (i.e., the level that existed prior to impact/mitigation activities

Based on the HEA calculations, direct impacts to hardbottom and hardbottom habitats would require the creation of artificial hardbottom habitat for low relief hardbottom habitat. The proposed mitigation will be type-for-type, to ensure impacted habitat will be mitigated for assuming similar species to colonize the created habitat. A range of 4.9 -9.8 acres is proposed representing a 1:1 – 2:1 ratio of impacts/mitigation. Final mitigation needs will be determined during the public review of the report between the Corps and Federal/state agencies. The tables and calculations of the HEA are included in Appendix ZZ.

4.0 PROPOSED PLAN

This mitigation plan focuses on compensation options available for unavoidable impacts associated with implementation of the recommended plan to seagrass and hardbottom habitats located within Lake Worth. Other options evaluated did not provide in-kind type-for-type replacement of habitat lost and may not be acceptable to the resource agencies unless opportunities to provide like replacement were not available or did not have a likely probability of success.

4.1 Seagrass Restoration

In order to replace local seagrass functions and values, restoration will be implemented in an area near Lake Worth within an area that has been anthropogenically disturbed in the past (Fonseca et al. 1998). Several previously identified dredge hole sites located throughout Lake Worth are

being considered (see Figure 1/Table 1). The final site will be determined based on several factors including:

- a good candidate for cost-effective hauling or pumping of borrow material from the project site for the purpose of topographic restoration (subject to a cost-feasibility analysis),
- experience a relatively calm but well-circulated tidal current and little or no daily perturbations from boating activities, and,
- there are sites within the hole that can be restored to seagrass over a sufficient area to achieve the desired amount of mitigation.

Based on the combined observations of the latest bathymetry and the subsequent discussions with the Town of Palm Beach Environmental Resource Management Davison, the following screening criteria were developed to assist in locating a specific seagrass restoration site within the Lake Worth area. The preferred site should:

- maximize the facilitation of natural recruitment from adjacent *Johnson's* beds,
- avoid impacts to existing seagrass both outside and within the site,
- have sufficient access and working area for the required equipment with no risk of damage to adjacent shallow resources.

The preferred seagrass restoration site should have the following characteristics:

- The site varies in depth from about 12 to 17 feet.
- Portions of the site are bordered by steep walls while other portions are bordered by sloping topography.
- Those portions of the site below the 16 to 17 foot contour are unvegetated.
- Areas of natural grade adjacent to the site are dominated by Johnson's with *H. decipiens* and *H. wrightii* also being present.

4.1.1 Conceptual Seagrass Site Design

The goal of the mitigation is to compensate for the loss of climax-community seagrass habitat at the impact site by restoring a productive climax-community seagrass habitat at the mitigation site. To compensate for 4.5 acres of projected seagrass losses at the impact site, a minimum of 8.25 acres of seagrass habitat are expected to be constructed within the Proposed Seagrass Mitigation Site . However, the Corps has the option to construct more than 8.25 acres of habitat if he sees it economically feasible. The Corps has the option of conducting mitigation prior to construction or simultaneously.

A pre-construction survey will be conducted within a reference site that will serve as a background area for comparison of species composition, density, patchiness, and other characteristics. The reference site should be located within the same general vicinity of the mitigation site and be at a comparable depth to the final target elevation of the mitigated

seagrass. Success is defined as achievement of the target acreage of seagrass coverage within 5 years of site construction. Success will be determined by coverage based on the Braun-Blanquet technique (Braun-Blanquet 1965) comparing the mitigated site to reference sites of similar species composition in the surrounding area.

Cover Class	Description
0	Absent or no measurable cover
0.1	Solitary shoot with small cover
0.5	Few shoots, less than 5% cover
1	Numerous shoots, less than 5% cover
2	Any number of shoots but with 5% to 25% cover
3	Any number of shoots but with 25% to 50% cover
4	Any number of shoots but with 50% to 75% cover
5	Any number of shoots but with >75% cover

Success determination will be accomplished by counts of plant shoots and estimation of percent coverage within sample quadrat and sub-quadrat to determine density and percent coverage (in contrast to bare areas). The success criteria for vegetation establishment within restored areas include:

- Braun-Blanquet score within 1 unit of reference site within 3 years
- Contingency measures as part of the Adaptive Management Plan will be implemented if indicators determine that success criteria are not being met, and that the restoration is determined to be failing.

To achieve success, the following objectives will be implemented:

1. Fill unvegetated areas of Mitigation site with native material (dredge material) to restore topography for climax community seagrasses (target elevation).
2. Utilize dredged material of a consistency that will allow for settling and achievement of stable slopes and for support of the maximum possible surface area of fine capping fill material.
3. Using finer capping fill material, create a stabilized surface treatment of approximately 12 acres in size (target acreage) to achieve an elevation and substrate composition suitable for recruitment of seagrasses.
4. Design the site to maximize facilitation of recruitment from adjacent seagrass beds but also incorporate strategic planting to achieve recovery if not already done so within the desired timeframe.

5. Possible use of bird roosting stakes can also promote the recruitment of seagrasses within the mitigation area with a high level of reliability and low expense (Kenworthy, 2000).

To achieve these objectives, dredged material would either be hauled up the ICW or pumped to the mitigation site. The site boundaries will be clearly delineated in the field prior to deposition of fill. The first step will be to fill the holes to the base fill elevation. The base fill elevation is estimated to be between (-) 5 to (-) 7 feet MLLW, or the elevation below which seagrass communities no longer grow. Based on data from a latest bathymetry survey conducted by the Town of Palm Beach, the available capacity at the target elevation of (-) 6 feet MLLW is approximately 12 acres. Where the delineated site border meets a steep pit wall the fill will be leveled as closely as possible to adjacent seagrass elevation (target elevation) in order to encourage recruitment and also to improve connectivity of the restoration site to the adjacent seagrass bed community. In these specific areas, some resources may be covered by material on the narrow eroded shelf described earlier that occurs between natural grade and the sharp drop (see Figure 4). Wherever the delineated site border does not meet a steep wall the fill will be sloped up from the base fill elevation in order to avoid impacting existing seagrasses. The material will be deposited in two phases: coarse fill phase and capping phase. The material will be placed in a manner beginning at the most eastern edge of the mitigation area filling up to the target elevation, then continuing westward until the required acres of mitigation area is achieved. This placement method will help reduce the amount of sedimentation on nearby seagrass resources. The coarse fill phase will attempt to utilize dredge spoil, or may allow quarried native material, for the purpose of providing a supporting base for the site. Any mixture of rock and/or sandy material is acceptable for this phase provided that stable compaction and slopes are achieved. The coarse fill will be brought to within a minimum two feet of the final target elevation for the site, approximately (-) 6 to (-) 8 feet MLLW. The capping phase will utilize finer grain material suitable for seagrass recruitment and will be brought up to the target elevation, approximately (-) 4 to (-) 6 feet MLLW. The capping material will be constructed to an elevation between (-) 4 to (-) 6 feet MLLW maximum, with a minimum two-foot depth. The contractor will be provided with criteria that will limit the quality of the material to be placed in the mitigation site. At this time, there are no specific criteria provided by resource agencies, therefore USACE will develop standards to be followed. At a minimum, material will have less than 20% fines, and will be required to match as closely as possible to characteristics of surrounding material; however, turbidity standards will be the ultimate controlling parameter. Further details limiting composition will be provided in the project plans and specifications. Although the site design does not specifically seek to provide seagrass or other communities on the side slopes of the mounded areas, it is likely that either seagrass and/or hardbottom communities (calcareous algae and sponges) will grow on the side slopes, based on observations in the field of similar features as the mitigation site.

As a potential option to further increase the growth rate of seagrass, the use of bird roosting stakes may be explored. Bird stakes provide an inexpensive option to help promote seagrass growth by increasing nutrient loading through nitrogen and phosphorus enriched feces. Bird roosting stakes should be constructed using ½ - ¾ inch diameter PVC pipe capped with a pressure treated wooden block, ranging in size from 2 in. by 2 in. by 4in, or alternatively 4 in. by 4 in. by 2 in (Kenworthy et al. 2000 and FP&L 2010). Roosting stakes should be placed in a uniform grid across the mitigation area with no greater than ½ acre by ½ acre cells. Stakes

should remain in place for up to two years, pending achievement of success criteria (FLP, 2010). Coordination with the U.S. Coast Guard will be required to ensure bird stakes are clearly marked as navigational hazards with the use of "No Boating" signs in the mitigation area.

It is currently envisioned that the construction of the site would incorporate the following features:

- Transport: Barge access would be restricted to deep water. It appears that, should the barge transport method be used, there is more than sufficient depth and area to push the barge along the ICW, enter and exit the site, and turn the barge within the site. Additional channel surveys will need to be conducted prior to transport to verify depths. Barges may need to be light-loaded in the event the channel depths are not sufficient to accommodate full loads. If a piping method is used, the pipe could be placed in deep water wherever possible. The transport method is not expected to have significant impacts on surrounding seagrass beds adjacent to the transport route or the mitigation site.
- Turbidity Control: Some method of turbidity control such as curtains would be employed at the site in order to ensure compliance with state water quality standards. Significant turbidity is not expected during construction since the majority of the fill will consist of coarse grain material that will drop quickly during deployment. The calm conditions that make this site a good seagrass restoration candidate will also help to contain turbidity.
- Site Grading: Regardless of the method used to transport and deploy the fill, site finishing and grading will need to achieve the target elevation as closely as possible. A flat-blade excavator will most likely be used to grade the site to the specified elevation, but a combination of methods may be used.
- Planting: Planting will not initially be conducted with the assumption that natural recruitment will be successful. Monitoring will be conducted up to 5 years to ensure growth progress and success. In the event seagrass does not recruit as anticipated after 3 years, planting will be considered. Individual plots of *H. wrightii* and/or *Johnson's* may be distributed over portions of the site in areas where recruitment may otherwise be slow to occur based on post construction monitoring reports.

Once constructed, the site will be monitored. Monitoring will be designed to evaluate achievement of the following:

- recruitment of the site with seagrasses within 3 years, and
- Achievement of the target acreage of seagrass coverage within 5 years.

It is anticipated that seagrass recruitment will occur rapidly by *Johnson's* and *H. decipiens*. Other species including *H. wrightii* are expected to colonize the site at a slower rate.

In order to ensure the mitigation design is properly achieved, surveys will be taken after each stage of construction. Once the coarse fill material is placed, a survey will be taken to verify the target elevation of (-) 6 to (-) 8 feet MLLW is achieved. Any fill material will be removed or added in the event the target elevation is not successfully met. An additional survey will be conducted once the capping material has been placed to ensure accuracy. Sedimentation monitoring will be conducted in the adjacent seagrass beds to ensure material from the construction mitigation site is not shifting to existing areas, and will also ensure capping material

is not significantly shifting once the site is completed. Sedimentation traps will be placed throughout the surrounding area and data will be collected regularly based on the schedule provided in a detailed monitoring plan which will be completed once the actual site is chosen. Upon completion, the seagrass mitigation site will be monitored on a monthly basis for the first year, then twice a year for years two and three, and once a year for years four and five. Specific details of physical and sedimentation monitoring will be further outlined in the detailed monitoring plan once the site is chosen.

4.2 Artificial Hardbottom Creation

The proposed mitigation for hardbottom impacts will be type-for-type to ensure proper species recruitment is achieved. A total of 4.9 acres of low relief-low complexity (LRLC) hardbottom will be impacted by the widening and depending footprint and associated side sloe equilibrium. To compensate for these impacts, coordination with the Federal/state agencies will determine the mitigation acreage. A range of 4.9 – 9.8 acres is proposed representing a 1:1-2:1 ratio of impact/mitigation. The proposed location for mitigation of hardbottom, Singer Island Artificial Reef is found in Figure 1 and Figure 4. The Corps has the option of conducting mitigation prior to construction or simultaneously. Specific design requirements and the hardbottom design are described in this section.

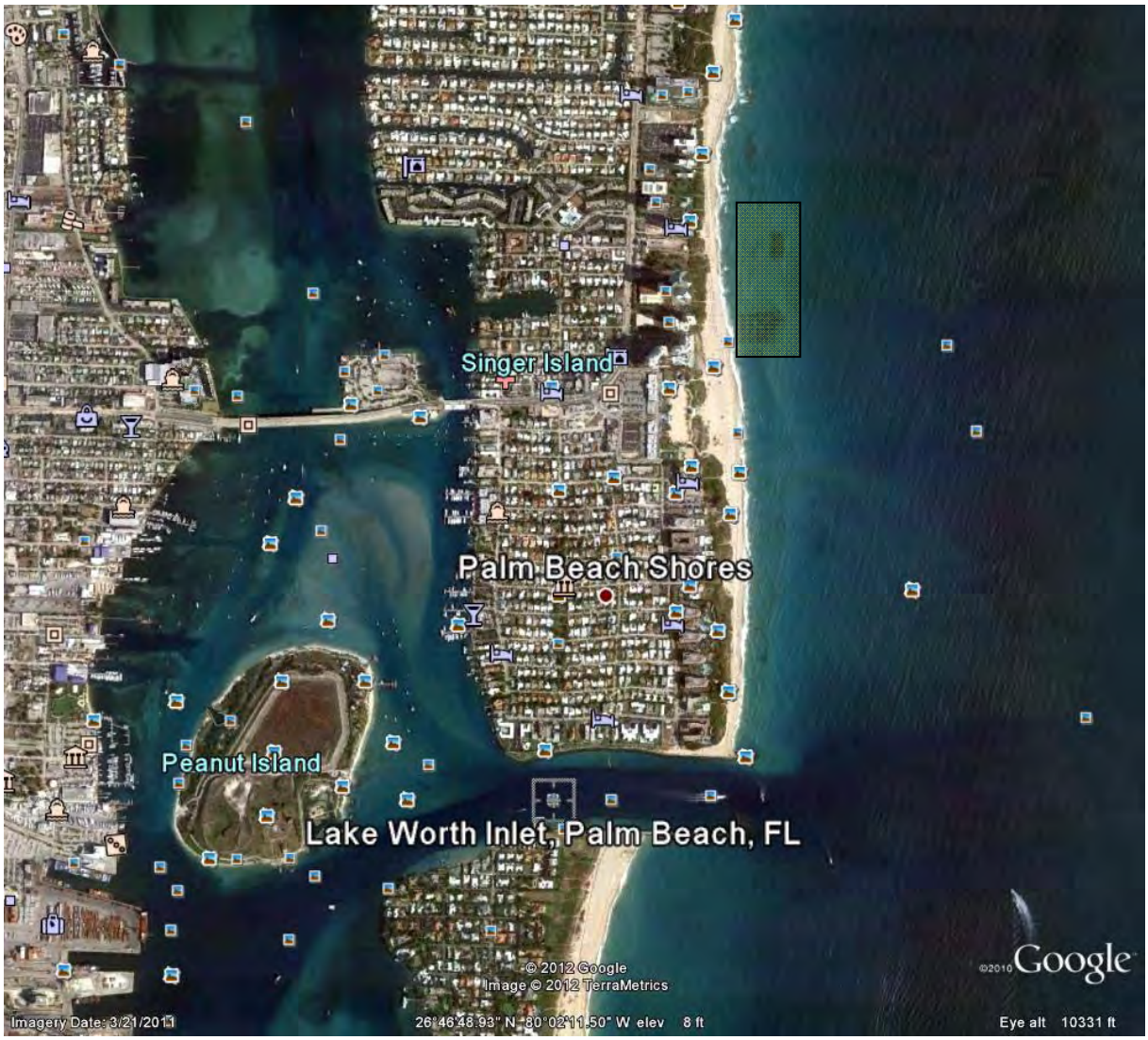


Figure 4. Proposed hardbottom mitigation site

4.2.1 General Design Requirements

Artificial hardbottoms are often proposed for mitigating impacts to natural hardbottom habitats as a result of construction project (Lutz 1998). Artificial hardbottoms have been used successfully for many years to mitigate impacts in sheltered waters (Duffy 1985; Davis 1985) or in relatively deep water offshore (Mostkoff 1993). Palm Beach County has had considerable success with deploying shallow water artificial hardbottoms as mitigation measures. The proposed design reflects the limitations on design and placement imposed by navigation regulations, liability issues, construction limitations, and stability concerns.

The most desirable areas for creation of hardbottom are areas that have a thin veneer of sand over bedrock, which limits the extent that deployed materials will settle. After reviewing the Palm Beach county permitted sites, it was determined that one of the sites (Singer Island Artificial Reef) already has some artificial hardbottom located within the boundaries, which would allow for quicker colonization of artificial hardbottom material, as well as allowing for easier monitoring since it is adjacent to a county mitigation site that is currently monitored. Water depths of this site are similar to the depths of low relief hardbottoms being impacted by the proposed project (8-12 feet). Several other permitted sites were reviewed for potential use but all had smaller capacities for additional artificial hardbottom than is needed for this project.

4.2.2 Hardbottom Design

Clean limestone rock excavated from the Entrance Channel or quarried native limestone will be used in hardbottom construction. The material will be deployed to mimic the orientation of typical natural hardbottoms. This hardbottom design will have a vertical relief of 3 to 4 feet and rocks will be deployed to provide the maximum structural complexity and to provide refugia for cryptic and reclusive species. As interstitial sand patches associated with hardbottom habitat are thought to be important in the ecological function of the hardbottom habitat, the hardbottom footprint will be 20 by 40 feet with space between modules consisting of mainly sand. Temporary buoys delineating the deployment strip will mark areas for deployment. Corner buoys for the sites shall be placed using Differential Global Positioning System (DGPS) with sub-meter accuracy. Natural limestone provides an ideal substrate for the establishment of a fouling community and colonization by the common hardbottom community species. Rock will be placed by crane and barge to ensure proper placement within the site.

Construction of mitigation hardbottoms may take place during dredging of the project, such that suitable rock material excavated from the channel may be used for hardbottom building.

4.2.3 Hardbottom Monitoring

The monitoring program for the mitigation hardbottoms will consist of both physical and biological components. An initial pre-construction monitoring event will be performed to provide baseline conditions for future comparison. Physical monitoring will assess the degree of settling of the hardbottom materials after the first year, and biological monitoring will assess populations of algae, invertebrates, and fishes, as compared with concurrent control sampling of natural hardbottoms for five years. Monitoring will be conducted annually in the summer months. In order to provide a permanent record of hardbottom conditions and biota, each sampling effort will include video transects covering representative areas of the mitigation hardbottoms.

Fish population evaluations will be based on visual censuses conducted via point-count method (Bohnsack and Bannerot 1986) used for fish assessment. This method has the advantage of gathering quantitative data in a relatively short time in a very repeatable pattern that is relatively insensitive to differences in habitat structure. Each census will have durations of 5 minutes and a

radius (the distance from the stationary observer) of 10 feet. Ten censuses will be collected on the mitigation site. Data from these types of censuses are rarely distributed, so the Wilcoxon Rank-Sum or a similar nonparametric test will be used for significance testing.

Results of all mitigation hardbottom-monitoring efforts will be summarized in an annual report to be completed by December 31 of each year the monitoring program is in place. Copies of the report will be distributed to all agencies and interested parties.

Success of mitigation site will be determined by comparison to natural communities of similar biologic assemblages within the project area. Transects (quadrats) will be compared at reference sites and mitigation site for species composition, percent cover and benthic assemblages. At each sampling location, a 0.7 m2 (1.0 × 0.7 m) PVC quadrat will be placed on the substrate. For each quadrat in situ mapping was conducted of all species including the dominant groups of Porifera and Hydroids, macroalgae, and other sessile invertebrates to lowest possible taxonomic rank. In addition to the in situ mapping of each quadrat, photographs will be taken to serve as a permanent visual record of the quadrats and qualitatively document the benthic community development on the artificial reef material. Bray-Curtis similarity indices (Bray and Curtis, 1957), which incorporate both species richness and species density into the calculations, will be used for analysis. Success is determined as a 75% similarity to the natural reference sites in terms of benthic assemblages and Bray-Curtis analysis.

5.00 Adaptive Management Plan

In the event that restoration measures fail to meet the goals as established by the success criteria as documented by monitoring event data, Adaptive management measures will be enacted and include:

- Plant seagrass species by shoot transplanting or re-seeding.
- Placement of bird stakes to encourage seagrass recruitment
- Utilize additional injury sites that show more promise of successful establishment than those currently in use
- Additional monitoring events or prolonged schedule until success criteria is documented as accomplished
- Create additional hardbottom habitat at a different location

6.00 Entity Responsible for Monitoring

All monitoring associated with this mitigation plan will be completed by or under the direction of the US Army Corps of Engineers; if the monitoring event is completed by a third party, this activity will be conducted under the direction and on behalf of the US Army Corps of Engineers. Therefore, the US Army Corps of Engineers will retain total responsibility of all activities related to the monitoring of this mitigation.

REFERENCES

Dunankl, M.J., M.O. Hall,and M. Merello, 2002. *Patterns of Change in the Seagrass dominated Florida Bay Hydroscope*; in *The Everglades, Florida Bay and Coral Hardbottoms of rhe Florida Keys, An Ecosystem Sourcebook.* Porter, J.W. and Porter, K.G., Eds., CRC Press, New Your, NY

Fonseca, M.S., W.J. Kenworthy, and G.W. Thayer. 1998. *Guidelines for the Conservation and Restoration of Seagrass in the United States and Adjacent Waters.* NOAA/COP Decision Analuysis Series no. 12, Silver Springs, MD: NOAA Coastal Ocean Office.

Fourqurean, J.W., M.J. Duranko, M.O. Hall, and L.N. Hefty, 2002. *Seagrass Distribution in the South Florida: a Multi-Agency Coordinated Monitoring Program,* in *The Everglades, Florida Bay and Coral Hardbottoms of the Florida Keys, An Ecosystem Sourcebook.* Porter, J.W., and Porter, K.G., Eds., CRC Press, Boca Raton, FL.

Kenworthy, W.J., M.S. Fonseca, P.W. Whitfield, K.K. Hammerstrom, and Schwartzschild, 2000. *A Comparison of Two Methods for Enhancing the Recovery of Seagrass into Propeller Scare: Mechanical Imjection of a Nutrient and Growth Hormone Solution vs. Defecation by Roosting Seabirds.* Final Report. Center for Coastal Fisheries and Habitat Research, NCCOS, NOAA, NOS, Beaufort, SC and the Dept. of Environmental Sciences, University of Virginia, Charlottesville, VA.

US Army Corps of Engineers, 2002 *Secion 204 Wcosystem Restoration Preort and Final Environmental Assessment Cockroach Bay, Hillsborough County, FL* Jacksonville District South Atlantic Division

RS Environmental Consulting, Inc for FPL, 2010. Revised Mitigation FPL Plan South Channel Relocation Project Seagrass Restoration in Biscayne Bay Aquatic Preserve (FDEP Permit no 13-0205980-002), Miami, FL

Seagrass Recovery, Inc, website 2011, http://www.seagrassrecovery.com/index.htm
St Petersburg, FL

Attachment 4

COST EFFECTIVE INCREMENTAL COST ANAYLSIS (CEICA)

FOR MITIGATION

1 COST EFFECTIVE INCREMENTAL COST ANALYSIS (CEICA) METHODOLGY OVERVIEW

The purpose of this CEICA document is to show that multiple mitigation sites were considered, and the sites that were most practical and still cost effective were chosen as the preferred sites. The Mitigation Plan, Section 3 of the Environmental Appendix, can and should be referenced for the specific details of the mitigation itself.

Three important ideas should be highlighted for the methodology of choosing the mitigation sites in this document.

First, the number of acres to mitigate for is a set number, determined by the HEA and UMAM models and refined through negotiations with the agencies. Therefore, each site will produce the required outputs. When outputs are the same, the basis of comparison for cost-effectiveness is cost per acre.

Second, project impacts are due to widening, not deepening. Therefore, since all the alternatives used the same widening footprint, this CEICA was only done for the NED/TSP plan.

Third, this document shows the "menu" of currently known and available sites in the Lake Worth Lagoon area and discusses the merits and costs of each. Sites will require verification of resources and conditions during the pre-construction, engineering, and design (PED) phase.

2 SEAGRASS MITIGATION

2.1 METHODOLOGY OF ESTABLISHING SEAGRASS

Throughout the Lake Worth Lagoon, there are several previously dredged holes which are suitable candidates for seagrass restoration. Their suitability is based on correspondence with Palm Beach County, Environmental Resources Management (ERM), and due to evidence that seagrasses currently grow just outside the holes at the natural, shallower, elevations. Palm Beach County, ERM, has had success regarding filling dredged holes (with no planting) to promote seagrass restoration within the Lake Worth lagoon, and it is this specific experience which especially supports the mitigation rationale for this project.

This project would fill dredged holes with dredged project material (any material will work, per ERM), and then would cap the top two feet with clean project sand. The combination of bringing the dredged hole(s) back up to their original elevation of surrounding landscape, and capping with sand, would allow optimum conditions for the existing seagrasses on the outer portions of the hole to grow.

2.2 SEAGRASS MITIGATION BENEFITS

The impact to seagrasses has been estimated at 4-5 acres, based on HEA model output. Assuming a 2.5 ratio, up to 11.25 acres or functional units, may be required.

2.3 SEAGRASS ALTERNATIVES

The locations of the potential seagrass and hardbottom mitigation sites are shown below in sites were immediately ruled out. Peanut Island Shoal is an area of shoaled sand, and would need to be dredged for seagrass restoration. There is a higher risk that the area would not support seagrasses and furthermore, that the area would soon beginning accumulating material. This area had a higher risk of not performing the function of supporting seagrass mitigation, and therefore was not considered further. Singer Island seagrass sanctuary was also ruled out because it would involve acquisition of privately owned land, which would be cost prohibitive.

The information, including distance from the project, cost per acre, and available capacity for the remaning five sites under consideration is listed in Table 1.

Figure 1. Two sites were immediately ruled out. Peanut Island Shoal is an area of shoaled sand, and would need to be dredged for seagrass restoration. There is a higher risk that the area would not support seagrasses and furthermore, that the area would soon beginning accumulating material. This area had a higher risk of not performing the function of supporting seagrass mitigation, and therefore was not considered further. Singer Island seagrass sanctuary was also ruled out because it would involve acquisition of privately owned land, which would be cost prohibitive.

The information, including distance from the project, cost per acre, and available capacity for the remaning five sites under consideration is listed in Table 1.

Figure 1: Location of potential Seagrass and Hardbottom Mitigation Sites

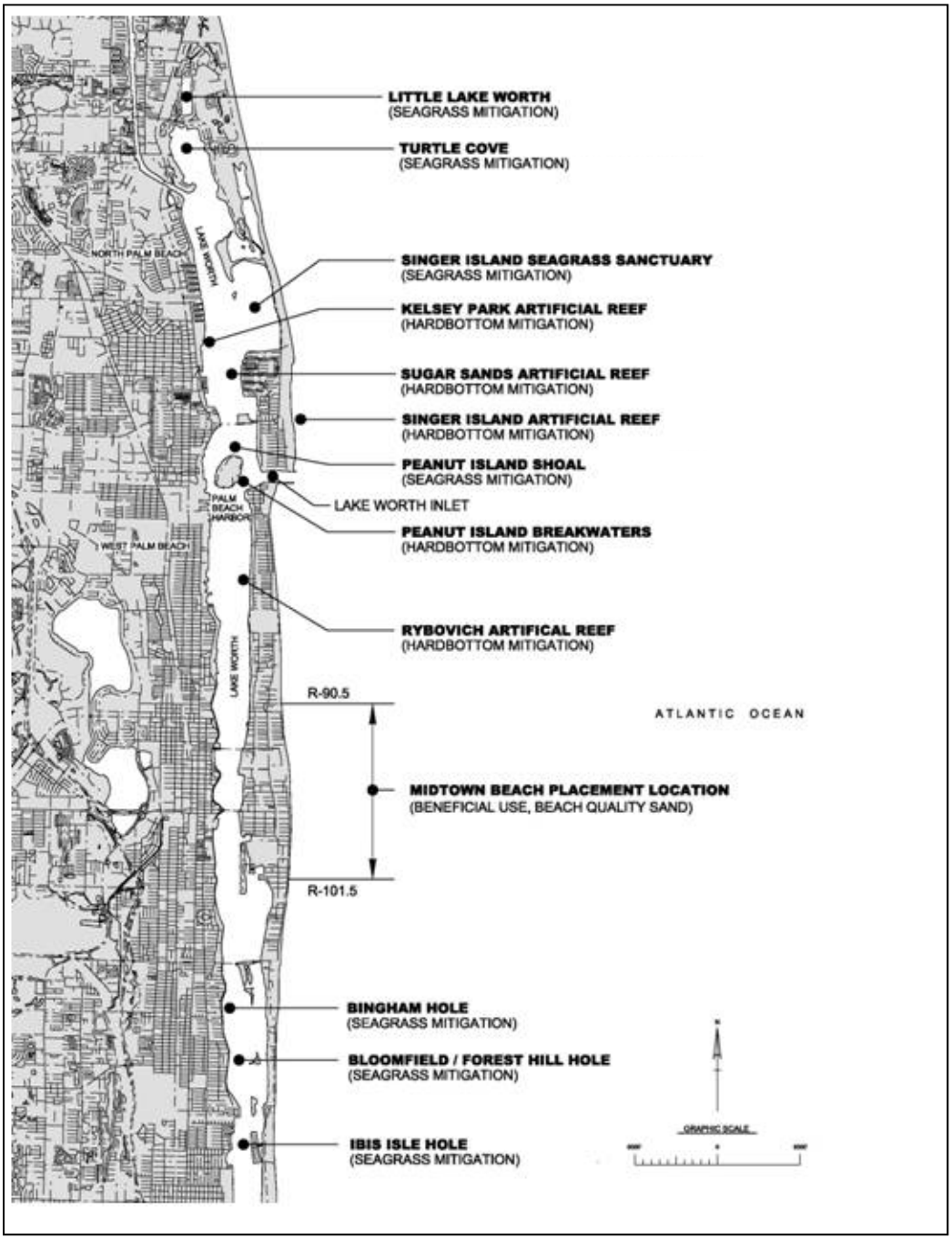


Table 1: Seagrass Mitigation Alternatives

Alt	Site	Distance (mi)	cost/acre	acres available
Alt 1	Little Lake Worth	5.81	488,889	11.25
Alt 2	Turtle Cove	5	204,444	11.25
Alt 3	Ibis Isle	8.83	306,667	11.25
Alt 4	Bingham	7.03	166,667	9
Alt 5	Bloomfield/Forest Hill	7.65	240,000	11.25

2.4 SEAGRASS SITE

All alternative sites have adequate capacity, with the exception of Alt 4, Bingham hole. Therefore, this was combined with the next most cost effective alternative, and plans were developed.

Table 2 shows that when the plans are compared, Plan 1 has the least average cost per acre, and therefore the least total cost. However, plan is the least cost but logistically and environmentally it does not make sense to go to two separate sites, when the next least cost site, Turtle Cove, which is also closer distance, can accommodate all the mitigation.

Therefore, Plan 2, Turtle Cove, is the mitigation site which is currently used in the cost estimate. This is the next most cost effective site, has a closer distance, and can accommodate all mitigation. It is more environmentally acceptable to do all the mitigation at one site and the county has had high success with seagrass restoration projects around this area.

Table 2: Seagrass Mitigation Plans

Plan	Alt	Site	Distance (mi)	cost/acre	Avg Cost/acre	Acres used	Subtotal cost	TOTAL cost
1	Alt 4	Bingham	7.03	166,667		9	$1,500,003	$1,960,002
	Alt 2	Turtle Cove	5	204,444	174,222	2.25	$459,999	
2	Alt 2	Turtle Cove	5	204,444	204,444	11.25		$2,299,995
3	Alt 5	Bloomfield/Forest Hill	7.65	240,000	240,000	11.25		$2,700,000
4	Alt 3	Ibis Isle	8.83	306,667	306,667	11.25		$3,450,004
5	Alt 1	Little Lake Worth	5.81	488,889	488,889	11.25		$5,500,001

3 HARD BOTTOM MITIGATION

Hard bottom mitigation will be required as a result of the combined effect of loss of habitat in Area C and loss of service in Area B2 due to the widening footprint is estimated to be 4-5 acres, based on HEA model output. Assuming a 2.5 ratio, up to 11.25 acres or functional units, may be required.

More detailed information on the analyses which determined the required mitigation can be found in Appendix D, Section 3, Mitigation Plan.

3.1 METHODOLOGY OF ESTABLISHING HARDBOTTOMS

MATERIAL

Two main options exist for the reef mitigation construction material:

1. Bring in an another source of material to serve as an artificial reef (quarry limestone rock or pre-fabricated material)
2. Use project rock to serve as the artificial reef

Material Option 1 would bring in an outside source of substrate for artificial reef creation. This could be any hard substrate, but most likely would be quarry limestone rock, which has had proven successful for other mitigation projects in the area.

Material Option 2 preserves the live hard bottom habitat as much as possible and would keep project rock within the lagoon system. With this option, at this stage in the feasibility study, there is uncertainty of what size of rock will be obtained with the dredge.

Material Option 1, using quarry limestone rock will be pursued as it is the most reliable means of establishing mitigation at this time. Option 2 may be revisited during the project pre-construction, engineering and design phase (PED) when geotechnical properties of the project rock are better understood.

PLACEMENT METHODS

Two broad options exist for mitigation placement methods, listed below, assuming that quarry limestone is being brought in from outside the project:

1. Crane-barge and scow barge
2. Diver placement

Placement Method 1 would be used if a source of rock was brought in, such as limestone boulders. An excavator and clamshell would still be used for the dredging portion, but would also require additional equipment consisting of a crane at the dockside loading location for picking up the mitigation material, loading the mitigation material on barges or split-hull scows, and using a crane-barge at the mitigation site to place the mitigation material from the barge.

For Placement Method 2, the excavator and clamshell would still be used for the dredging portion. Divers would be used to place each piece of hard bottom, rather than the split hull barges. This method would be extremely costly and potentially unsafe.

It is most likely, for performance and cost, that placement method 1 would be an acceptable method. Therefore, the crane-barge and scow barge will be assumed.

3.2 HARDBOTTOM ALTERNATIVES

The locations of the potential hardbottom mitigation sites are shown in sites were immediately ruled out. Peanut Island Shoal is an area of shoaled sand, and would need to be dredged for seagrass restoration. There is a higher risk that the area would not support seagrasses and furthermore, that the area would soon beginning accumulating material. This area had a higher risk of not performing the function of supporting seagrass mitigation, and therefore was not considered further. Singer Island seagrass sanctuary was also ruled out because it would involve acquisition of privately owned land, which would be cost prohibitive.

The information, including distance from the project, cost per acre, and available capacity for the remaning five sites under consideration is listed in Table 1.

Figure 1. The information, including distance from the project, cost per acre, and available capacity for five sites under consideration is listed in Table 3.

Table 3: Hardbottom Mitigation Alternatives

Alt	Site	Distance (mi)	cost/acre	acres available
Alt 1	Kelsey Park Artificial Reef	2.5	612,500	4
Alt 2	Sugar Sands Artificial Reef	1.8	683,333	3
Alt 3	Peanut Island Breakwaters	0.6	1,250,000	1
Alt 4	Singer Island Artificial Reef	2.4	995,556	11.25
Alt 5	Rybovich Reef	1.2	725,000	2

3.3 HARDBOTTOM SITE

Out of the five sites, only one (Singer Island Artificial Reef) has enough capacity for the currently assumed mitigation of 11.25 acres. Therefore, this was combined with the next most cost effective alternative, and plans were developed.

Table 4 shows that when the plans are compared, Plan 1 has the least average cost per acre, and therefore the least total cost. However, this plan is not logistically favorable as it includes palcing material at 4 different sites. These sites include Keslea Park Artifical Reef and Rybovich artifical reef. Both of these sites are unlikely to recruit the same species as are impacted (per the county), and are therefore less likely to be accepted by agencies. Plan 4 is the next most cost-effective, but again is not logistically favorable as it still includes placement at 3 different sites. Plan 3 allows all the needed mitigation to occur at one site, and has the highest chance of success due to the proven pod formations which currently exist, as well as for availability at the time of project construction.

Table 4: Hardbottom Mitigation Plans

Plan	Alt	Site	Distance (mi)	cost/acre	Avg Cost/acre	acres used	Subtotal cost	TOTAL cost
1	Alt 1	Kelsey Park Artificial Reef	2.5	612,500	728,000	4	$2,450,000	$8,190,000

	Alt 2	Sugar Sands Artificial Reef	1.8	683,333		3	$2,049,999	
	Alt 5	Rybovich Reef	1.2	725,000		2	$1,450,000	
	Alt 4	Singer Island Artificial Reef	2.4	995,556		2.25	$2,240,001	
2	Alt 4	Singer Island Artificial Reef	2.4	995,556		10.25	$10,204,449	
	Alt 3	Peanut Island Breakwaters	0.6	1,250,000	1,018,173	1	$1,250,000	$11,454,449
3	Alt 4	Singer Island Artificial Reef	2.4	995,556	995,556	11.25	$11,200,005	$11,200,005
4	Alt 2	Sugar Sands Artificial Reef	1.8	683,333		3	$2,049,999	
	Alt 4	Singer Island Artificial Reef	2.4	995,556		7.25	$7,217,781	
	Alt 3	Peanut Island Breakwaters	0.6	1,250,000	934,914	1	$1,250,000	$10,517,780

Therefore, Plan 3, Singer Island Artificial Reef, is the mitigation site which was used in the cost estimate. This is still a cost effective site, and can accommodate all mitigation. It is more environmentally acceptable to do all the mitigation at one site and it has had proven success.

4 CONCLUSION

In conclusion, a "menu" of potential candidate sites have been researched for seagrass and hardbottom mitigation sites. The site used for the cost estimate for seagrass mitigation is Turtle Cove, and the site used for hardbottom mitigation is Singer Island Artificial Reef. In both cases, these sites can

accommodate the full mitigation of 11.25 acres, which is assumed at this time, and have had proven success for the species needed. If the required mitigation is determined to be less, or if these sites are not available at the time of construction, then many other potential candidate sites which have been mentioned in this document can be referenced and may be used.

Seagrass Survey,
Federal Navigation Channel and Harbor Area,
Lake Worth Inlet, Palm Beach Harbor, FL

Final Report

January 2012

Prepared for:
U.S. Army Corps of Engineers
Jacksonville District
701 San Marco Blvd.
Jacksonville, FL 32207

Prepared by:
Dial Cordy and Associates Inc.
490 Osceola Ave.
Jacksonville Beach, FL 32250

TABLE OF CONTENTS

Page

LIST OF FIGURES III

LIST OF TABLES III

1.0 INTRODUCTION 1

2.0 TECHNICAL APPROACH 1

2.1 Marine Resource Survey 1

2.1.1 Reconnaissance Survey 1

2.1.2 Scientific Diver Survey 4

2.1.3 Seagrass Quantitative Data 5

2.1.4 Hardbottom Quantitative Data 5

2.1.5 Transect Qualitative Data 5

2.2. Analysis and Interpretation of Marine Habitat Data 6

3.0 RESULTS 6

3.1. Reconnaissance Survey Results 6

3.2. Marine Resource Habitat Types 6

3.3 Seagrass Communities 8

3.3.1 Seagrass Species Frequency of Occurrence, Abundance, and Density 8

3.4 Hardbottom Communities 11

4.0 DISCUSSION 15

5.0 REFERENCES 16

Appendix A Reconnaissance Towed Video Survey (DVD)

Appendix B Habitat Photographs

LIST OF FIGURES

Page

Figure 1 Location of Study Area 2

Figure 2 Towed Video reconnaissance Tracklines and Diver Survey Transects 3

Figure 3. Delineation of Seagrass and Marine Habitat..... 7

Figure 4 a *Halophila johnsonii* covered in filamentous red algae and cyanobacteria..... 10

Figure 4 b *Halophila johnsonii* (Braun Blanquet score 1 (<5% cover). 10

Figure 5 Continuous Hardbottom Habitat with Juvenile Reef Fish in the Foreground..... 11

Figure 6 Sand with scattered hardbottom habitat with reef fish..... 12

Figure 7 Small *Sidereastrea radians* colony found along Transect 25. 14

LIST OF TABLES

Page

Table 1. Braun-Blanquet Abundance Scale Values 4

Table 2. Habitat Classification System Used for Mapping of Habitat Types 5

Table 3. Acreage of marine resources community types including seagrasses, hardbottom, and abiotic bottom by zone. 6

Table 4. Summary of seagrass frequency of occurrence, abundance, and density for each transect where seagrasses were documented..... 9

Table 5. List of benthic invertebrates and macroalgae documented along transects. 12

Table 6. Fish species documented within project area. 13

Table 7. Percent cover of hardbottom constituents including hydroids, sponge, hard coral, macroalgae, tunicates and bare space along each transect where hardbottom was documented. Transect totals add to 100% only if the entire transect consisted of hardbottom. 13

Table 8. Number and size of corals encountered along transects..... 14

1.0 INTRODUCTION

Dial Cordy and Associates Inc. (DC&A) was contracted under contract No. GS-10F-0124L (Jacksonville District Work Order W912EP.11-F-0016) by the U.S. Army Corps of Engineers (USACE) to determine the pre-construction condition of the benthic environment with respect to seagrasses and hardbottom resources surrounding the existing federal navigation channel and harbor area in Lake Worth Inlet, Palm Beach County, FL (Figure 1).

The Lake Worth Inlet, within Palm Beach County is within the *Halophila johnsonii* critical habitat. *H. johnsonii* was listed as a threatened species by National Marine Fisheries Service (NMFS) on September 14, 1998 (63 FR 49035) and a re-proposal to designate critical habitat pursuant to Section 4 of the Endangered Species Act (ESA) was published on December 2, 1998 (64 FR 64231). The final rule for critical habitat designation for *H. johnsonii* was published April 5, 2000 (Federal Register, vol. 65, No. 66). *H. johnsonii* has one of the most limited geographic ranges of all seagrass species. It is only known to occur between Sebastian Inlet and northern Biscayne Bay on the east coast of Florida (Kenworthy 1997). This report and others (PBS&J 2009) document the occurrence of *H. johnsonii* within the project area (Figure 1).

2.0 TECHNICAL APPROACH

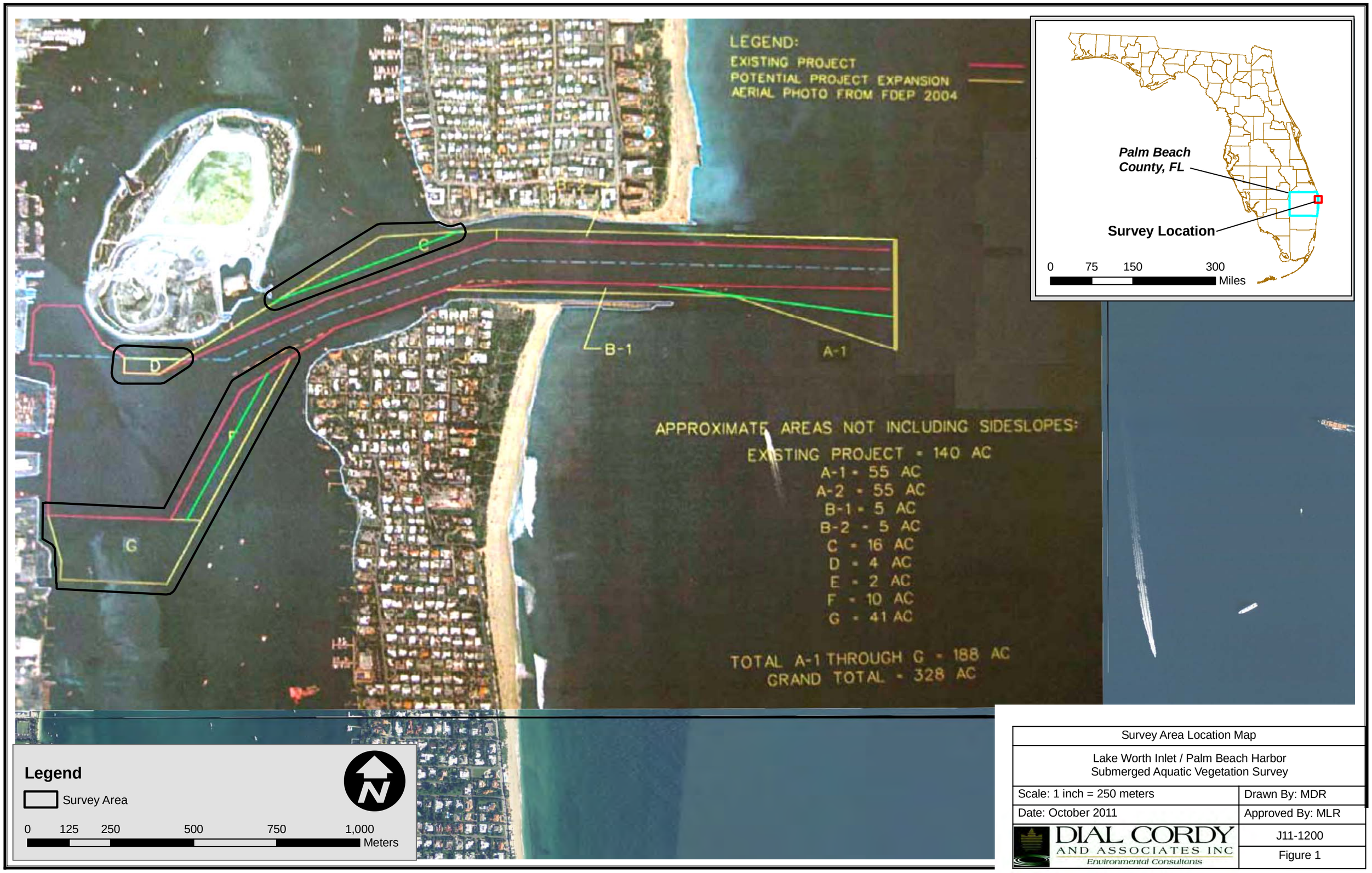
This section describes the technical approach used to collect and analyze data associated with the benthic surveys conducted in August of 2011 in Lake Worth Inlet, Palm Beach County, FL.

2.1 Marine Resource Survey

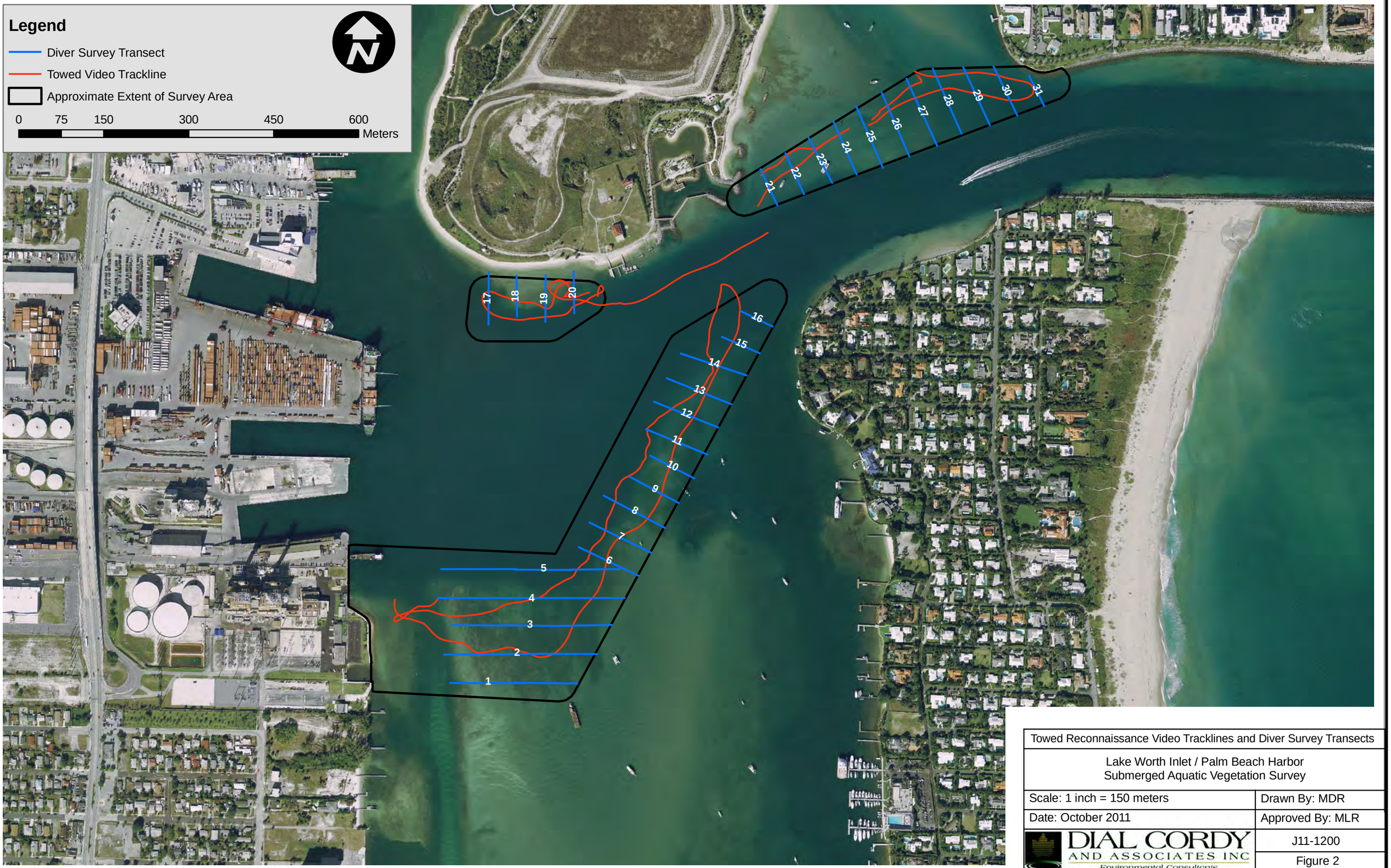
A description of methods utilized to document and characterize marine benthic resources within the study area (Figure 1) is provided below. The survey was conducted from August 17-30, 2011.

2.1.1 Reconnaissance Survey

A towed video reconnaissance survey was performed utilizing an integrated towed calibrated video system which records high definition digital video and is linked to geo-referenced navigational software and a precision positioning system (DGPS) with sub-meter accuracy. Such geo-referenced navigational software programs display the geographical coordinates in real time. The calibrated video system included a single camera facing forward and downward at a ~315° angle and traveled at a speed of 1-2 knots behind the vessel. The video was viewed in real time aboard the survey vessel's video screen and recorded directly to mini-DVs, and later transferred to CD. Continuous video transects were towed sinuously across the project site (Figure 2) (Appendix A).



Survey Area Location Map	
Lake Worth Inlet / Palm Beach Harbor Submerged Aquatic Vegetation Survey	
Scale: 1 inch = 250 meters	Drawn By: MDR
Date: October 2011	Approved By: MLR
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J11-1200
	Figure 1



Towed Reconnaissance Video Tracklines and Diver Survey Transects	
Lake Worth Inlet / Palm Beach Harbor Submerged Aquatic Vegetation Survey	
Scale: 1 inch = 150 meters	Drawn By: MDR
Date: October 2011	Approved By: MLR
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J11-1200
	Figure 2

2.1.2 Scientific Diver Survey

Scientific diver surveys were conducted in areas where seagrasses were identified as present during the towed video reconnaissance survey and followed the "Recommendation for Sampling *Halophilia johnsonii* at a project site" (Fonseca et al. 1998). Since seagrasses were pervasive except in the northeastern portion of the project area, survey transects were placed in all project site polygons. Per the NOAA recommended survey protocol for "large sites," 28 survey transects were placed within polygons C, D, F, and G, perpendicular to the axis of the channel, every 50 meters (150 feet) (Fonseca et al. 1998). Transect lengths included the project area and a 15m (50 foot) buffer on the landward side and where feasible on the channelward side (Figure 2). Divers swam between transects noting the extent of seagrass beds between transects.

Line-intercept and point quadrat data were collected to quantitatively and qualitatively describe the substrate types, assess percent cover, frequency of occurrence, abundance and density of seagrass and species composition within the survey area.

Transects were generally surveyed beginning at the channel edge and proceeded in a landward direction. Transect beginning and end points were recorded using DGPS with sub-meter accuracy in Hypack navigational software. Along each transect, quantitative data were recorded within $1m^2$ square quadrats (centered on the transect line), every 5m, starting at meter mark zero. Each quadrat was subdivided into 100 10 x 10cm sub-units. Data collected within each $1m^2$ quadrat included the number of 10 x 10cm sub-units that contained at least one seagrass shoot, marine benthic invertebrate or macroalgae) (Virnstein 1995; Fonseca et al. 1998; Braun-Blanquet 1965). The Braun-Blanquet abundance scale was also used to estimate the abundance and density of seagrass species (Table 1).

Table 1. Braun-Blanquet Abundance Scale Values

0	Species absent from quadrat
0.1	Species represented by a solitary short shoot, <5% cover
0.5	Species represented by a few (< 5%) short shoots, <5% cover
1.0	Species represented by many (> 5%) short shoots, <5% cover
2.0	Species represented by many (> 5%) short shoots 5% - 25% cover
3.0	Species represented by many (> 5%) short shoots 25%- 50% cover
4.0	Species represented by many (> 5%) short shoots 50%- 75% cover
5.0	Species represented by many (> 5%) short shoots 75%-100% cover

2.1.3 Seagrass Quantitative Data

Quantitative seagrass data were processed to provide transect frequency of occurrence, abundance, and density for each seagrass species as follows:

Frequency of occurrence = Number of occupied sub-units/total number of sub-units
Abundance = Sum of abundance scale values/number of occupied quadrats
Density = Sum of abundance scale values/total number of quadrats

2.1.4 Hardbottom Quantitative Data

Quantitative data collected for hardbottom habitat included percent cover of each group encountered within the sampled $1m^2$ quadrats, which were placed every 5m along a transect. Data collected for hardbottom benthic invertebrates and algae were collected at the lowest possible taxonomic level and are presented as functional groups in the results. All hard corals encountered, whether or not they fell within the surveyed $1m^2$ quadrat, were recorded by species and size.

2.1.5 Transect Qualitative Data

Qualitative line-point intercept data were collected within a 2m swath along the centerline of each transect. Scientific divers surveyed each transect noting the linear extent of bottom type within a 2m wide area swath, centered on the transect line. Habitat classifications were developed from the qualitative data collected and used for habitat mapping (Table 2).

Table 2. Habitat Classification System Used for Mapping of Habitat Types

Habitat Types	Description
Halophila decipiens	Monospecific bed of this species
Halophila decipiens/Halophila johnsonii	Mixed beds of these species
Halophila johnsonii	Monospecific bed of this species
Halophila johnsonii/Halodule wrightii	Mixed beds of these species
Sand	Sand with no seagrass or live bottom
Sand with cyanobacteria	Sand with cyanobacteria cover
Shell hash	Sand and shell mixture
Sand with scattered hardbottom	Mix of hardbottom and sand
Hardbottom	Continuous hardbottom
Hardbottom ledge	Vertical hardbottom ledge

2.2. Analysis and Interpretation of Marine Habitat Data

Distribution of habitat types and their potential occurrence in an area were mapped for each transect from survey data.

3.0 RESULTS

This section includes a description and review of the results of the benthic community survey, including acreages of marine resources surveyed, percent cover, species occurrence, abundance, and density for seagrasses and hardbottom communities.

3.1. Reconnaissance Survey Results

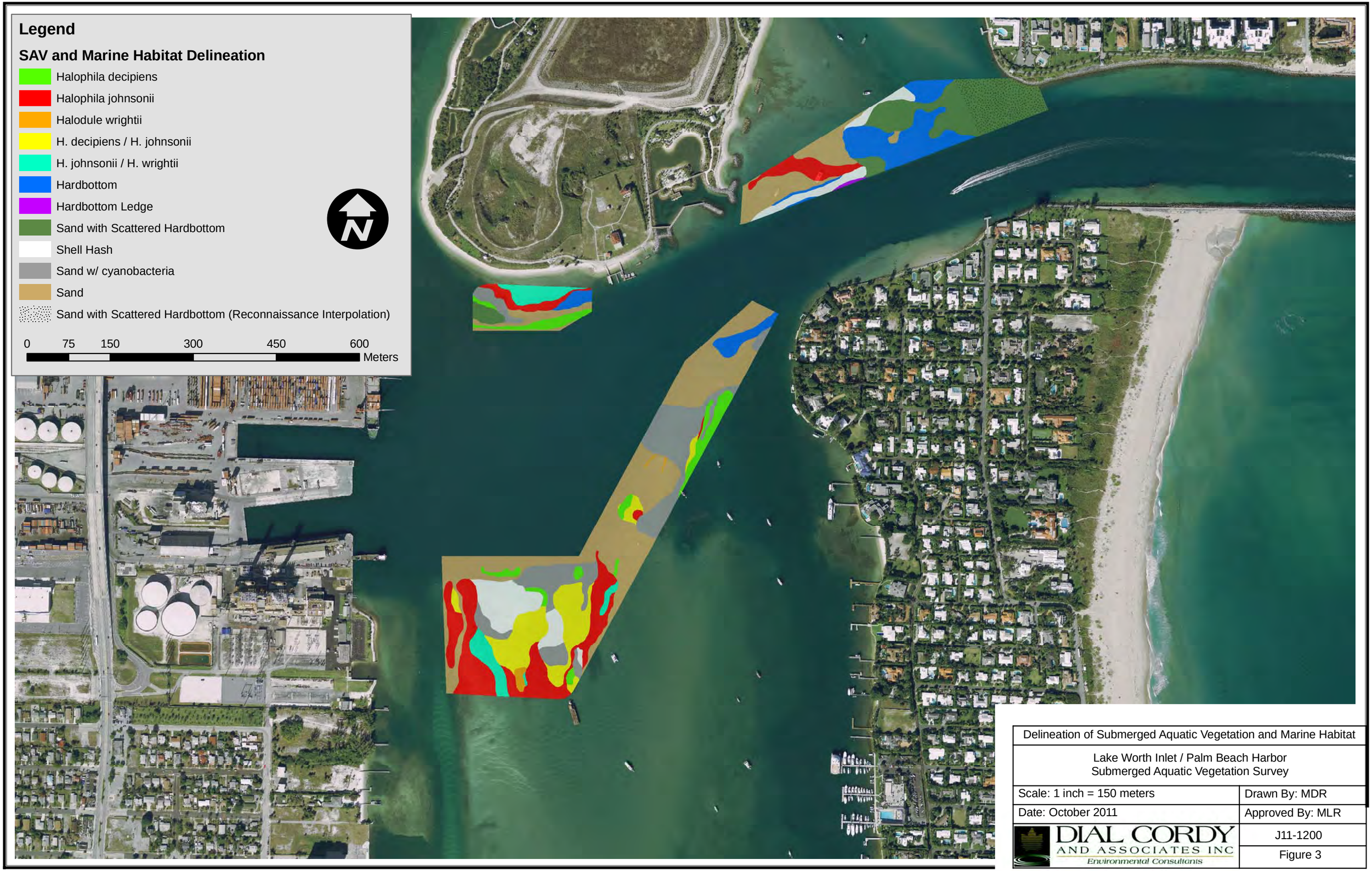
The towed video reconnaissance survey revealed widespread seagrass and hardbottom communities. Video was qualitatively analyzed aboard the vessel to determine the extent of habitat encountered throughout the survey area. Start and stop GPS points were recorded along the towed trackline to mark habitat types for verification during diver surveys.

3.2. Marine Resource Habitat Types

Seagrass, hardbottom, and sand habitats were identified and assessed within the Lake Worth survey area in August 2011. Of the nearly 50 acres surveyed, 14.6 acres were comprised of seagrasses including the species *Halophila johnsonii, H. decipiens* and *Halodule wrightii.* Over ten acres included hardbottom habitat, which included continuous hardbottom, sand with scattered hardbottom, and hardbottom ledge habitats. Nearly half of the survey area consisted of sand, sand covered by cyanobacteria, or shell hash (Table 3 and Figure 3). Photographs were taken to characterize the habitat qualitatively and the complete set of photographs is included as Appendix B.

Table 3. Acreage of marine resources community types including seagrasses, hardbottom, and abiotic bottom by zone.

Community Type	Zone C	Zone D	Zone F	Zone G	Total
Halophila decipiens	0	0.7	1.0	0.5	2.2
Halophila decipiens/Halophila johnsonii	0	0	0.3	3.6	3.9
Halophila johnsonii	1.1	0.6	0.1	4.9	6.7
Halophila johnsonii/Halodule wrightii	0	0.8	0	1.0	1.8
Halodule wrightii	0	0	0.0	0.2	0.2
Sand	2.7	0.8	8.0	3.2	14.7
Sand with cyanobacteria	0	0.4	3.4	2.4	6.2
Shell hash	1.1	0	0	2.4	3.5
Sand with scattered hardbottom	5.4	0.4	0	0	5.8
Hardbottom	3.6	0.3	0.7	0	4.6
Hardbottom ledge	0.1	0	0	0	0.1
TOTAL	**14.0**	**4.0**	**13.5**	**18.1**	**49.6**



Delineation of Submerged Aquatic Vegetation and Marine Habitat	
Lake Worth Inlet / Palm Beach Harbor Submerged Aquatic Vegetation Survey	
Scale: 1 inch = 150 meters	Drawn By: MDR
Date: October 2011	Approved By: MLR
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J11-1200
	Figure 3

3.3 Seagrass Communities

Seagrass habitat cover type, abundance, and density for the study area are described below. Distribution and occurrence observations for the 2011 survey included surveys areas C, D, F, and G (Figure 3). In general, seagrasses occurred throughout the entire project area, with the exception of the northeastern portion of the project area, where hardbottom predominated (Figure 3).

3.3.1 Seagrass Species Frequency of Occurrence, Abundance, and Density

General Occurrence

Marine seagrass species observed within the study area included *Halodule wrightii*, *Halophila decipiens*, and *Halophila johnsonii*. Of the 28 transects surveyed, marine seagrass species were observed at 19 transects, or 68% of transects. One or more species of seagrass occurred within every zone, C, D, F and G. *H. johnsonii* was present within all zones to some extent. A summary of occurrence records for each transect where seagrass was found is presented in Table 4. Seagrass habitat maps are included in Figure 3.

Frequency of Occurrence

H. johnsonii

H. johnsonii occurred within 16 of the 28 transects sampled. Frequency of occurrence values ranged from 0 to 0.12 with a mean of 0.07. *H. johnsonii* was often growing under filamentous red algae and cyanobacteria (Figure 4a, b).

Other species

H. decipiens occurred within 14 transects sampled, while *H. wrightii* occurred within only seven transects. Frequency of occurrence for *H. decipiens* values ranged between 0 to 0.12 with a mean of 0.03. In comparison, *H. wrightii* had a range of occurrence values between 0 and 0.20 with a mean of 0.07 over the study area.

Abundance

H. johnsonii

Abundance values for *H. johnsonii* ranged from 0.1 to 1.38 among transects. The average abundance for *H. johnsonii* was 0.6 (< 5% cover). *H. johnsonii* had the lowest abundance values of all species over all transects.

Other Species

Cover abundance for *H. wrightii* was low and ranged from 0.5 to 1.2 with a mean 0.66. *H. decipiens* had the highest abundance score for all seagrasses, ranging from 0.5 to 2.33 with a mean of 1.03.

Table 4. Summary of seagrass frequency of occurrence, abundance, and density for each transect where seagrasses were documented.

		Halodule wrightii	Holophila decipiens	Halophila johnsonii	Halodule wrightii	Holophila decipiens	Halophila johnsonii	Halodule wrightii	Holophila decipiens	Halophila johnsonii
Zone	**Transect**	**Frequency of Occurrence**			**Abundance**			**Density**		
G	**T01**	**0.04**	**0.03**	**0.12**	**0.67**	**2.33**	**0.56**	**0.08**	**0.14**	**0.34**
G	**T02**	**0.02**	**0.02**	**0.06**	**0.50**	**1.75**	**0.55**	**0.05**	**0.06**	**0.19**
G	**T03**		**0.12**	**0.08**		**1.59**	**0.68**		**0.29**	**0.19**
G	**T04**	**0.01**	**0.02**	**0.05**	**0.50**	**1.17**	**0.50**	**0.01**	**0.10**	**0.14**
G	**T05**		**0.00**	**0.00**		**0.30**	**0.50**		**0.01**	**0.01**
F	**T06**		**0.00**	**0.01**		**0.50**	**0.50**		**0.02**	**0.02**
F	**T08**		**0.01**	**0.00**		**0.75**	**0.10**		**0.06**	**0.00**
F	**T10**	**0.00**	**0.01**		**0.50**	**0.50**		**0.02**	**0.06**	
F	**T11**		**0.07**	**0.01**		**1.30**	**0.50**		**0.30**	**0.05**
F	**T12**		**0.07**			**1.25**			**0.20**	
F	**T13**		**0.07**			**1.33**			**0.32**	
D	**T17**	**0.04**	**0.03**	**0.01**	**1.0**	**0.33**	**0.50**	**0.05**	**0.05**	**0.05**
D	**T18**	**0.20**		**0.36**	**0.71**		**1.06**	**0.33**		**0.57**
D	**T19**	**0.18**	**0.01**	**0.07**	**1.21**	**0.50**	**0.50**	**0.47**	**0.06**	**0.28**
D	**T20**	**0.03**	**0.03**	**0.01**	**0.50**	**0.50**	**0.37**	**0.09**	**0.16**	**0.07**
C	**T21**			**0.01**			**0.50**			**0.03**
C	**T22**			**0.07**			**0.75**			**0.18**
C	**T23**			**0.27**			**1.38**			**0.72**
C	**T24**			**0.02**			**0.70**			**0.14**

* Species present but quantity was below 0.01

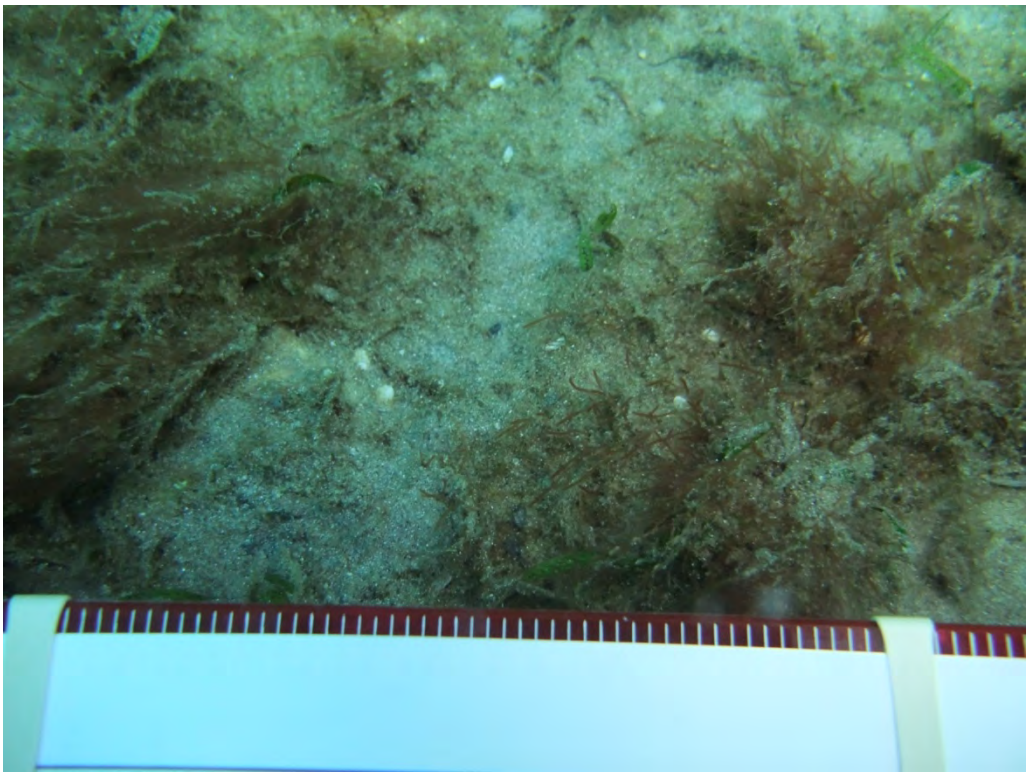


Figure 4 a ***Halophila johnsonii*** **covered in filamentous red algae and cyanobacteria.**

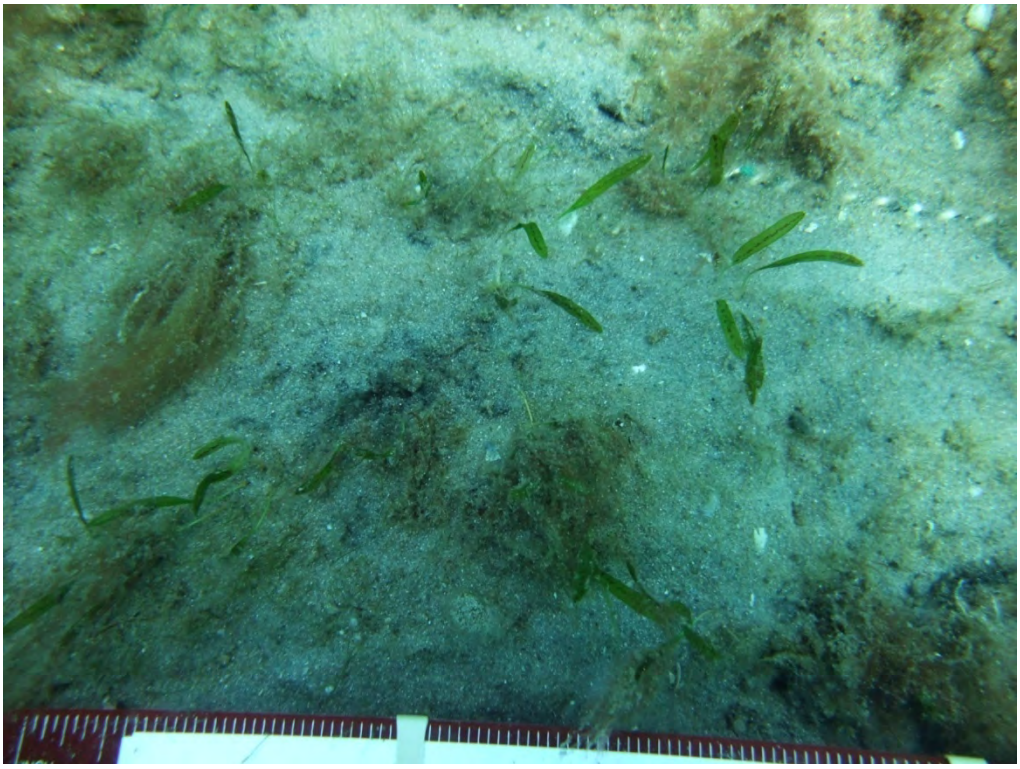


Figure 4 b ***Halophila johnsonii*** **(Braun Blanquet score 1 (<5% cover).**

Density

H. johnsonii

Density for *H. johnsonii* was the highest of all species in the study area, with an average value of 0.17. The range of density values for *H. johnsonii* was 0 to 0.57.

Other Species

H. wrightii had the second highest density values encountered, with a range of 0.01 to 0.47 with an average of 0.15. *Halophila decipiens* had the lowest density of the three species with values ranging from 0.01 to 0.3 with a mean of 0.13.

3.4 Hardbottom Communities

Hardbottom communities occurred in the northeastern portion of the project area within Zones C, D and F, along portions of Transects 15, 16, 17, 20, 25, 26, 27, and 28. Hardbottom communities included areas of continuous hardbottom, sand with scattered hardbottom, and hardbottom ledges (cut edge of channel). Continuous hardbottom areas were places where limestone hardbottom was at the surface or under a thin veneer (>1cm) of sand (Figure 5). The sand with scattered hardbottom habitat type included areas where sand pockets were interspersed with pockets of hardbottom (Figure 6). All hardbottom habitat types supported mixed juvenile and adult reef fish. Some transects had a mix of seagrass and hardbottom habitat types (e.g. T21).

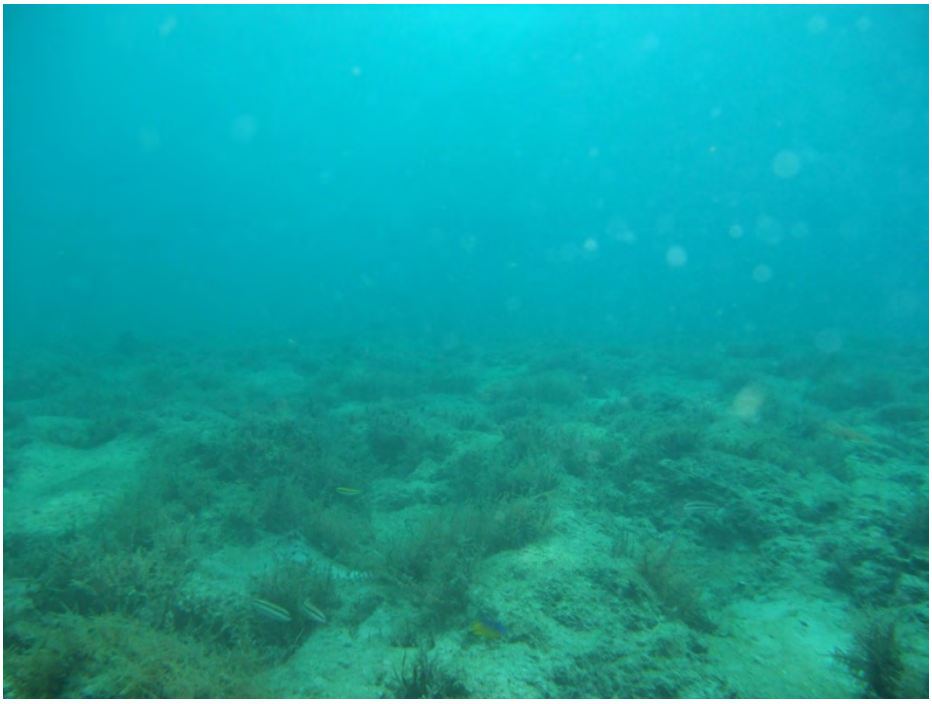


Figure 5 Continuous Hardbottom Habitat with Juvenile Reef Fish in the Foreground.

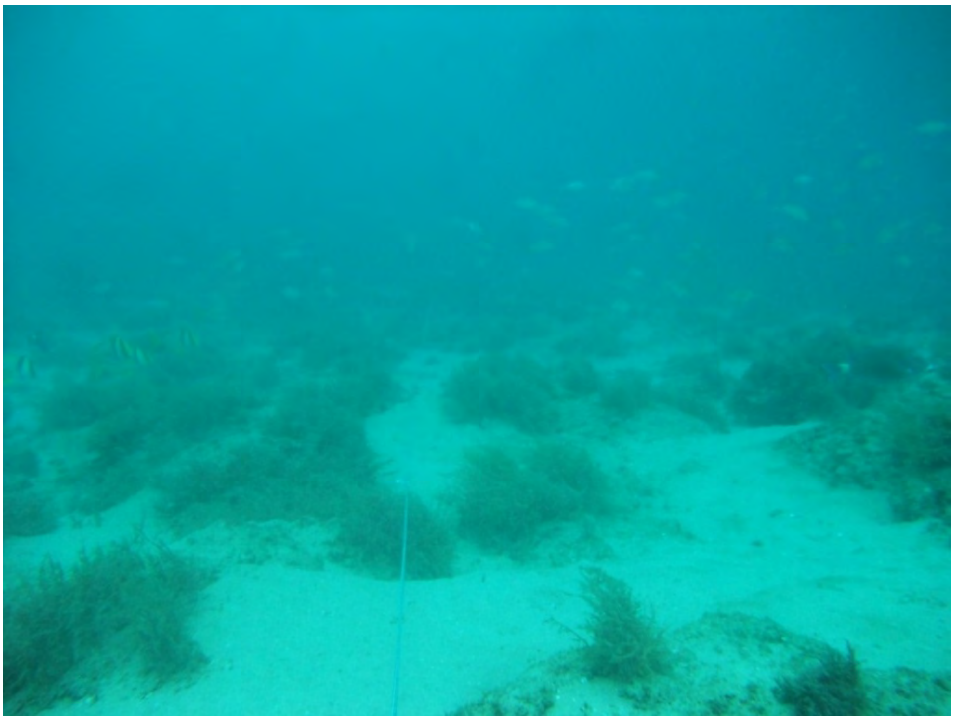


Figure 6 Sand with scattered hardbottom habitat with reef fish.

Continuous hardbottom, sand with scattered hardbottom and hardbottom ledge habitat included a number of benthic organisms unique to hardbottom habitat which were not found in seagrass habitats. Hardbottom benthic organisms were documented to the lowest taxonomic level and are listed in Table 5. Fish populations associated with hardbottom habitat were also documented (Table 6).

Table 5. List of benthic invertebrates and macroalgae documented along transects.

Common Name	Species Name
Sponge	
Black ball sponge	*Ircinia strobilina*
Orange boring sponge	*Cliona delitrix*
Lumpy overgrowing sponge	*Holopsamma helwegi*
Hard Corals	
Lesser starlet coral	*Siderastrea siderea*
Greater starlet coral	*Siderastrea radians*
Hydroids	
Feather bush hydroids	*Dentitheca dendritica*
Macroalgae	
Geen feather algae	*Caulerpa sertularoides*
Y branched algae	*Dictyota* sp.
Oval Blade algae*	*Caulerpa prolifera*

*Documented in seagrass habitat and hardbottom habitat.

Table 6. Fish species documented within project area.

Fish Common Name	Fish Species
Porkfish	*Anisotremus virgincus*
Gray Angelfish	*Pomacanthus arcuatus*
Stoplight Parrotfish	*Sparisoma viride*
Tomtates	*Haemulon aurolineatum*
Grunts (j)	*Haemulon* (spp.)
Blue tang	*Acanthurus coeruleus*
Bluehead wrasse (j,a)	*Thalassoma bifasciatum*

The relative abundance of hardbottom benthic organisms to each other and the percent cover of functional groups along transects is described in Table 7. Hardbottom habitat occurred in Zones C, D, and F, but was not documented in G. Zone C had the greatest cover of hardbottom habitat, followed by Zones F and D. Hard corals were noted along transects, whether or not they fell within $1m^2$ quadrats. A total of five hard corals were documented along all transects surveyed and included *Siderastrea siderea* and *S. radians* (Table 8; Figure 7). Noteably, no soft corals were documented during this survey.

Table 7. Percent cover of hardbottom constituents including hydroids, sponge, hard coral, macroalgae, tunicates and bare space along each transect where hardbottom was documented. Transect totals add to 100% only if the entire transect consisted of hardbottom.

Zone	Transect	Hydroid	Sponge	Hard Coral	Macroalgae	Tunicate	Bare	Total
F	**T14**	0	2.3	0	0.5	0.01	2.3	5.11
F	**T15**	3.3	3.3	0	0	0	6.6	13.2
F	**T16**	4.6	2	0	1.2	0.23	12.8	20.83
D	**T17**	0.8	0.8	0	0	0	1.6	3.2
D	**T20**	9.4	3.8	0	0	0.38	24.0	37.58
C	**T21**	0	6.6	0	0	0	10	16.6
C	**T22**	1.6	2	0	0	0	4.4	8
C	**T25**	17.0	1.4	0.05	0	0.05	34.1	52.6
C	**T26**	16.8	0.66	0.06	1.33	0	33.4	52.25
C	**T27**	15.7	3.9	0.04	0	0	71.5	91.14
C	**T28**	18.7	0.83	0	0	0	76.3	95.83

Table 8. Number and size of corals encountered along transects.

Zone	Transect	Species	Size (cm)
D	T20	*Siderastrea radians*	2
C	T25	*Siderastrea radians*	5
C	T25	*Siderastrea radians*	2
C	T26	*Siderastrea radians*	2
C	T26	*Siderastrea siderea*	3

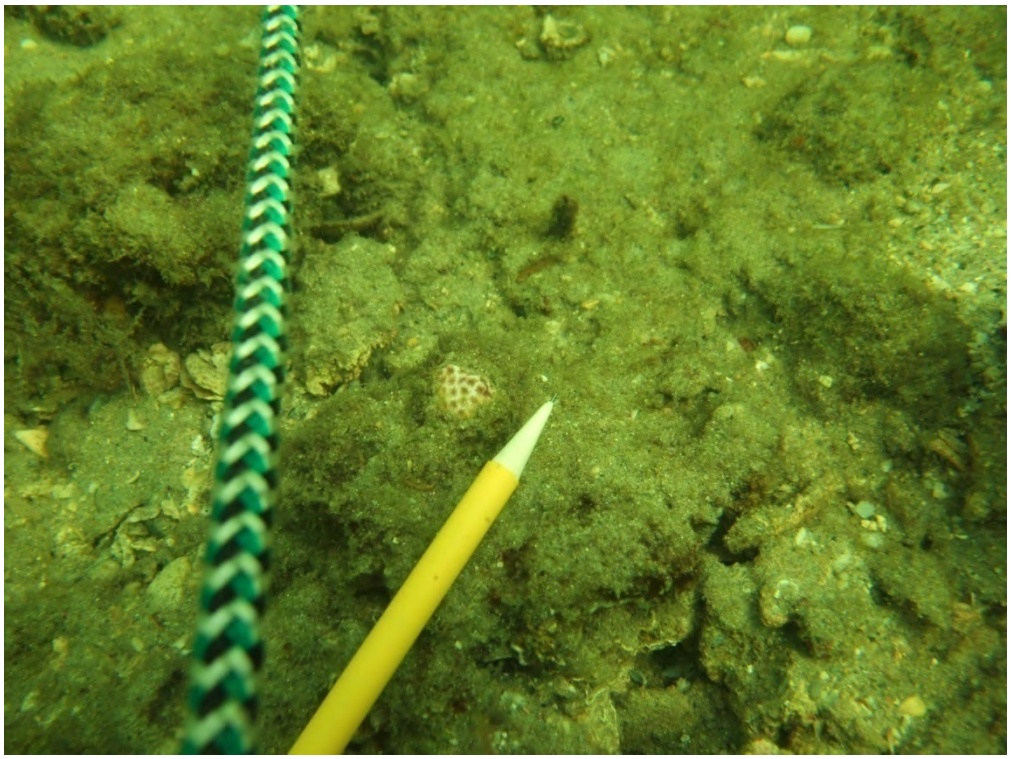


Figure 7 Small *Sidereastrea radians* colony found along Transect 25.

Hardbottom habitat was mostly bare, covered with a thin veneer of sand (<1cm) (Table 7). The dominant hardbottom benthic organisms were feather bush hydroids and sponges. Macroalgae cover was low and patchy in distribution. Solitary tunicates and hard corals were also present.

4.0 DISCUSSION

The benthic survey conducted within the Lake Worth Inlet, Palm Beach Harbor, Palm Beach Florida for the USACE documented seagrass and hardbottom communities within the project area. The surveyed site, nearly 50 acres, included Zones C, D, F, and G (Figure 1). Almost 20 acres, or 40% of the project area surveyed consisted of sand, sand with cyanobacteria, and shell hash habitat type, which were devoid of macro-epibenthic communities. Seagrass beds comprised of *Halophila johnsonii, H. decipiens* and *Halodule wrightii* covered 14.6 acres of the project area, while over ten acres included hardbottom habitat types. Seagrass communities were found throughout the project area (Zones C, D, F and G), except within the extreme northeastern portion of the project area (Zone C), where only hardbottom habitat was documented. Hardbottom habitat increased toward the inlet, to the northeast and was not documented in the southern portion of the project area (Zone G) (Figure 3).

Seagrass communities were dominated by sparse cover of *H. johnsonii* in single species and mixed beds in shallow to mid-water depth (0-4m), while *H. decipiens* predominated in water depth greater than 4m. *Halodule wrightii* was also found in shallow water, primarily less than 2m. Frequency of occurrence, cover abundance scores, and density were relatively low for all seagrass beds documented. Frequency of occurrence across an entire transect was highest for *H. johnsonii* along Transect 18, with a value of 0.36 out of a possible 1.0. Cover abundance scores for all species, *H. johsonii*, *H. decipiens* and *Halodule wrightii* were less than 26% cover (maximum of 2.33; Table 4) across all transects; which means that seagrasses covered less than 26% of the bottom where they were found. The highest density score, which is the sum of cover abundance scores for a species, divided by the total number of quadrats within a transect, was 0.72. Overall, seagrass were present in 14.6 acres, but their coverage was low throughout that 14.6 acres.

Hardbottom habitat types including continuous hardbottom, sand with scattered hardbottom, and hardbottom ledge were present within the northeastern portion of the project area and covered nearly 10 acres of the survey area. Bare space, which was limestone rock covered by a thin veneer of sand with no benthic organisms attached to it, was the dominant feature of the hardbottom habitat documented. Hydroids and sponges were the predominant benthic organisms encountered in hardbottom habitat. Hard corals were present, but octocorals were absent. Abundant juvenile and adult reef fish populations utilized all hardbottom habitat types.

5.0 REFERENCES

Braun-Blanquet, J. 1965. Plant sociology: the study of plant communities. Hafner Publications, London. 439p.

Fonseca, M.S., J.W. Kenworthy, and G.W. Thayer. 1998. Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters. NOAA Coastal Ocean Program Decision Analysis Series, No. 12. NOAA Coastal Ocean Office, Silver Spring, MD.

Kenworthy, W.J. 1997. An updated status review and summary of the proceedings of a workshop to review the biological status of the seagrass *Halophila johnsonii* Eisemon. Report to Office of Protected Species, NMFS, NOAA. 23pp.

Kenworthy, W.J. 1993. The distribution, abundance and ecology of Halophila johnsonii Eiseman in the lower Indian River, Florida. Final Report to the Office of Protected Resources, National Marine Fisheries Service, Silver Spring, MD. 72pp.

PBS&J and Ardaman and Associates. 2008. Palm Beach Harbor Navigation: Feasibility Study Environmental Resources Report: A complete submerged aquatic resources survey for the Port of Palm Beach, extending from the 42-ft contour shoreward. Conducted June-October 2008. Prepared for the Corps of Engineers. 81pp.

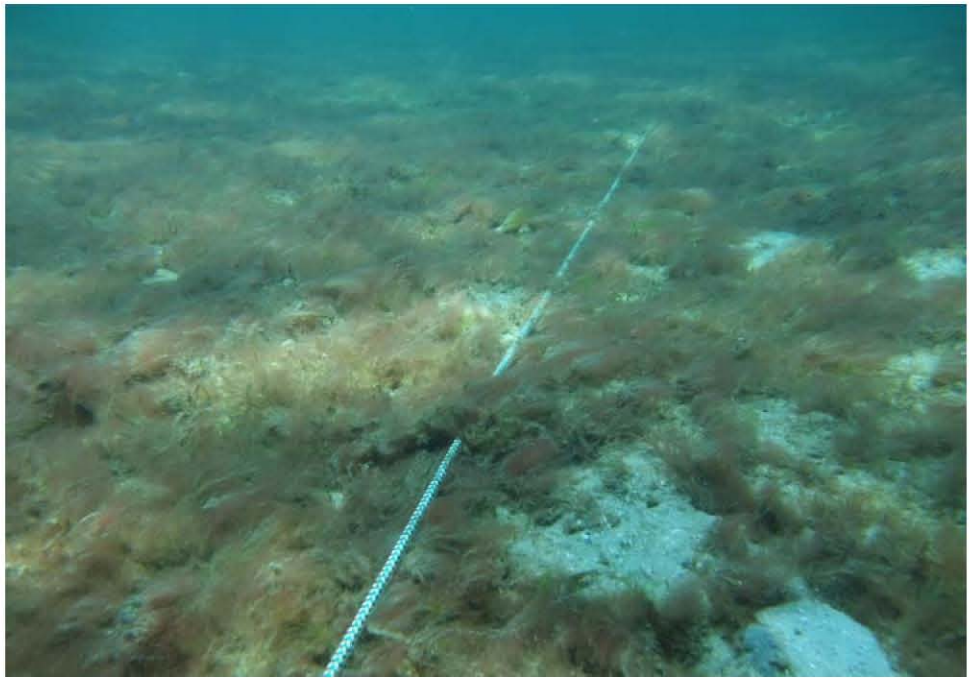
Virnstein, R.W. 1995. Seagrass landscape diversity in the Indian River Lagoon, Florida: The Importance of scale and pattern. Bulletin of Marine Sciences. 57(1):67-74.

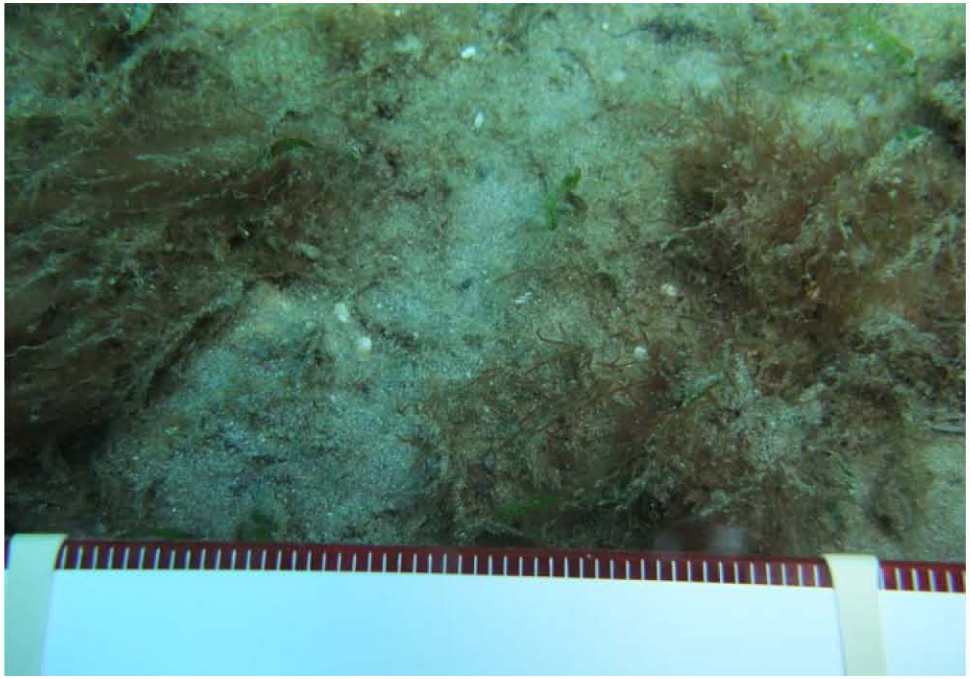
APPENDIX A

Reconnaissance Towed Video Survey (DVD)

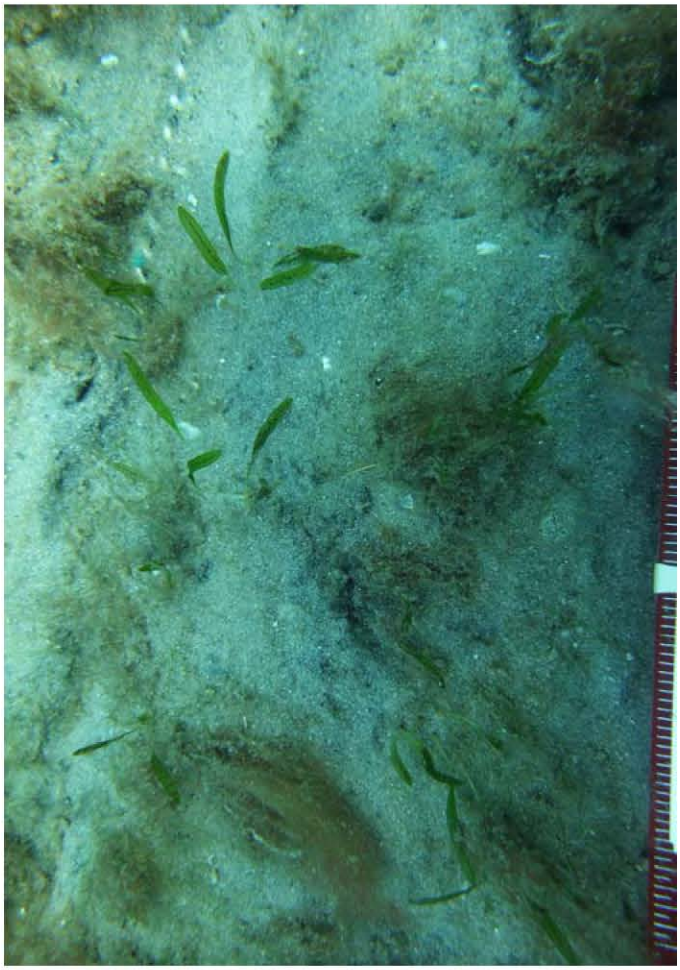
APPENDIX B

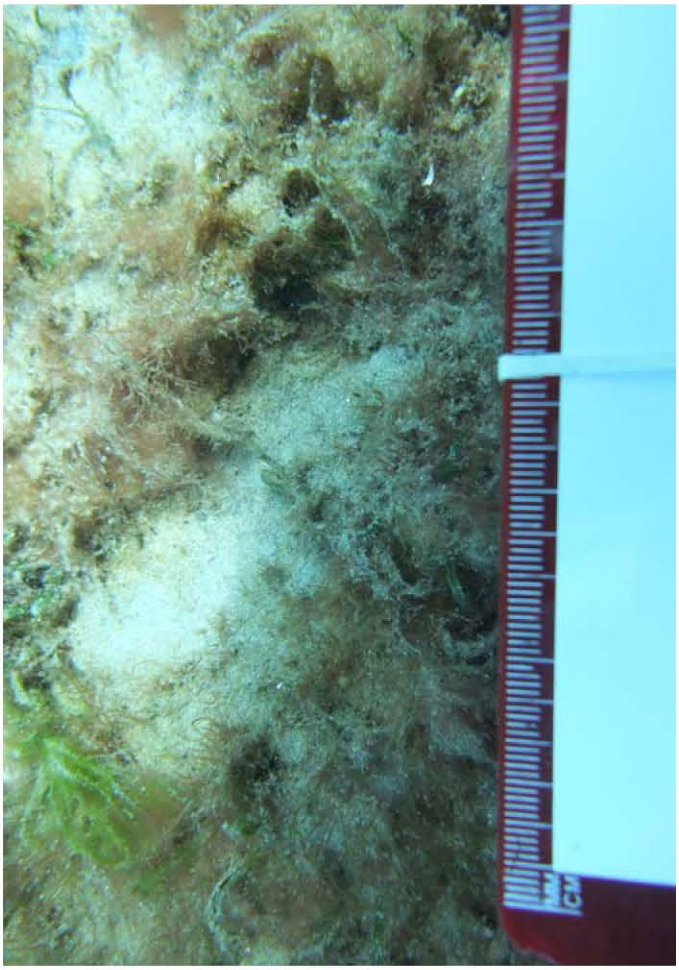
Habitat Photographs

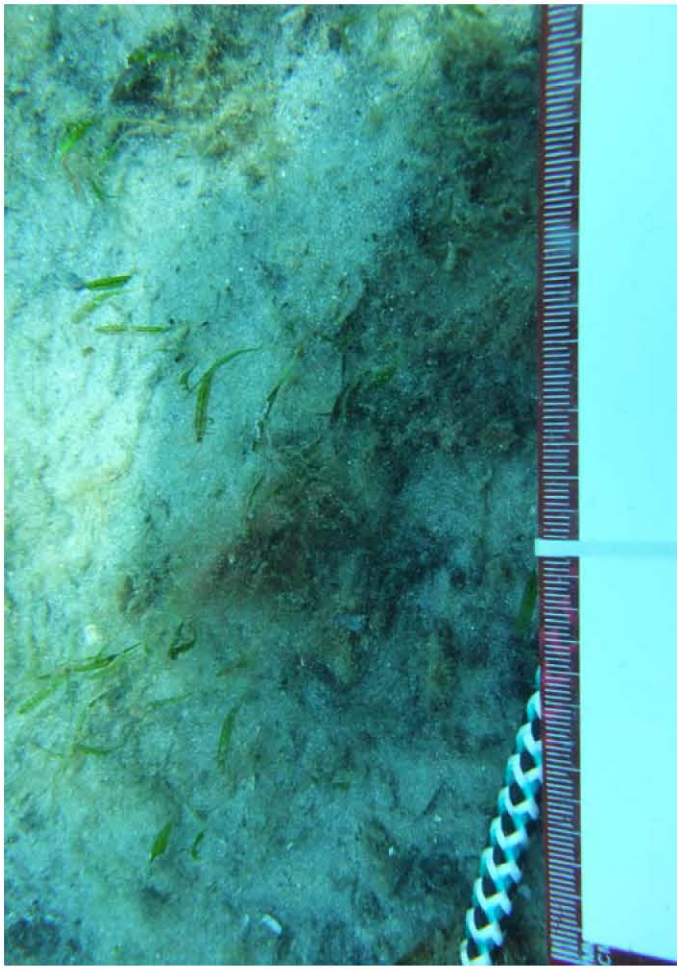


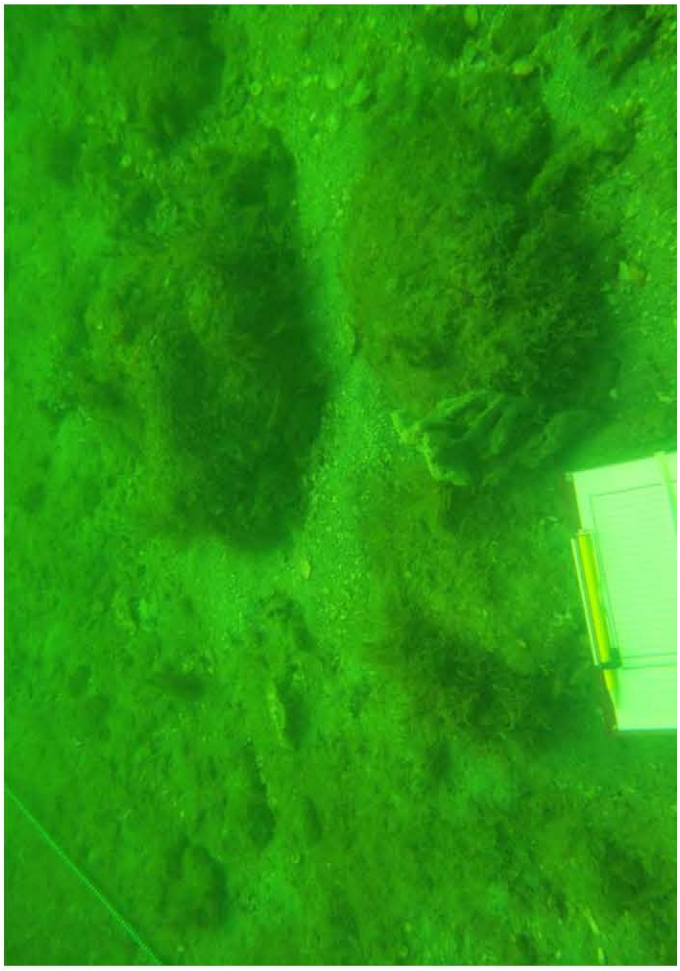


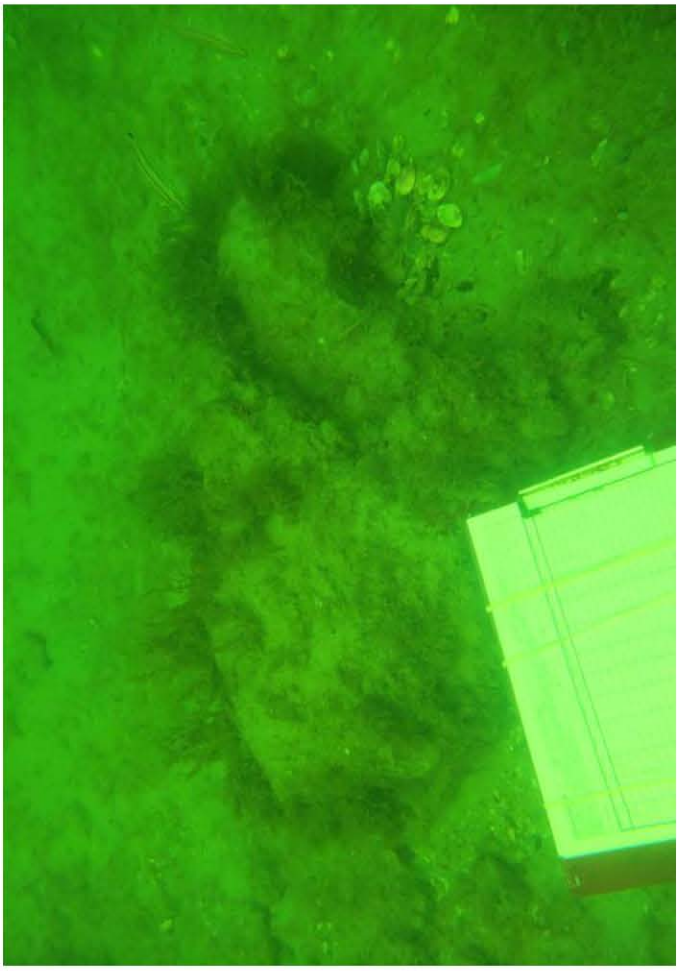
NO VESSEL
IN THIS
AREA

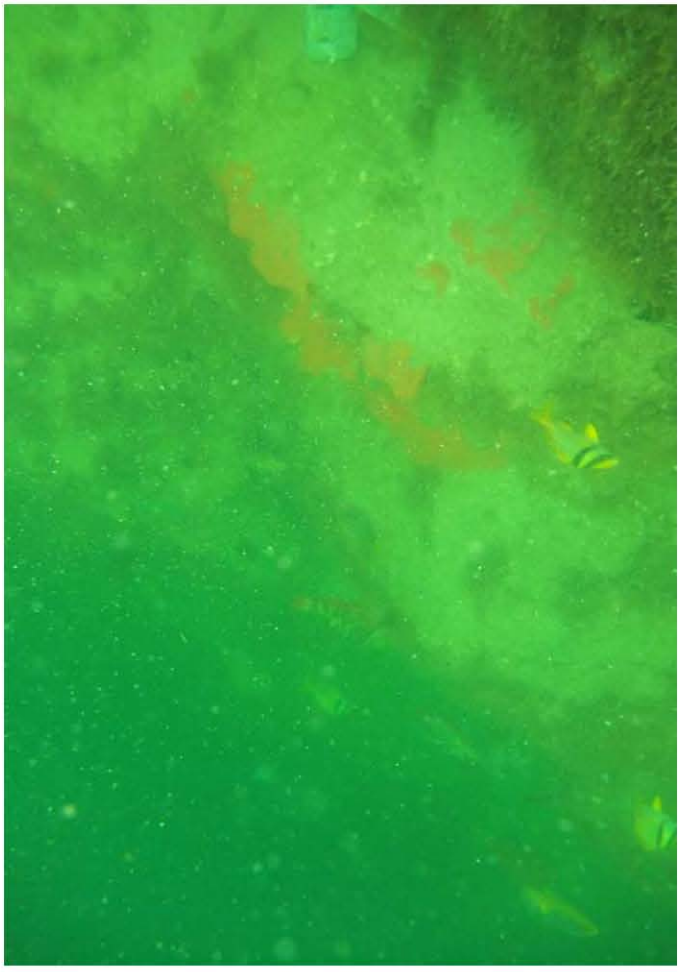


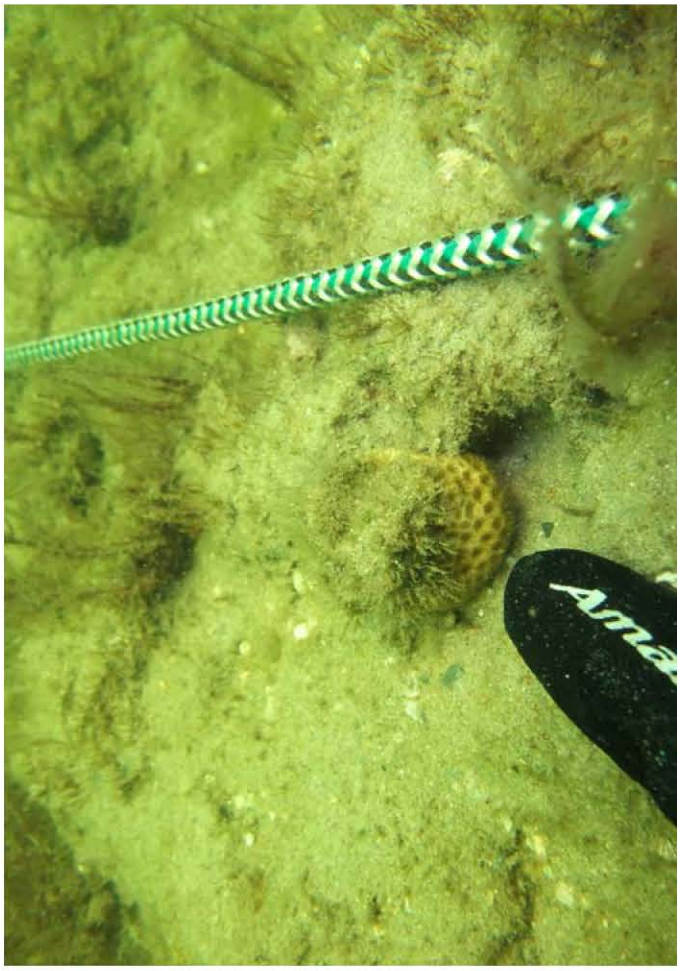


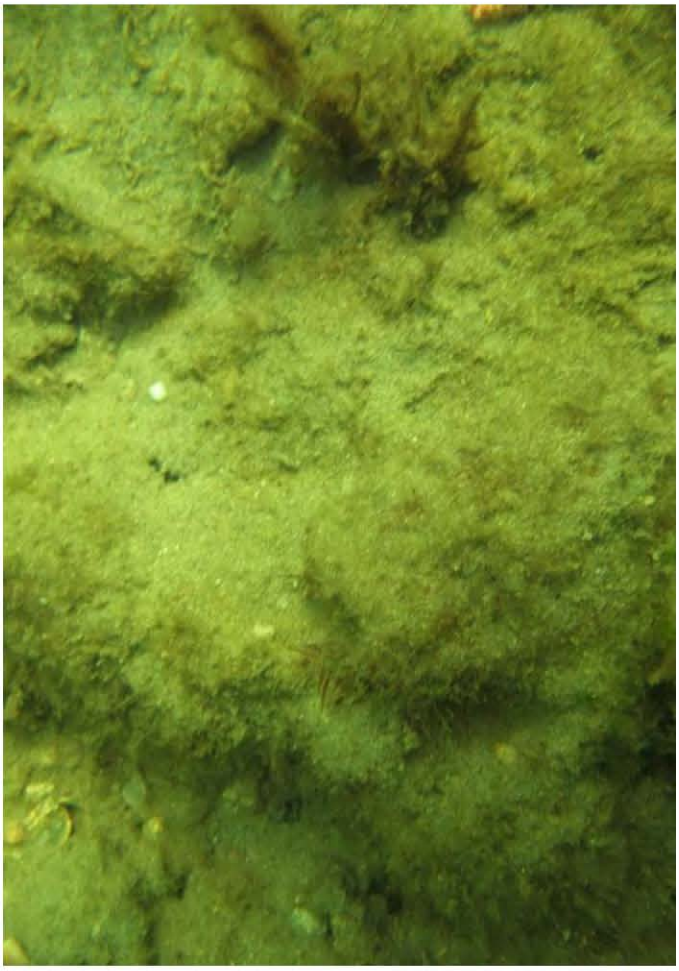


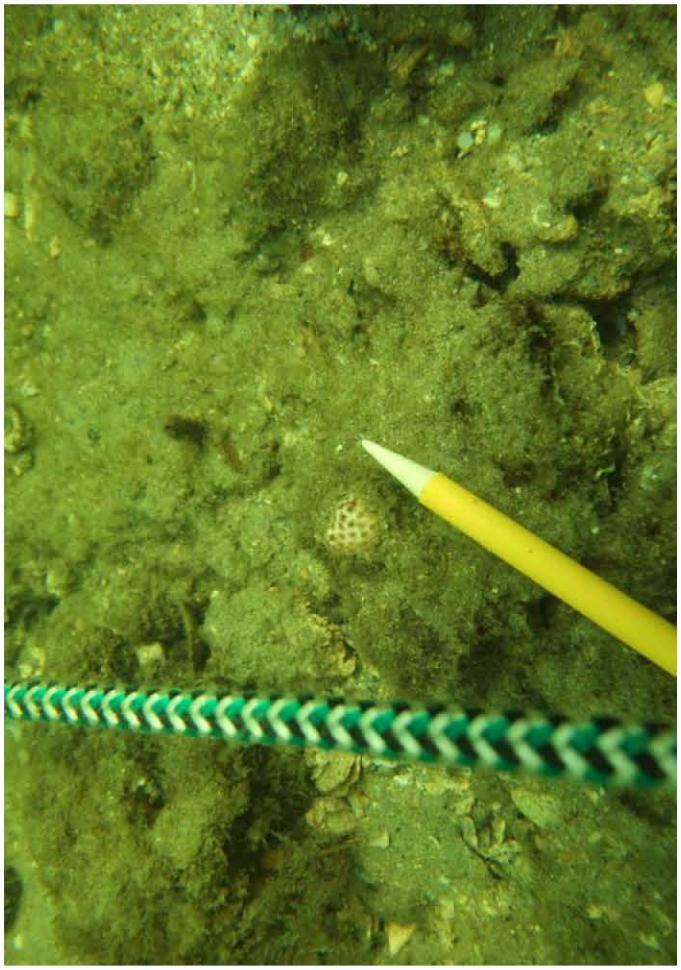


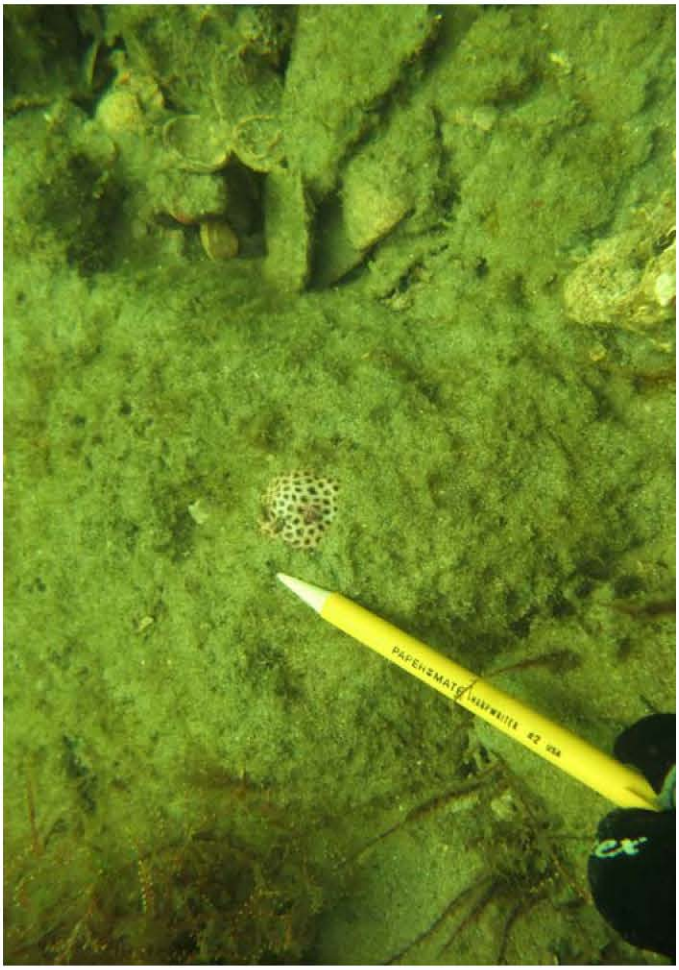


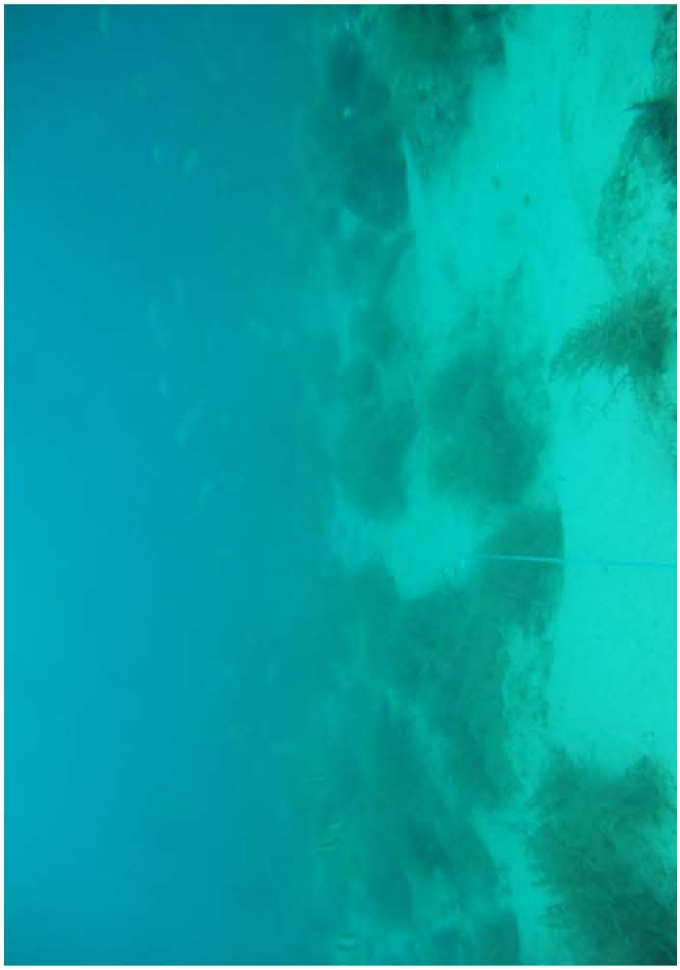


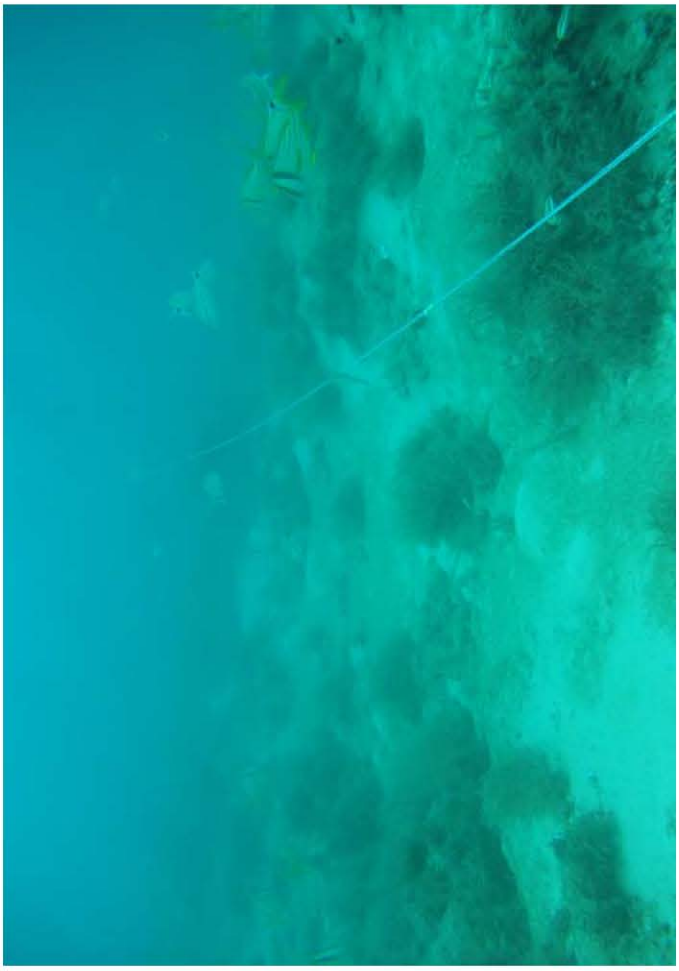


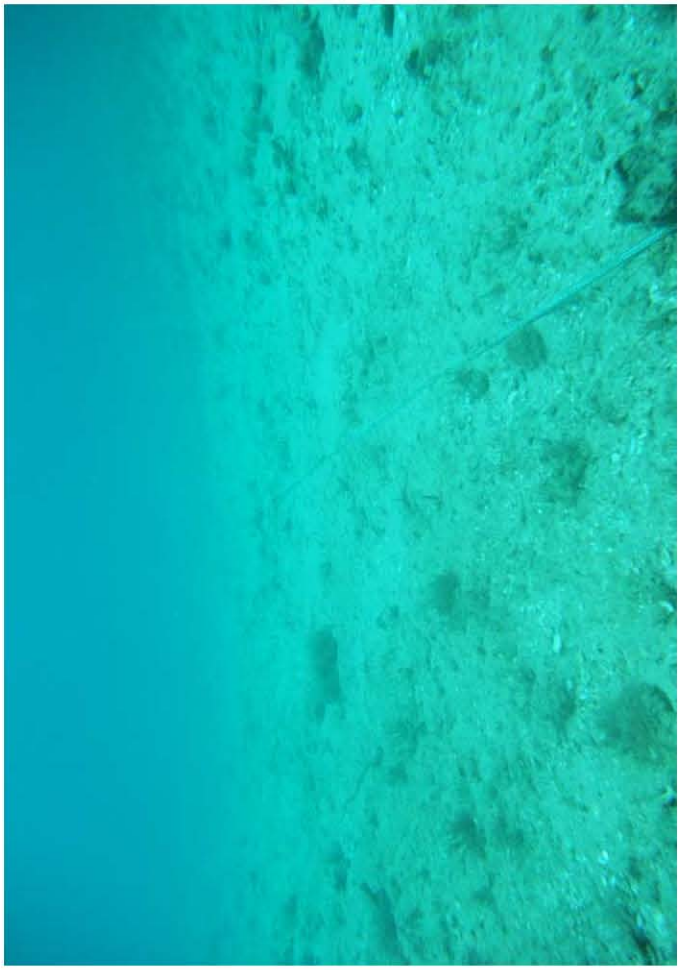












DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

JUL 06 2012

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

Mr. David Bernhart
NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
Saint Petersburg, FL 33701

Dear Mr. Bernhart:

Pursuant to Section 7(a) of the Endangered Species Act, please find enclosed the Biological Assessment for the Lake Worth Inlet Widening and Deepening addressing the concerns of the threatened and endangered species under the purview of the National Marine Fisheries Service (NMFS). Listed species which may occur in the vicinity of the proposed work and are under the jurisdiction of the NMFS are: green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), Johnson's seagrass (*Halophila johnsonii*), blue (*Balenoptera musculus*), humpback, (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), fin (*Balenoptera physalus*) and sperm (*Physeter macrocephalus*) whales and smalltooth sawfish (*Pristis pectinata*). Based on the enclosed Biological Assessment, the Corps has determined that the proposed expansion of Lake Worth Inlet may adversely affect Johnson's seagrass within the action area. The proposed project may affect, but not likely to adversely affect; the green turtle, loggerhead turtle, Kemp's ridley turtle, Hawksbill turtle, leatherback turtle, humpback whale, sperm whale, and smalltooth sawfish. The Corps requests your written concurrence on this determination.

If you have any questions or need further information, please contact Mr. Pat Griffin at 904-232-2286 or by email: Patrick.M.Griffin@usace.army.mil.

Sincerely,

Kenneth R Quigley
for Eric P. Summa
Chief, Environmental Brach
Planning Division

Enclosure

Biological Assessment to
National Marine Fisheries Service
Lake Worth Inlet Widening and Deepening
Palm Beach County, Florida

Description of the Project Area – Palm Beach Harbor is on the Atlantic coast of Florida, approximately 53 miles south of Fort Pierce Harbor, and 71 miles north of Miami Harbor. The harbor entrance (also known as Lake Worth Inlet) is an artificial cut through the barrier beach and limestone formation connecting Lake Worth, a coastal lagoon, with the Atlantic Ocean. Communities bordering Palm Beach Harbor are Palm Beach Shores on the barrier beach to the north, Riviera Beach on the west shore of Lake Worth, and the town of Palm Beach to the south. West Palm Beach is located immediately south of Riviera Beach and is the largest community in the area. Lake Worth Inlet contains a federally autheroized channel and associated features which support a deepwater port located on the Atlantic Ocean in Palm Beach County, Florida.

Lake Worth is an estuary that exhibits characteristics typical of estuarine systems in southeast Florida. Much of the beach and dune ecosystem in this vicinity has been altered by development. Structures such as seawalls and bulkheads have reduced a significant amount of the vegetation that would naturally occur here (Applied Technology and Management Inc. 1995).

The existing channel sediments in the Inlet are predominantly sand and shell and are subject to considerable shifting by wave and tidal action. Limestone rock outcrops are found on either side of the Federal channel at the interface between the Inlet channel and the Intracoastal Waterway (IWW). Littoral drift in the area is predominantly north to south. The mean tidal range is 2.8 feet and the spring tidal range is 3.3 feet. Shoaling continues to be a recurring problem in Palm Beach Harbor.

A sand transfer plant is located on the north jetty of the inlet. The sand transfer plant takes the sand that accumulates on the north jetty, slurries the material with sea water, and passes it under the inlet and to the beach south of the south jetty. Sand continues to accumulate at a rapid rate in this area. The areas to be dredged are located within the Federal project limits.

Action Area

The project proposes to widen and deepen Lake Worth Inlet navigation channel (Figure 1). The authorized project depths are as follows: entrance channel to a depth of 37 feet (from STA 30+00 to STA 47+00); from the inner channel to a depth of 33 feet; from the turning basin to a depth of 33 feet; and to a depth of 25 feet in the extended turning basin located north of the existing project basin. The existing settling basin and the extended settling basin are maintained at 35 feet and are located adjacent to the entrance channel and north jetty.

Deepening will occur within the entrance channel from the current 37 feet to 47 feet, with depths within the turning basin increasing from 33 feet to 43 feet deep. Widening is needed in certain areas of the project for safe navigation of larger vessels. The entrance channel requires a flare to the south as prevailing currents cause navigation hazards entering the channel as currently

configured. The flare starts at the south jetty and extends approximately 2500 feet to the southeast. Within the entrance channel, the northern channel wall would be widened by 60 feet from the north jetty to the beginning of the turn to the southwest. At the turn, the northern side of the channel would be widened 150 feet to ensure a 400 foot channel width throughout. The area at the southern edge of Peanut Island would be deepened to 43 feet. Finally, the southern edge of the turning basin would be widened 150 feet to the south.

Based on geotechnical boring data from the entrance channel and turning basin, sand and rock of varying hardness are expected to be encountered during widening and deepening. Sand, soft rock and rock fragments will be removed via traditional dredging methods. Where hard rock is encountered, the Corps anticipates that contractors could utilize other methods, including confined blasting or large cutterhead dredge equipment to pre-treat the rock prior to removal. Dredged material would be deposited at up to four locations. All beach quality sand material shall be placed on the existing beach disposal template just south of the inlet (figure 2). Sandy material not considered beach quality under the existing permit will be placed in the authorized nearshore placement site south of the inlet. Other rock/coarse materials would likely be placed in a previously dredged depression within Lake Worth as part of construction to create seagrass habitat as compensatory mitigation for seagrass impacts. Dredged rock and other materials that cannot be beneficially utilized for mitigation may be transported to the Ocean Dredged Materials Disposal Site (ODMDS) or placed in a permitted, upland disposal site on Peanut Island.

Figure 1: Current project and proposed changes in yellow

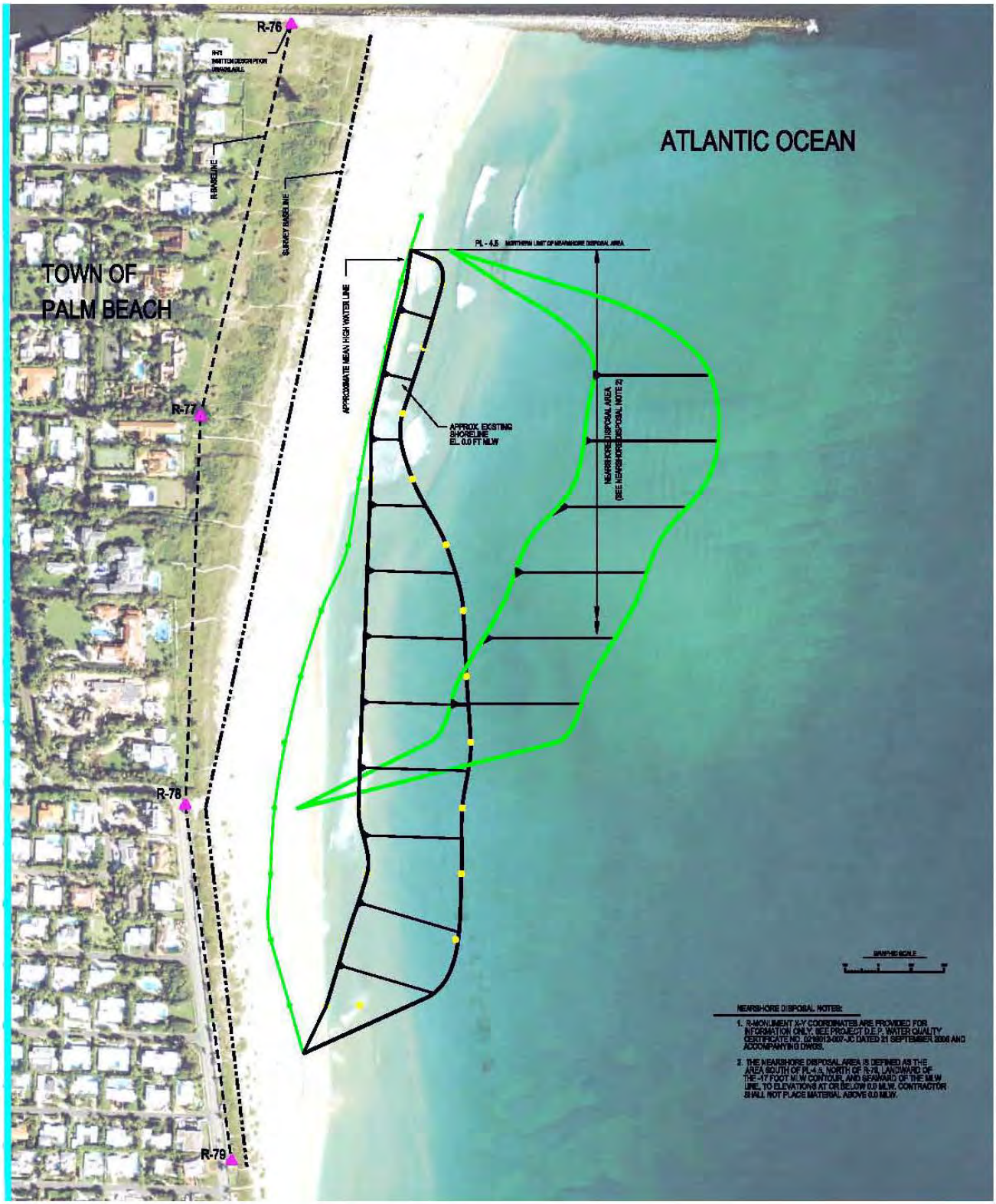


Figure 2. Beach placement site south of inlet

Protected Species Included in this Assessment

The U.S. Army Corps of Engineers, Jacksonville District (Corps) has determined that the following listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) occur in the action area: green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), Johnson's seagrass (*Halophila johnsonii*), blue (*Balenoptera musculus*), humpback, (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), fin (*Balenoptera physalus*) and sperm (*Physeter macrocephalus*) whales and smalltooth sawfish (*Pristis pectinata*). The Corps has relied heavily upon the Surtass LFA Biological Opinion that was completed by NMFS on May 31, 2002 for biological information concerning the biology, life history and status for the large whale species discussed in this assessment. This document was accessed from the NMFS website at: http://www.nmfs.noaa.gov/prot_res/readingrm/ESAsec7/7pr_surtass-2020529.pdf.

The Corps has reviewed the biological, status, threats and distribution information presented in this assessment and believes that the following species will be in or near the action area and thus may be affected by the proposed project: the five sea turtle species; humpback and sperm whales, Johnson's seagrass and smalltooth sawfish.

Six species of endangered marine mammals may be found seasonally in the waters offshore southeastern Florida. The Corps believes that only the sperm and humpback whales may be adversely affected by activities associated with the proposed action. These effects would be a result of acoustic harassment.

The blue, fin, northern right and sei whales are not discussed in detail because they are unlikely to be within the vicinity of the project. Additional information on blue, fin and sei whales can be found in Waring *et al*. (1999). Due to the rarity of sightings of these four whale species near the project area, the Corps believes that any effects to them by the project are discountable. Discountable effects under Section 7 of the ESA are those "extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur."

The endangered Florida manatee (*Trichecus manatus*) and the American crocodile (*Crocodylus acutus*) also occur with the action area and the Corps has initiated consultation with the U.S. Fish and Wildlife Service concerning the effects of the proposed action on these species.

Status and Distribution of the Species

Green Turtle

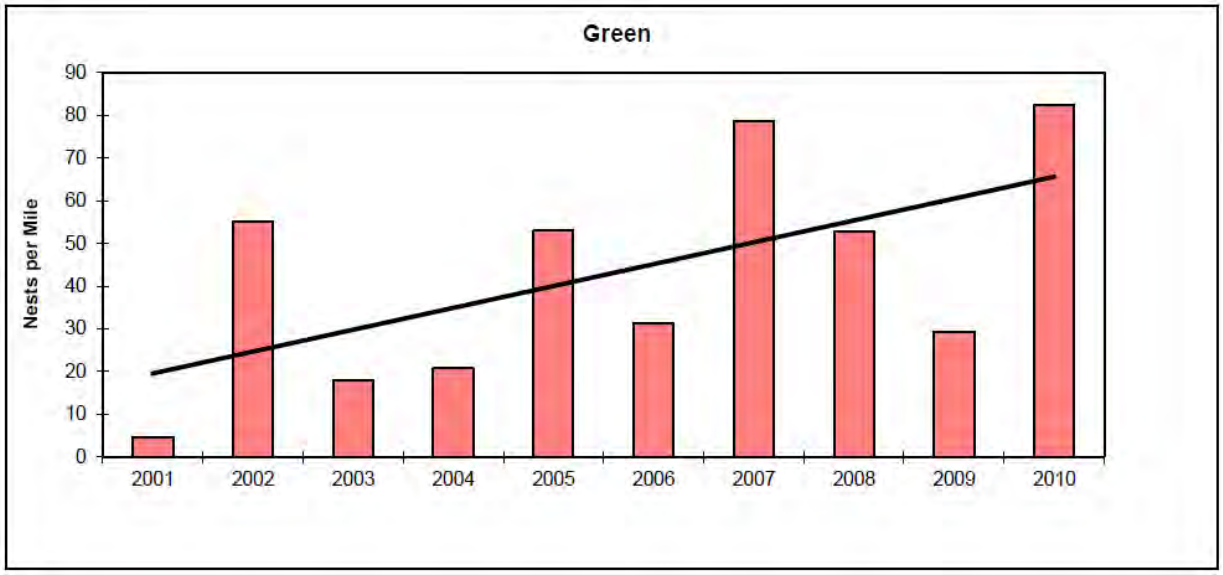
Distribution. Green turtles are distributed circumglobally. In the western Atlantic they range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare north of Cape Hatteras (Wynne and Schwartz, 1999). Several major nesting assemblages have been identified and studied in the western Atlantic (Peters 1954; Carr and Ogren, 1960; Carr *et al.*, 1978). Most green turtle nesting in the continental United States occurs on the Atlantic Coast of Florida (Ehrhart 1979). Green turtles are the largest of the hard-shelled

sea turtles. Adult male green turtles are smaller than adult females whose lengths range from 92 to 110 cm (36 to 43 in.) and weights range from 119 to 182 kg (200 to 300 lbs). Their heads are small compared to other sea turtles and the biting edge of their lower jaws is serrated.

Green turtles have a more tropical distribution than loggerhead turtles; they are generally found in waters between the northern and southern 20°C isotherms (Hirth 1971). Green turtles, like most other sea turtles, are distributed more widely in the summer when warmer water temperatures allow them to migrate north along the Atlantic coast of North America. In the summer, green turtles are found around the U.S. Virgin Islands, Puerto Rico, and continental North America from Texas to Massachusetts. Immature greens can be distributed in estuarine and coastal waters from Long Island Sound, Chesapeake Bay, and the North Carolina sounds south throughout the tropics (Musick and Limpus, 1997). In the United States, green turtles nest primarily along the Atlantic Coast of Florida, the U.S. Virgin Islands, and Puerto Rico. In the winter, as water temperatures decline, green turtles that are found north of Florida begin to migrate south into subtropical and tropical water.

Status and Population Trends. The green turtle was protected under the ESA in 1978; breeding populations off the coast of Florida and the Pacific coast of Mexico are listed as endangered, all other populations are listed as threatened. Recent population estimates for the western Atlantic area are not available. However, there is evidence that green turtle nesting has been on the increase during the past decade. Recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Certain Florida nesting beaches where most green turtle nesting activity occurs have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the six years of regular monitoring since establishment of the index beaches in 1989. A nesting summary for the county in which the proposed project resides is found in Table 1.

Table 1: Summary of Green Turtle (*Chelonia mydas*) Nesting in Palm Beach County, 2001-2010



Natural History. While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida, the northwestern coast of the Yucatan Peninsula, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet (Bjorndal 1997). Post-pelagic green turtles feed primarily on sea grasses and benthic algae but also consume jellyfish, salps, and sponges. In the western Atlantic region, the summer developmental habitat encompasses estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds, and south throughout the tropics (Musick and Limpus, 1997). Like loggerheads and Kemp's ridleys, green sea turtles that use northern waters during the summer must return to southern waters in autumn, or face the risk of cold stunning.

Threats. The greatest threat to this species is the loss of its nesting habitat. Throughout the tropical and subtropical distribution of this species, beaches are eroded, armored, renourished, or converted for residential or commercial purposes. Green turtles are also threatened by fibropapilloma disease; incidental takes in commercial or recreational fishing gear; and poaching (although poaching is infrequent in the United States). Green turtles are harvested in some nations for food, leather, and jewelry. Green turtles are also threatened by natural causes including hurricanes; predation by fire ants, raccoons, and opossums; and poaching of eggs and nesting females.

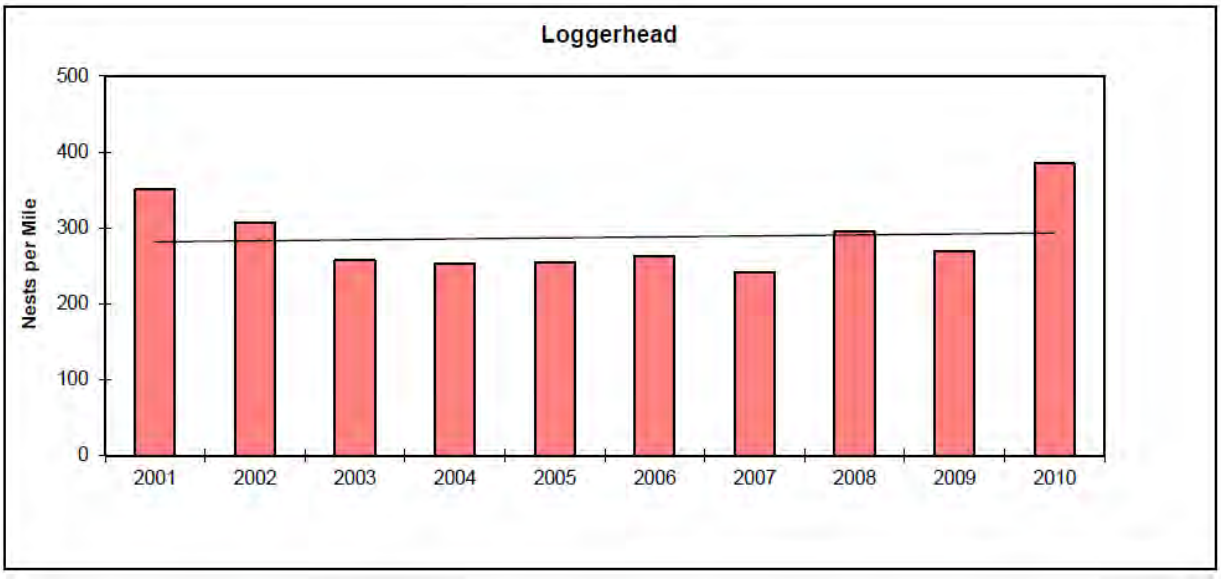
Anthropogenic impacts to the green turtle population are similar to those for other sea turtle species. Sea sampling coverage in the pelagic driftnet, pelagic longline, scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. In addition, the NMFS/Northeast Fisheries Science Center (NEFSC) is conducting a review of bycatch levels and patterns in all fisheries in the western Atlantic for which observer data is available. Bycatch estimates will be made for all fisheries for which sample sizes are sufficiently large to permit reasonable statistical analysis. This will be compiled into an assessment report. Until that analysis is completed, the only information on the magnitude of takes available for fisheries in the action area are unextrapolated numbers of observed takes from the sea sampling data. Preliminary sea sampling data summary (1994-1998) shows the following total take of green turtles: one (anchored gillnet), two (pelagic driftnet), and two (pelagic longline). Stranding reports indicate that between 200-300 green turtles strand annually from a variety of causes (Sea Turtle Stranding and Salvage Network, unpublished data). As with the other species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality.

Critical Habitat. In 1998, NMFS designated the waters surrounding the islands of Culebra, Puerto Rico as critical habitat for the green turtle. This area supports major seagrass beds and reefs that provide forage and shelter habitat. The action area does not comprise critical habitat for green turtles.

Loggerhead Turtle

Distribution. Loggerhead turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and are the most abundant species of sea turtle occurring in U.S. waters. Loggerheads concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (NRC 1990). The largest known nesting aggregation of loggerhead turtles occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani, 1982). In the western Atlantic, most loggerhead turtles nest from North Carolina to Florida and along the gulf coast of Florida. The best scientific and commercial data available on the genetics of loggerhead turtles suggests there are four major subpopulations of loggerheads in the northwest Atlantic: (1) a northern nesting subpopulation that occurs from North Carolina to northeast Florida, about 29° N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29° N on the east coast to Sarasota on the west coast (approximately 83,400 nests in 1998); (3) a Florida panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nests in 1998); and (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990) (approximately 1,000 nests in 1998, according to TEWG, 2000). This biological assessment will focus on the northwest Atlantic subpopulations of loggerhead turtles, which occur in the action area. A nesting summary for the county in which the action is proposed is included in Table 2.

Table 2: Summary of Loggerhead (*Caretta caretta*) Nesting in Palm Beach County, 2001-2010



Although NMFS and FWS have not completed the administrative processes necessary to formally recognize populations or subpopulations of loggerhead turtles, these sea turtles are generally grouped by nesting locations. Based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG, 1998; TEWG 2000), NMFS and FWS treat these loggerhead turtle nesting aggregations as distinct subpopulations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood that one or more of these nesting aggregations would survive and recover would appreciably reduce the species' likelihood of survival and recovery in the wild. Consequently, this biological opinion will focus on the four nesting aggregations of loggerhead turtles identified in the preceding paragraph (which occur in the action area) and treat them as subpopulations for the purposes of this analysis. Natal homing to the nesting beach provides the genetic barrier between these subpopulations, preventing recolonization from turtles from other nesting beaches. The importance of maintaining these subpopulations in the wild is shown by the many examples of extirpated nesting assemblages in the world. In addition, recent fine-scale analysis of mtDNA work from Florida rookeries indicate that population separations begin to appear between nesting beaches separated by more than 50-100 km of coastline that does not host nesting (Francisco *et al.* 2000) and tagging studies are consistent with this result (Richardson 1982, Ehrhart 1979, CMTTP: in NMFS SEFSC 2001). Nest site relocations greater than 100 km occur, but generally are rare (Ehrhart 1979; CMTTP; Bjorndal *et al.* 1983: *in* NMFS SEFSC 2001).

The loggerhead turtles in the action area are likely to represent differing proportions of the four western Atlantic subpopulations. Although the northern nesting subpopulation produces about 9% of the loggerhead nests, they comprise more of the loggerhead sea turtles found in foraging areas from the northeastern U.S. to Georgia: between 25 and 59 percent of the loggerhead turtles in this area are from the northern subpopulation (NMFS SEFSC 2001; Bass *et al*., 1998; Norrgard, 1995; Rankin-Baransky, 1997; Sears 1994, Sears *et al.*, 1995). In the Carolinas, the northern subpopulation is estimated to make up from 25% to 28% of the loggerheads (NMFS

SEFSC 2001; Bass *et al.* 1998, 1999). About ten percent of the loggerhead turtles in foraging areas off the Atlantic coast of central Florida are from the northern subpopulation (Witzell *et al*., in prep). In the Gulf of Mexico, most of the loggerhead turtles in foraging areas will be from the South Florida subpopulation, although the northern subpopulation may represent about 10% of the loggerhead sea turtles in the Gulf (Bass pers. comm). In the Mediterranean Sea, about 45 - 47 percent of the pelagic loggerheads are from the South Florida subpopulation and about two percent are from the northern subpopulation, while only about 51% originated from Mediterranean nesting beaches (Laurent *et al.*, 1998). In the vicinity of the Azores and Madiera Archipelagoes, about 19% of the pelagic loggerheads are from the northern subpopulation, about 71% are from the South Florida subpopulation, and about 11% are from the Yucatán subpopulation (Bolten *et al*., 1998).

Natural History. Loggerhead turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years. Turtles in this life history stage are called "pelagic immatures" and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal *et al*., in press). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm SCL they recruit to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico.

Benthic immatures have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico (R. Márquez-M., pers. comm.). Large benthic immature loggerheads (70-91 cm) represent a larger proportion of the strandings and in-water captures (Schroeder *et al.*, 1998) along the south and western coasts of Florida as compared with the rest of the coast, but it is not known whether the larger animals actually are more abundant in these areas or just more abundant within the area relative to the smaller turtles. Benthic immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.*, 1995; Keinath, 1993; Morreale and Standora, 1999; Shoop and Kenney, 1992), and migrate northward in spring. Given an estimated age at maturity of 21-35 years (Frazer and Ehrhart, 1985; Frazer and Limpus, 1998), the benthic immature stage must be at least 10-25 years long. NMFS SEFSC 2001 analyses conclude that juvenile stages have the highest elasticity and maintaining or decreasing current sources of mortality in those stages will have the greatest impact on maintaining or increasing population growth rates.

Like other sea turtles, the movements of loggerheads are influenced by water temperature. Since they are limited by water temperatures, sea turtles do not usually appear on the summer foraging grounds until June, but are found in Virginia as early as April. The large majority leaves the Gulf of Maine by mid-September but may remain in these areas until as late as November and December. Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz, 1999). Under certain conditions they may also scavenge fish, particularly if they are easy to catch (e.g., caught in nets) (NMFS and USFWS, 1991).

Adult female loggerheads in the western Atlantic come ashore to nest primarily from North Carolina southward to Florida. Additional nesting assemblages occur in the Florida Panhandle

and on the Yucatán Peninsula. Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

Threats. Loggerhead sea turtles face a number of human-related threats in the marine environment, including oil and gas exploration, development, and transportation; marine pollution; trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries (see below); underwater explosions; dredging, offshore artificial lighting; power plant entrapment; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching.

Although loggerhead turtles are most vulnerable to pelagic longlines during their pelagic, immature life history stage, there is some evidence that benthic immatures may also be captured, injured, or killed by pelagic fishery operations. Recent studies have suggested that not all loggerhead turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic immatures, followed by permanent settlement into benthic environments. Some may not totally circumnavigate the North Atlantic. In addition, some of these turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or they may move back and forth between pelagic and coastal habitats (Witzell , 1999.). Any loggerhead turtles that follow this developmental model would be adversely affected by shark gill nets and shark bottom longlines set in coastal waters, in addition to pelagic longlines.

On their nesting beaches in the U.S., loggerhead turtles are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; exotic dune and beach vegetation; predation by fire ants, raccoons, armadillos, opossums; and poaching. Elimination/control of these threats are especially important because, from a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species: it is second in size only to the nesting aggregations in the Arabian Sea off Oman and represents about 35 and 40 percent of the nests of this species. The status of the Oman nesting beaches has not been evaluated recently, but they are located in a part of the world that is vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), the resulting risk facing this nesting aggregation and these nesting beaches is cause for considerable concern (Meylan *et al*., 1995).

Loggerhead turtles also face numerous threats from weather and coastal processes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November) and loggerhead turtle nesting season (March to November); hurricanes can have potentially disastrous effects on the survival of eggs in sea turtle nests. In 1992, Hurricane Andrew affected turtle nests over a 90-mile length of coastal Florida; all of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton *et al*., 1992). On Fisher Island near Miami, Florida, 69% of the eggs did not hatch after Hurricane Andrew, probably because they were drowned by the storm surge. Nests from the northern subpopulation were destroyed by hurricanes, which made landfall in North Carolina in

the mid to late 1990's. Sand accretion and rainfall that result from these storms can appreciably reduce hatchling success. The recent landfall of Hurricane Charley on Florida's southwest coast and the impending landfall of Hurricane Frances will also have adverse effects on nest success. These natural phenomena probably have significant, adverse effects on the size of specific year classes; particularly given the increasing frequency and intensity of hurricanes in the Caribbean Sea and northwest Atlantic Ocean.

Status and Population Trends. The loggerhead turtle was listed as threatened under the ESA on July 28, 1978. The most recent work updating what is known regarding status and trends of loggerhead sea turtles is contained in NMFS SEFSC 2001. The recovery plan for this species (NMFS and USFWS 1991) state that southeastern U.S. loggerheads can be considered for delisting if, over a period of 25 years, adult female populations in Florida are increasing and there is a return to pre-listing annual nest numbers totaling 12,800 for North Carolina, South Carolina, and Georgia combined. This equates to approximately 3,100 nesting females per year at 4.1 nests per female per season. NMFS SEFSC 2001 concludes, "…nesting trends indicate that the numbers of females associated with the South Florida subpopulation are increasing. Likewise, nesting trend analyses indicate potentially increasing nest numbers in the northern subpopulation" (TEWG 2000). However, NMFS SEFSC 2001 also cautions that given the uncertainties in survival rates (of the different life stages, particularly the pelagic immature stage), and the stochastic nature of populations, population trajectories should not be used now to quantitatively assess when the northern subpopulation may achieve 3,100 nesting females.

Several published reports have presented the problems facing long-lived species that delay sexual maturity in a world replete with threats from a modern, human population (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high, annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general tenet of population ecology originated in studies of sea turtles (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles would adversely affect large segments of the total loggerhead sea turtle population.

The four major subpopulations of loggerhead sea turtles in the northwest Atlantic, northern, south Florida, Florida panhandle, and Yucatán are all subject to fluctuations in the number of young produced annually because of natural phenomena like hurricanes as well as human-related activities. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merrit Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection and probably cause fluctuations in sea turtle nesting success. Sea turtles nesting in the southern and central counties of Florida can be affected by beach armoring, beach renourishment, beach cleaning, artificial lighting, predation, and poaching (NMFS & FWS 1991).

As discussed previously, the survival of juvenile loggerhead sea turtles is threatened by a completely different set of threats from human activity once they migrate to the ocean. Pelagic immature loggerhead sea turtles from these four subpopulations circumnavigate the North

Atlantic over several years (Carr 1987, Bjorndal 1994). During that period, they are exposed to a series of long-line fisheries that include an Azorean long-line fleet, a Spanish long-line fleet, and various fleets in the Mediterranean Sea (Aguilar *et al*., 1995, Bolten *et al.*, 1994, Crouse 1999). Based on their proportional distribution, the capture of immature loggerhead sea turtles in long-line fleets in the Azores and Madiera Archipelagoes and the Mediterranean Sea will have a significant, adverse effect on the annual survival rates of juvenile loggerhead sea turtles from the western Atlantic subpopulations, with a disproportionately large effect on the northern subpopulation that may be significant at the population level.

In waters off coastal U.S., a suite of fisheries in Federal and State waters threatens the survival of juvenile loggerhead sea turtles. Loggerhead turtles are captured, injured, or killed in shrimp fisheries off the Atlantic coast; along the southeastern Atlantic coast, loggerhead turtle populations are declining where shrimp fishing is intense off the nesting beaches (NRC 1990). Conversely these nesting populations do not appear to be declining where nearshore shrimping effort is low or absent. The management of shrimp harvest in the Gulf of Mexico demonstrates the correlation between shrimp trawling and impacts to sea turtles. Waters out to 200nm are closed to shrimp fishing off of Texas each year for approximately a three-month period (mid-May through mid-July) to allow shrimp to migrate out of estuarine waters; sea turtle strandings decline dramatically during this period (NMFS, STSSN unpublished data). Loggerhead sea turtles are captured in fixed pound-net gear in the Long Island Sound, in pound-net gear and trawls in summer flounder and other finfish fisheries in the mid-Atlantic and Chesapeake Bay, in gill net fisheries in the mid-Atlantic and elsewhere, in fisheries for monkfish and for spiny dogfish, and in northeast sink gillnet fisheries (see further discussion in the *Environmental Baseline* of this Opinion). Witzell (1999) compiled data on capture rates of loggerhead and leatherback turtles in U.S. longline fisheries in the Caribbean and northwest Atlantic; the cumulative takes of these fisheries approach those of the U.S. shrimp fishing fleet (Crouse 1999, NRC 1990).

Based on the data available, it is not possible to estimate the size of the loggerhead population in the U.S. or its territorial waters. There is, however, general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage. Nesting data collected on index nesting beaches in the U.S. from 1989-1998 represent the best dataset available to index the population size of loggerhead turtles. However, an important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates. Given this, between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,016-89,034 annually, representing, on average, an adult female population of 44,780 [(nests/4.1) * 2.5]. On average, 90.7% of the nests were from the South Florida subpopulation, 8.5% were from the northern subpopulation, and 0.8% were from the Florida Panhandle subpopulation. There is limited nesting throughout the Gulf of Mexico west of Florida, but it is not known to what subpopulation they belong. Based on the above, there are only an estimated 3,800 nesting females in the northern loggerhead subpopulation. The status of this population, based on number of loggerhead nests, has been classified as stable or declining (TEWG 2000). Another consideration adding to the vulnerability of the northern subpopulation is that NMFS scientists estimate, using genetic data from Texas, South Carolina, and North Carolina in combination with juvenile sex ratios from those states, that the northern

subpopulation produces 65% males, while the Florida subpopulation is estimated to produce 80% females (NMFS SEFSC 2001, Part I).

Critical Habitat. No critical habitat has been designated for loggerhead turtles.

Leatherback Turtle

Distribution. The leatherback is the largest living turtle. Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972).

Leatherback turtles undertake the longest migrations of any other sea turtle and exhibit the broadest thermal tolerances (NMFS and USFWS 1998). Leatherback turtles are able to inhabit intensely cold waters for a prolonged period of time because leatherbacks are able to maintain body temperatures several degrees above ambient temperatures. Leatherback turtles are typically associated with continental shelf habitats and pelagic environments, and are sighted regularly in offshore waters (>328 ft). Leatherback turtles regularly occur in deep waters (>328 ft), and an aerial survey study in the north Atlantic Ocean sighted leatherback turtles in water depths ranging from 3 to 13,618 ft, with a median sighting depth of 131.6 ft (CeTAP 1982). This same study found leatherbacks in waters ranging from 7 to 27.2°C.

Natural History. Although leatherbacks are a long lived species (> 30 years), they are somewhat faster to mature than loggerheads, with an estimated age at sexual maturity reported as about 13-14 years for females, and an estimated minimum age at sexual maturity of 5-6 years, with 9 years reported as a likely minimum (Zug and Parham 1996).

Leatherback sea turtles are predominantly distributed pelagically where they feed on jellyfish such as *Stomolophus, Chryaora,* and *Aurelia* (Rebel 1974). Leatherbacks are deep divers, with recorded dives to depths in excess of 1000 m, but they may come into shallow waters if there is an abundance of jellyfish nearshore. They also occur annually in places such as Cape Cod and Narragansett bays during certain times of the year, particularly the fall.

Status and Threats. The leatherback was listed as endangered on June 2, 1970 and a recovery plan was issued in 1998. Leatherback turtles are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which effectively bans trade.

Globally, leatherback turtle populations have been decimated worldwide. The global leatherback turtle population was estimated to number approximately 115,000 adult females in 1980 (Pritchard 1982), but only 34,500 in 1995 (Spotila *et al*. 1996). The decline can be attributed to many factors including fisheries as well as intense exploitation of the eggs (Ross 1979). On some beaches nearly 100% of the eggs laid have been harvested (Eckert 1996). Eckert (1996) and Spotila *et al*. (1996) record that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries.

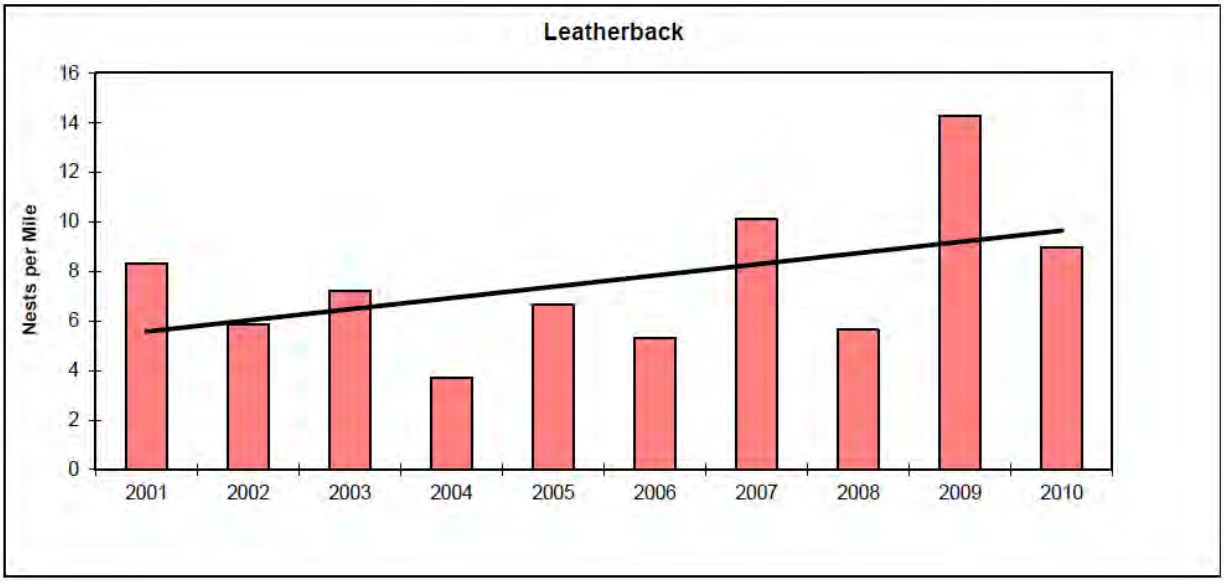
The status of the Atlantic population is not clear. In 1996, it was reported to be stable, at best (Spotila 1996), but numbers in the Western Atlantic at that writing were reported to be on the

order of 18,800 nesting females. According to Spotila (pers. com.), the Western Atlantic population currently numbers about 15,000 nesting females, whereas current estimates for the Caribbean (4,000) and the Eastern Atlantic (i.e. off Africa, numbering ~ 4,700) have remained consistent with numbers reported by Spotila *et al*. in 1996. Between 1989 and 1995, marked leatherback returns to the nesting beach at St. Croix averaged only 48.5%, but that the overall nesting population grew (McDonald, et. al 1993). This is in contrast to a Pacific nesting beach at Playa Grande, Costa Rica, where only 11.9% of turtles tagged in 1993-94 and 19.0% of turtles tagged in 1994-95 returned to nest over the next five years. Characterizations of this population suggest that it has a very low likelihood of survival and recovery in the wild under current conditions.

Spotila *et al*. (1996) describe a hypothetical life table model based on estimated ages of sexual maturity at both ends of the species= natural range (5 and 15 years). The model concluded that leatherbacks maturing in 5 years would exhibit much greater population fluctuations in response to external factors than would turtles that mature in 15 years. Furthermore, the simulations indicated that leatherbacks could maintain a stable population only if both juvenile and adult survivorship remained high, and that if other life history stages (i.e. egg, hatchling, and juvenile) remained static, stable leatherback populations could not withstand an increase in adult mortality above natural background levels without decreasing.

The primary threats to leatherback turtles are entanglement in fishing gear (e.g., gillnets, longlines, lobster pots, weirs), boat collisions, and ingestion of marine debris (NMFS and USFWS 1997). The foremost threat is the number of leatherback turtles killed or injured in fisheries. Spotila (2000) states that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific during the 1990s is 1,500 animals. He estimates that this represented about a 23% mortality rate (or 33% if most mortality was focused on the East Pacific population). As noted above, leatherbacks normally live at least 30 years, usually maturing at about 12-13 years. Such long-lived species cannot withstand such high rates of anthropogenic mortality.

Table 3: Summary of Leatherback (*Dermochelys coriacea*) Nesting in Palm Beach County, 2001-2010



Critical Habitat. NMFS and FWS designated certain areas of the US Virgin Islands as critical habitat for the leatherback turtle. The action area does not comprise designated critical habitat for the species.

Hawksbill Turtle

Distribution. Hawksbill turtles occur in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Recognized subspecies occupy the Atlantic Ocean (ssp. *imbricata*) and the Pacific Ocean (ssp. *squamata*). Richardson *et al*. (1989) estimated that the Caribbean and Atlantic portions of the U.S. support a minimum of 650 hawksbill turtle nests each year. In the United States, hawksbill turtles have been recorded in all states along the Gulf of Mexico and along the Atlantic coast from Florida to Massachusetts. United States populations nest primarily in the U.S. Virgin Islands and Puerto Rico, but occasionally on the Atlantic coast of Florida. Two hawksbill turtle carcasses have been found in the vicinity of the action area (Wendy Teas, pers com, 2002, NMFS - SEFSC Miami Laboratory).

Natural History. Hawksbill turtles use different habitats for different stages in their life cycles. Post-hatchling hawksbill turtles remain in pelagic environments to take shelter in weedlines that accumulate at convergence points. Juvenile hawksbill turtles (those with carapace lengths of 20-25 cm) re-enter coastal waters where they become residents of coral reefs, which provide sponges for food and ledges, and caves for shelter. Hawksbill turtles are also found around rocky outcrops, high-energy shoals, and mangrove-fringed bays and estuaries (particularly in areas where coral reefs do not occur). Hawksbill turtles remain in coastal waters when they become subadults and adults.

Status and Threats. The hawksbill turtle was listed as an endangered species on June 2, 1970 (35 FR 8491). Populations are threatened by significant modifications of its coastal habitat throughout its range. The National Research Council (1990), and NMFS/FWS (1993) have published general overviews of the effects of habitat alteration on hawksbill turtles. In the U.S. Virgin Islands, problems such as egg poaching, domestic animals, beach driving, litter, and recreational use of beaches have presented problems for nesting hawksbill turtles. In addition,

beachfront lights appear to pose a serious problem for hatchling hawksbill (and other) turtles in the U.S. Virgin Islands. At sea, activities that damage coral reefs and other habitats that are important to the hawksbill turtle threaten the continued existence of this species. Hawksbill turtles are also threatened by stochastic events (e.g., hurricanes); predation by fire ants, raccoons and opossums; and by poaching of eggs and nesting females by humans.

Critical Habitat. In 1998, NMFS designated the waters surrounding Mona and Monito Islands, Puerto Rico as critical habitat for the hawksbill turtle. The action area does not comprise designated critical habitat for the species.

Kemp's Ridley Sea Turtle

Status and Population Trends. Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempi*) (USFWS and NMFS 1992) contains a description of the natural history, taxonomy, and distribution of the Kemp's ridley turtle. Kemp's ridleys nest in daytime aggregations known as *arribadas*. The primary arribada in the Gulf of Mexico is at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970's, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing.

After unprecedented numbers of Kemp's ridley carcasses were reported from Texas and Louisiana beaches during periods of high levels of shrimping effort, NMFS established a team of population biologists, sea turtle scientists, and managers, known as the Turtle Expert Working Group (TEWG) to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG 1998).

The TEWG (1998) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment where they are available to nearshore mortality sources that often result in strandings. Benthic immature ridleys are estimated to be 2-9 years of age and 20-60 cm in length. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the U.S. Fish and Wildlife Service (FWS) and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 due, in part, to the

introduction of turtle excluder devices (TEDs). Adult ridley numbers have now grown from a low of approximately 1,050 adults producing 702 nests in 1985, to greater than 3,000 adults producing 1,940 nests in 1995 and about 3,400 nests in 1999.

The TEWG (1998) was unable to estimate the total population size and current mortality rates for the Kemp's ridley population. However, the TEWG listed a number of preliminary conclusions. The TEWG indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. Nesting data indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and a low of 702 nests in 1985. This trajectory of adult abundance tracks with trends in nest abundance from an estimate of 9,600 in 1966 to 1,050 in 1985. The TEWG estimated that in 1995 there were 3,000 adult ridleys. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994. The population model in the TEWG projected that Kemp's ridleys could reach the intermediate recovery goal identified in the Recovery Plan of 10,000 nesters by the year 2020 if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the Gulf of Mexico in shallow near shore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in nearshore coastal waters including estuaries of the Gulf of Mexico and the Atlantic.

The TEWG (1998) identified an average Kemp's ridley population growth rate of 13% per year between 1991 and 1995. Total nest numbers have continued to increase. However, the 1996 and 1997 nest numbers reflected a slower rate of growth, while the increase in the 1998 nesting level has been much higher and decreased in 1999. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular inter-nesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

Hurricane Gilbert expanded the area surveyed for ridley nests in Mexico in 1990 due to destruction of the primary nesting beach. The TEWG (1998) assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. As noted by TEWG, trends in Kemp's ridley nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp's Ridley Recovery Plan.

Natural History. Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Post-pelagic ridleys feed primarily on crabs, consuming a variety of species, including *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* sp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal,

1997). Juvenile ridleys migrate south as water temperatures cool in fall, and are predominantly found in shallow coastal embayments along the Gulf Coast during fall and winter months. Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 centimeters in carapace length, and weighing less than 20 kilograms (Klinger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June, and migrating to more southerly waters from September to November (Keinath *et al.*, 1987; Musick and Limpus, 1997). In the Chesapeake Bay, ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick, 1985; Bellmund *et al.*, 1987; Keinath *et al.*, 1987; Musick and Limpus, 1997). The juvenile population in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus, 1997).

Research being conducted by Texas A&M University has resulted in the intentional live-capture of hundreds of Kemp's ridleys at Sabine Pass and the entrance to Galveston Bay. Between 1989 and 1993, Galveston NMFS Laboratory staff tracked 50 of these turtles using satellite and radio telemetry. The tracking study was designed to characterize sea turtle habitat and to identify small and large-scale migration patterns. Preliminary analysis of the data collected during these studies suggests that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, NMFS Galveston Laboratory, pers. comm.).

Threats. Observations in the northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. As with loggerheads, a large number of Kemp's ridleys are taken in the southeast shrimp fishery each year. Kemp's ridleys were also affected by the apparent large-mesh gillnet interaction that occurred in spring off of North Carolina. A total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 277 loggerhead carcasses were found. This is expected to be a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all carcasses washed ashore. Stranding events illustrate the vulnerability of Kemp's ridley and loggerhead turtles to the impacts of human activities in nearshore Gulf of Mexico waters as well (TEWG 1998). While many of the stranded turtles observed in recent years in Texas and Louisiana have been incidentally taken in the shrimp fishery, other sources of mortality, such as those observed in the northeastern and southeastern Atlantic zones, exist in these waters.

Critical Habitat. No critical habitat has been designated for the Kemp's ridley turtle.

Smalltooth Sawfish

All modern sawfish belong to the Suborder Pristoidea, Family Pristidae, and Genus *Pristis*. Although they are rays, sawfish appear to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. The snout of all sawfish is extended as a long narrow flattened rostral blade with a series of transverse teeth along either edge, hence the vernacular name. Species in the genus *Pristis* are separable into two groups according to whether the caudal fin has a distinct lower lobe or not. The smalltooth sawfish, *Pristis pectinata*, is the sole known representative on the western side of the Atlantic of the group lacking a defined lower caudal lobe (NMFS, 2000).

Distribution. The smalltooth sawfish has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. In U.S. waters, *P. pectinata* historically occurred from North Carolina south through the Gulf of Mexico, where it was sympatric with the largetooth sawfish (west and south of Port Arthur, TX) (Adams and Wilson, 1995. It also was an occasional visitor to waters as far north as New York. As with all sawfishes, it is euryhaline, occurring in fresh water, nearshore estuaries and in coastal waters to depths of 25 meters.

Pristis pectinata is the largest of the sawfishes, reported to reach 760 cm while more commonly growing to 550 cm (Last and Stevens 1994). Bigelow and Schroeder (1953) reported litter size of 15-20 embryos. Overall, life history parameters for this species are largely unknown.

Smalltooth sawfish were once common in Florida as detailed by the Final Smalltooth Sawfish Recovery Plan (NMFS, 2009) and are very rarely reported in southeast Florida. Their core range extends along the Everglades coast from the Ten Thousand Islands to Florida Bay, with moderate occurrence in the Florida Keys and at the mouth of the Caloosahatchee River. Outside of these areas, sawfish are rarely encountered and appear to be relatively rare (Simpfendorfer, 2006). It does not appear to be a coincidence that the core range of smalltooth sawfish corresponds to the section of Florida with the smallest amount of coastal habitat modification.

In the United States, smalltooth sawfish are generally a shallow water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters. Records indicate that smalltooth sawfish have been found in the lower reaches of the St. Johns River and the Indian River lagoonal system. Individuals have also historically been reported to migrate northward along the Atlantic seaboard in the warmer months.

Updated collection records from the Florida Museum of Natural History of the University of Florida include 13 records of *P. pectinata* from 1912 to 1998 (with one record not dated). Nine of these specimens were recorded from the Gulf of Mexico off Florida, three came from the Atlantic side of Florida, and one animal was caught in Pacific waters off Ecuador. Three additional records of smalltooth sawfish from the Atlantic coast of Florida have yet to be cataloged in this collection: one specimen is from 1979; the second is not dated (the Museum received both these fish from the Harbor Branch Oceanographic Institute); a third specimen was landed May 22, 1998 from the Indian River (Burgess, pers. comm.). There are eight reports of smalltooth sawfish along the Florida east coast in the 1990's, most from coastal rather than lagoonal areas.

General Human-related impacts. The principal habitats for smalltooth sawfish in the southeast U.S. are the shallow coastal areas and estuaries, with some specimens moving upriver in freshwater (Bigelow and Schroeder, 1953). The continued urbanization of the southeastern coastal states has resulted in substantial loss of coastal habitat through such activities as agricultural and urban development; commercial activities; dredge and fill operations; boating; erosion and diversions of freshwater run-off (SAFMC, 1998). Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. With the K-selected life history strategy of smalltooth sawfish, including slow growth, late maturation, and low fecundity, long-term commitments to habitat protection are necessary

for the eventual recovery of the species.

A complete review of the factors contributing to the decline of the smalltooth sawfish can be found in the "Status Review of Smalltooth Sawfish (*Pristis pectinata*)", (NMFS, 2000) and will not be repeated in detail here.

Status and Trends. The smalltooth sawfish was added to the list of species as candidates under the ESA in 1991, removed in 1997, and placed back on the list again in 1999. In November 1999, NMFS received a petition from the Center of Marine Conservation requesting that this species be listed as endangered under the ESA. NMFS completed a status review for smalltooth sawfish in December 2000, and published a proposed rule to list this the U.S. population of this species as endangered under the ESA on April 16, 2001. On April 1, 2003, the National Marine Fisheries Service (NOAA Fisheries) announced its final determination to list smalltooth sawfish as an endangered species under the Endangered Species Act (ESA).

According to NMFS (2000) "The U.S. DPS of smalltooth sawfish has experienced a ninety percent curtailment of its range and severe declines in abundance. Agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater run-off have resulted in the destruction and modification of smalltooth habitat throughout the southeastern U.S. Although habitat degradation is not likely the primary reason for the decline of smalltooth sawfish abundance and their contracted distribution, it has likely been a contributing factor. Over 50% of the U.S. human population lives within fifty miles of the ocean or Great Lakes. Migration to the coastlines for home, livelihood or recreation is predicted to increase by the year 2010 (National Ocean Service, 2000). Increases in coastal human populations will likely result in additional losses of marine habitats and increased pollution, further threatening the survival of smalltooth sawfish."

Simpfendorfer (2000) used a demographic approach to estimate intrinsic rate of natural increase and population doubling time. Since there are very limited life history data for smalltooth sawfish, much of the data (e.g. reproductive periodicity, longevity and age-at-maturity) were inferred from the more well-known largetooth sawfish. The litter size of smalltooth sawfish in the literature is given as 15 – 20 and Simpfendorfer used a mean of 17.5. However, the data on which this litter size is based are somewhat dubious. To account for uncertainty in the life-history parameters several different scenarios were tested, covering longevities from 30 to 70 years and ages-at-maturity from 10 to 27 years. The results indicated that the intrinsic rate of population increase ranged from 0.08/year to 0.13/ year, and population-doubling times ranged from 5.4 years to 8.5 years. These models assume the literature value for litter size is correct; doubling times would be longer if litter sizes are more in the range observed for largetooth sawfish (1 to 13, with a mean of 7.3). Simpfendorfer concluded:

> The estimated population doubling times for smalltooth sawfish indicate that the recovery times for this population will be very long. There are no data available on the size of the remaining populations, but anecdotal information indicates that smalltooth sawfish survive today in small fragmented areas where the impact of humans, particularly from net fishing, has been less severe. Fragmenting of the population will increase the time that it takes for recovery since the demographic models used in the study above assume a

single inter-breeding population. The genetic effects of recovery from very small population sizes may also impact conservation efforts. It is likely that even if an effective conservation plan can be introduced in the near future, recovery to a level where the risk of extinction is low will take decades, while recovery to pre-European settlement levels would probably take several centuries.

Humpback Whale

Species description and distribution. Humpback whales typically migrate between tropical/sub-tropical and temperate/polar latitudes. Humpback whales feed on krill and small schooling fish on their summer grounds. The whales occupy tropical areas during winter months when they are breeding and calving, and polar areas during the spring, summer, and fall, when they are feeding, primarily on small schooling fish and krill (Caldwell and Caldwell 1983).

In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Six separate feeding areas are utilized in northern waters after their return. This area will not be affected because it is within the biologically important area defined by the 200-m (656-ft) isobath on the North American east coast. Humpback whales also use the mid-Atlantic as a migratory pathway and apparently as a feeding area, at least for juveniles. Since 1989, observations of juvenile humpbacks in that area have been increasing during the winter months, peaking January through March (Swingle *et al.* 1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, by targeting fish schools and filtering large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill.

Life History. Humpback whale reproductive activities occur primarily in winter. They become sexually mature at age four to six. Annual pregnancy rates have been estimated at about 0.40-0.42 (NMFS unpublished and Nishiwaki 1959). Cows will nurse their calves for up to 12 months. The age distribution of the humpback whale population is unknown, but the portion of calves in various populations has been estimated at about 4B12% (Chittleborough 1965, Whitehead 1982, Bauer 1986, Herman *et al.* 1980, and Clapham and Mayo 1987).

The information available does not identify natural causes of death among humpback whales or their number and frequency over time, but potential causes of natural mortality are believed to include parasites, disease, predation (killer whales, false killer whales, and sharks), biotoxins, and entrapment in ice.

Humpback whales exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes, euphausiids, and other large zooplankton. Fish prey in the North Pacific include herring, anchovy, capelin, pollack, Atka mackerel, eulachon, sand lance, pollack, Pacific cod, saffron cod, arctic cod, juvenile salmon, and rockfish. In the waters west of the Attu Islands and south of Amchitka Island, Atka mackerel were preferred prey of humpback

whales (Nemoto 1957). Invertebrate prey includes euphausiids, mysids, amphipods, shrimps, and copepods.

Diving and social behavior. In Hawaiian waters, humpback whales remain almost exclusively within the 1820 m isobath and usually within 182 m. Maximum diving depths are approximately 150 m (492 ft) (but usually <60 m [197 ft]), with a very deep dive (240 m [787 ft]) recorded off Bermuda (Hamilton *et al.* 1997). They may remain submerged for up to 21 min (Dolphin 1987). Dives on feeding grounds ranged from 2.1-5.1 min in the north Atlantic (Goodyear unpubl. manus.). In southeast Alaska average dive times were 2.8 min for feeding whales, 3.0min for non-feeding whales, and 4.3 min for resting whales (Dolphin 1987). In the Gulf of California humpback whale dive times averaged 3.5 min (Strong 1989). Because most humpback prey is likely found above 300 m depths most humpback dives are probably relatively shallow.

Clapham (1986) reviewed the social behavior of humpback whales. They form small stable groups during the breeding season. During the feeding season they form small groups that occasionally aggregate on concentrations of food. Feeding groups are sometimes stable for long periods of times. There is good evidence of some territoriality on feeding grounds (Clapham 1994, 1996), and on wintering ground (Tyack 1981). On the breeding grounds males sing long complex songs directed towards females, other males or both. The breeding season can best be described as a floating lek or male dominance polygyny (Clapham 1996). Intermale competition for proximity to females can be intense as expected by the sex ratio on the breeding grounds that may be as high as 2.4:1.

Vocalizations and hearing. Humpbacks produce a wide variety of sounds. During the breeding season males sing long, complex songs, with frequencies in the 25-5000 Hz range and intensities as high as 181 dB (Payne 1970; Winn *et al.* 1970a; Thompson *et al.* 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson *et al.* 1979). The songs appear to have an effective range of approximately six to 12 miles (10 to 20 km). Animals in mating groups produce a variety of sounds (Tyack 1981; Tyack and Whitehead 1983, Silber 1986). Sounds are produced less frequently on the summer feeding grounds. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 sec and source levels of 175-192 dB (Thompson *et al.* 1986). These sounds are attractive and appear to rally animals to the feeding activity (D=Vincent *et al.* 1985; Sharpe and Dill 1997). In summary, humpback whales produce at least three kinds of sounds: 1) complex songs with components ranging from at least 20Hz B 4 kHz with estimated source levels from 144 B 174 dB, which are mostly sung by males on the breeding grounds (Payne 1970; Winn *et al.* 1970a; Richardson *et al.* 1995); 2) social sounds in the breeding areas that extend from 50Hz B more than 10 kHz with most energy below 3kHz (Tyack and Whitehead 1983, Richardson *et al.* 1995); and 3) Feeding area vocalizations that are less frequent, but tend to be 20Hz B 2 kHz with estimated sources levels in excess of 175 dB re 1 µPa-m (Thompson *et al.* 1986; Richardson *et al.* 1995). Sounds often associated with possible aggressive behavior by males (Tyack 1983; Silber 1986) are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz. These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983). A general description of the anatomy of the ear for cetaceans is provided in the description of the blue whale above. Humpback whales respond to low frequency sound. Humpback whales have been known to react to low frequency industrial noises at estimated

received levels of 115 B 124 dB (Malme *et al.* 1985), and to conspecific calls at received levels as low as 102dB (Frankel *et al.* 1995). Humpback whales apparently reacted to 3.1 B 3.6 kHz sonar by changing behavior (Maybaum 1990 1993). Malme *et al.* (1985) found no clear response to playbacks of drill ship and oil production platform noises at received levels up to 116dB re 1 µPa. Studies of reactions to airgun noises were inconclusive (Malme *et al.* 1985). Humpback whales on the breeding grounds did not stop singing in response to underwater explosions (Payne and McVay 1971). Humpback whales on feeding grounds did not alter short-term behavior or distribution in response to explosions with received levels of about 150dB re 1 µPa/Hz at 350Hz (Lien *et al.* 1993; Todd *et al.* 1996). However, at least two individuals were likely killed by the high intensity, impulsed blasts and had extensive mechanical injuries in their ears (Ketten *et al.* 1993; Todd *et al.* 1996). The explosions may also have increased the number of humpback whales entangled in fishing nets (Todd *et al.* 1996). Frankel and Clark (1998) showed that breeding humpbacks showed only a slight statistical reaction to playback of 60 B 90 Hz bounds with a received level of up to 190 dB. While these studies have shown short-term behavioral reactions to boat traffic and playbacks of industrial noise, the potential for habituation, and thus the long term effects of these disturbances are not known.

Status and Trends. Humpback whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for the species.

New information has become available on the status and trends of the humpback whale population in the North Atlantic (NMFS, 2001). Although current and maximum net productivity rates are unknown at this time, the population is apparently increasing. It has not yet been determined whether this increase is uniform across all six feeding stocks (Waring *et al. in prep.*). Katona and Beard (1990) estimated the rate of increase at 9.0 percent, while Barlow and Clapham (1997) reported a 6.5 percent rate for the Gulf of Maine using data through 1991. The rate reported by Barlow and Clapham (1997) may roughly approximate the rate of increase for the portion of the population within the action area. The best estimate of abundance for the North Atlantic humpback whale population is 10,600 animals (CV=0.067; Smith *et al.* 1999), while the minimum population estimate used for NMFS management purposes is 10,019 animals (CV = 0.067; Waring *et al. in prep.*). The Northeast Fisheries Science Center is considering recommending that NMFS identify the Gulf of Maine feeding stock as the management stock for this population in U.S. waters. A population estimate for the Gulf of Maine portion of the population is not available.

Threats. In the 1990s, no more than 3 humpback whales were killed annually in U.S. waters by commercial fishing operations in the Atlantic and Pacific Oceans. Between 1990 and 1997, no humpback whale deaths have been attributed to interactions with groundfish trawl, longline and pot fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska (Hill and DeMaster 1999). Humpback whales have been injured or killed elsewhere along the mainland U.S. and Hawaii (Barlow *et al.* 1997). In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill *et al.* 1997). In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone.

Humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989, Clapham *et al.* 1993, Atkins and Swartz 1989). Their responses to noise are variable and have been correlated with the size, composition, and behavior of the whales when the noises occurred (Herman *et al.* 1980, Watkins *et al.* 1981, Krieger and Wing 1986). Several investigators have suggested that noise may have caused humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979b, Dean *et al.* 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.* 1993; Wiley *et al.* 1995).

Many humpback whales are killed by ship strikes along both coasts of the U.S. On the Atlantic coast, 6 out of 20 humpback whales stranded along the mid-Atlantic coast showed signs of major ship strike injuries (Wiley *et al.* 1995). Almost no information is available on the number of humpback whales killed or seriously injured by ship strikes outside of U.S. waters.

Sperm Whale

Species description and distribution. Sperm whales are distributed in the entire world's oceans. Sperm whales have a strong preference for the 3,280 ft (1,000 m) depth contour and seaward. Berzin (1971) reported that they are restricted to waters deeper than 300 m (984 ft), while Watkins (1977) and Reeves and Whitehead (1997) reported that they are usually not found in waters less than 3,281 ft (1,000m) deep. While deep water is their typical habitat, sperm whales have been observed near Long Island, NY, in waters of 41-55 m (135-180 ft) (Scott and Sadove 1997). When found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956). They can dive to depths of at least 2000 m (6562 ft), and may remain submerged for an hour or more (Watkins *et al.* 1993). Sperm whales feed primarily on buoyant, relatively slow-moving squid (Clark *et al.* 1993), but may also eat a variety of fish, including salmon (*Oncorhynchus* spp.), rockfish (*Sebastes* spp.), and lingcod (*Ophiodon elongatus*) (Caldwell and Caldwell 1983).

In the Atlantic Ocean, NMFS' most recent stock assessment report notes that sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight. There is also a very large population of sperm whales found in the Gulf of Mexico near the Mississippi River delta.

Life History. Female sperm whales take about 9 years to become sexually mature (Kasuya 1991, as cited in Perry *et al.* 1999). Male sperm whales take between 9 and 20 years to become sexually mature, but will require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). Adult females give birth after about 15 months gestation and nurse their calves for 2 - 3 years. The calving interval is estimated to be about four to six years (Kasuya 1991). The age distribution of the sperm whale population is unknown, but sperm whales are believed to live at least 60 years (Rice 1978). Estimated annual mortality rates

of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980, as cited in Perry *et al.* 1999). Sperm whales are known for their deep foraging dives (in excess of 3 km). They feed primarily on mesopelagic squid, but also consume octopus, other invertebrates, and fish (Tomilin 1967, Tarasevich1968, Berzin 1971). Perez (1990) estimated that their diet in the Bering Sea was 82% cephalopods (mostly squid) and 18% fish. Fish eaten in the North Pacific included salmon, lantern fishes, lancetfish, Pacific cod, pollack, saffron cod, rockfishes, sablefish, Atka mackerel, sculpins, lumpsuckers, lamprey, skates, and rattails (Tomilin 1967, Kawakami 1980, Rice 1986b). Sperm whales taken in the Gulf of Alaska in the 1960s had fed primarily on fish. Daily food consumption rates for sperm whales ranges from 2 - 4% of their total body weight (Lockyer 1976b, Kawakami 1980). Potential sources of natural mortality in sperm whales include killer whales and papilloma virus (Lambertson *et al.* 1987).

Diving and social behavior. Sperm whales are likely the deepest and longest diving mammals. Typical foraging dives last 40 min and descend to about 400m followed by approximately 8 min of resting at the surface (Gordon 1987; Papastavrou et al. 1989). However, dives of over 2 hr and as deep as 3,000 m have been recorded (Clarke 1976; Watkins et al. 1985). Descent rates recorded from echosounders were approximately 1.7m/sec and nearly vertical (Goold and Jones 1995). There are no data on diurnal differences in dive depths in sperm whales. However, like most diving vertebrates for which there is data (e.g. rorqual whales, fur seals, chinstrap penguins), sperm whales probably make relatively shallow dives at night when organisms from the ocean's deep scattering layers move toward the ocean's surface.

The groups of closely related females and their offspring develop dialects specific to the group (Weilgart and Whitehead 1997) and females other than birth mothers will guard young at the surface (Whitehead 1996b) and will nurse young calves (Reeves and Whitehead 1997).

Vocalizations and hearing. Sperm whales produce loud broadband clicks from about 0.1 to 20 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). These have source levels estimated at 171 dB re 1 µPa (Levenson 1974). Current evidence suggests that the disproportionately large head of the sperm whale is an adaptation to produce these vocalizations (Norris and Harvey 1972; Cranford 1992; but see Clarke 1979). This suggests that the production of these loud low frequency clicks is extremely important to the survival of individual sperm whales. The function of these vocalizations is relatively well studied (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). Long series of monotonous regularly spaced clicks are associated with feeding and are thought to be produced for echolocation. Distinctive, short, patterned series of clicks, called codas, are associated with social behavior and intragroup interactions; they are thought to facilitate intra-specific communication, perhaps to maintain social cohesion with the group (Weilgart and Whitehead 1993).

A general description of the anatomy of the ear for cetaceans is provided in the description of the blue whale above. The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1975; Watkins *et al.* 1985). They also stop vocalizing for brief periods

when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Sperm whales have moved out of areas after the start of air gun seismic testing (Davis *et al.* 1995). Seismic air guns produce loud, broadband, impulsive noise (source levels are on the order of 250 dB) with shots at every 15 seconds, 240 shots per hour, and 24 hours per day during active tests. Because they spend large amounts of time at depth and use low frequency sound sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll *et al* 1999). Furthermore, because of their apparent role as important predators of mesopelagic squid and fish, changes in their abundance could affect the distribution and abundance of other marine species.

Status and Trends. Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). Sperm whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for sperm whales.

The best abundance estimate that is currently available for the western North Atlantic sperm whale population is 2,698 (CV=0.67) animals, and the minimum population estimate used for NMFS management purposes is 1,617 (CV=0.67) (Waring *et al. in prep.*). Due to insufficient data, no information is available on population trends at this time for the western North Atlantic sperm whale stock.

Threats. In U.S. waters in the Pacific, sperm whales are known to have been incidentally taken only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991-1995 (Barlow *et al.* 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longlines in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

Johnson's Seagrass

Species Description. Johnson's seagrass was listed as threatened under the ESA on September 14, 1998 based on the results of fieldwork and a status review initiated in 1990 and is the first marine plant ever listed. Kenworthy (1993, 1997, 1999) discusses the results of the field studies and summarizes an extensive literature review and associated interviews regarding the status of Johnson's seagrass.

The species has only been found growing along approximately 200 km of coastline in southeastern Florida from Sebastian Inlet, Indian River County to northern Key Biscayne. This narrow range and apparent endemism indicates that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world.

Johnson's seagrass occurs in dynamic and disjunct patches throughout its range. Growth appears to be rapid and leaf pairs have short life spans while horizontally spreading from dense apical meristems (Kenworthy 1997). Kenworthy suggested that horizontal spreading rapid growth pattern and a high biomass turnover could explain the dynamic patches observed in distribution studies. New information reviewed in Kenworthy (1999, 1997) confirms *H. johnsonii's* limited geographic distribution in patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay. Surveys conducted by NMFS and Florida staff in Biscayne Bay, Florida Bay, the Florida Keys, outer Florida Bay, Puerto Rico, and the Virgin Islands provided no verifiable sightings of Johnson's seagrass outside of the range already reported.

Extent of critical habitat. The northern and southern ranges of Johnson's seagrass are defined as Sebastian Inlet and central Biscayne Bay, respectively. These limits to the species' range have been designated as critical habitat for Johnson's seagrass. Within its range, Johnson's seagrass critical habitat designations have been designated for 10 areas: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay. There is no designated critical habitat within the action area.

Life History

Reproductive strategy

The species is perennial and may spread even during winter months under favorable conditions (Virnstein *et al.* 1997). Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys in the Indian River Lagoon have not discovered male flowers, fertilized ovaries, fruits, or seeds either in the field or under laboratory conditions (Jewett-Smith *et al.* 1997). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting that the species does not reproduce sexually or that the male flowers are difficult to observer or describe, as noted for other *Halophila* species (Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean, suggesting that inlet conditions are qualitatively better for flowering than conditions further inshore (Kenworthy pers. comm. 1998). It is possible that male flowers, if they exist, occur near inlets as well. Maintenance of good water quality around inlets may be essential for promoting flowering in the Johnson's seagrass population.

Niche

The essential features of habitat appear to be adequate water quality, salinity, water clarity and stable sediments free from physical disturbance. Important habitat characteristics include shallow intertidal as well as deeper subtidal zones (2-5 m). Water transparency appears to be critical for Johnson's seagrass, limiting its distribution at depth to areas of suitable optical water quality (Kenworthy 1997). In areas in which long-term poor water and sediment quality have existed until recently, such as Lake Worth Lagoon, *H. johnsonii* appears to occur in relatively higher abundance perhaps due to the previous inability of the larger species to thrive. These

studies support unconfirmed previous observations that suspended solids and tannin, which reduce light penetration and water clarity, may be important factors limiting seagrass distribution. Good water clarity is essential for *Halophila johnsonii* growth in deeper waters.

Johnson's seagrass occurs over varied depths, environmental conditions, salinities, and water quality. In tidal channels *H. johnsonii* is found in coarse sand substrates, although it has been found growing on sandy shoals, in soft mud near canals and rivers where salinity many fluctuate widely (Virnstein *et al.* 1997). Virnstein has called Johnson's seagrass a "perennial opportunistic species." Within his study areas in the Indian River Lagoon, *H. johnsonii* was found by itself, with other seagrass species, in the intertidal, and (more commonly) at the deep edge of some transects in water depths of up to 180 cm. *H. johnsonii* was found shallowly rooted on sandy shoals, in soft mud, near the mouths of canals, rivers and in shallow and deep water (Virnstein *et al.* 1997). Additionally, recent studies have documented large patches of Johnson's seagrass on flood deltas just inside Sebastian Inlet, as well as far from the influence of inlets (reported at the workshop discussed in Kenworthy, 1997). These sites encompass a wide variety of salinities, water quality, and substrates.

Competitors:
Halophila johnsonii appears to be outcompeted in ideal seagrass habitats where environmental conditions permit the larger species to thrive (Virnstein *et al.* 1997, Kenworthy 1997).

Population Dynamics
Population stability
A factor leading to the listing of *H. johnsonii* is its rareness within its extremely restricted geographic range. Johnson's seagrass is characterized by small size (it is the smallest of all of the seagrasses found within its range, averaging about 3 cm in height), fragile rhizome structure and associated high turnover rate, and is apparently reliant on vegetative means to reproduce, grow and migrate across the sea bottom. These factors make Johnson's seagrass extremely vulnerable to human or environmental impacts by reducing its capacity to repopulate an area once removed. The species and its habitat are impacted by human-related activities throughout the length its range, including bridge construction and dredging, and the species' threatened status produces new and unique challenges for the management of shallow submerged lands. Vessel traffic resulting in propeller and anchor damage, maintenance dredging, dock and marine construction, water pollution, and land use practices could require special management within critical habitat.

Population (genetic) variability:
The Boca Raton and Boynton Beach sites proposed for critical habitat designation have populations that are distinguished by a higher index of genetic variation than any of the central and northern populations examined to date (Kenworthy, 1999). These two sites represent a genetically semi-isolated group that could be the reservoir of a large part of the overall genetic variation found in the species. Information is still lacking on the geographic extent of this genetic variability.

Status and Distribution. Kenworthy (1997, 1999) summarized the newest information on Johnson's seagrass biology, distribution, and abundance and confirmed the limited range and

rareness of this species within its range. Additionally, the apparent restriction of propagation through vegetative means suggests that colonization between broadly disjunct areas is likely difficult, suggesting that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means. Human impacts to Johnson's seagrass and its habitat include: (1) Vessel traffic and the resulting propeller dredging and anchor mooring; (2) dredging; (3) dock and marina construction and shading from these structures; (4) water pollution; and (5) land use practices including shoreline development, agriculture, and aquaculture.

Activities associated with recreational boat traffic account for the majority of human use associated with the proposed critical habitat areas. The destruction of the benthic community due to boating activities, propeller dredging, anchor mooring, and dock and marina construction was observed at all sites during a study by NMFS from 1990 to 1992. These activities severely disrupt the benthic habitat, breaching root systems, severing rhizomes, and significantly reducing the viability of the seagrass community. Propeller dredging and anchor mooring in shallow areas are a major disturbance to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity. Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat. Populations of Johnson's seagrass inhabiting shallow water and water close to inlets, where vessel traffic is concentrated, will be most affected.

The constant sedimentation patterns in and around inlets require frequent maintenance dredging, which could either directly remove essential seagrass habitat or indirectly affect it by redistributing sediments, burying plants and destabilizing the bottom structure. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson's seagrass and its habitat through direct removal of the plant, fragmentation of habitat, and shading. Docking facilities that, upon meeting certain provisions, are exempt from state permitting also contribute to loss of Johnson's seagrass through construction impacts and shading. Fixed add-ons to exempt docks (such as finger piers, floating docks, or boat lifts) have recently been documented as an additional source of seagrass loss due to shading (Smith and Mezich, 1999).

Decreased water transparency caused by suspended sediments, water color, and chlorophylls could have significant detrimental effects on the distribution and abundance of the deeper water populations of Johnson's seagrass. A distribution survey in Hobe and Jupiter Sounds indicates that the abundance of this seagrass diminishes in the more turbid interior portion of the lagoon where reduced light limits photosynthesis.

Other areas of concern include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly attenuating shorter wavelengths of Photosynthetically Active Radiation.

Continuing and increasing degradation of water quality due to increased land use and water management threatens the welfare of seagrass communities. Nutrient overenrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off stimulates increased algal growth that may smother Johnson's seagrass, shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

A wide range of activities funded, authorized or carried out by Federal agencies may affect the essential habitat requirements of Johnson's seagrass. These include authorization by the COE for beach nourishment, dredging, and related activities including construction of docks and marinas; bridge construction projects funded by the Federal Highway Administration; actions by the U.S. Environmental Protection Agency and the COE to manage freshwater discharges into waterways; regulation of vessel traffic by the U.S. Coast Guard; management of national refuges and protected species by the U.S. Fish and Wildlife Service; management of vessel traffic (and other activities) by the U.S. Navy; authorization of state coastal zone management plans by NOAA's National Ocean Service, and management of commercial fishing and protected species by NMFS.

Rangewide trend:
Lamentably, there is currently insufficient information to clearly determine trends in the Johnson's seagrass population, which was described in 1980 and has only been extensively studied during the 1990s. Generally, seagrasses within the range of Johnson's seagrass have declined in some areas and increased in others. Where multiyear mapping studies have been conducted within the Indian River Lagoon, recent increases in Johnson's seagrass have been noted but may be attributed in part to the recent increase in search effort and increased familiarity with this species (Virnstein *et al.* 1997). The authors conclude that from 1994 through 1997, no strong seasonal distribution or increases or decreases in abundance or range can be discerned.

Protected Species Surveys within the project area.
Surveys specifically targeting protected species were conducted in the project vicinity for Johnson's seagrass. There is an Environmental Impact Statement (EIS) being prepared concurrently to satisfy NEPA regulations, which will have additional information covering all potentially impacted species. This assessment, literature reviews and consultations with NMFS serve as the basis for this biological assessment and the determination of which listed and protected species under NMFS' jurisdiction are found in the project area.

Sea Turtles
Palm Beach County is within the normal nesting range of three species of sea turtles: the loggerhead (*Caretta caretta*), the green turtle (*Chelonia mydas*), and the leatherback (*Dermochelys coriacea*). The green sea turtle and leatherback sea turtle are both listed under the U. S. Endangered Species Act, 1973 and Chapter 370, F.S. The loggerhead turtle is listed as a threatened species (Burney and Margolis, 1999). A summary of sea turtle nesting in Palm Beach County can be found in Tables 1, 2 and 3 in the species description section of this assessment. The waters offshore of Palm Beach County are also habitat used for foraging and shelter for the

three species listed above and possibly the hawksbill turtle (*Eretmochelys imbricata*), and the Kemp's ridley turtle (*Lepidochelys kempii*) (USACE, 2000). Table lists the number of sea turtle nests recorded by Palm Beach County for the beach placement area south of the south jetty (http://www.co.palm-beach.fl.us/erm/permitting/sea-turtles/nesting.htm).

Table 4. Sea Turtle Nesting Data for Beach Placement Area South of the South Jetty.

Year	Loggerhead	Green	Leatherback
2006	155	9	10
2007	99	9	8
2008	161	5	8
2009	136	3	15
2010	289	4	6
Mean	168	6	9.4

Johnson's Seagrass

Johnson's seagrass occurs within the project area, specifically in the areas south of the turning basin and north of the project around Peanut Island. Abundance and density values vary and the species is generally associated with *H. decipiens*. From a 2011 survey, Johnson's seagrass was present in 16 of 28 transects surveyed, with abundance and density estimated using the Braun-Blanquet abundance scale (Table 1).

Table 5. Braun-Blanquet Abundance Scale Values

0	Species absent from quadrat
0.1	Species represented by a solitary short shoot, <5% cover
0.5	Species represented by a few (< 5%) short shoots, <5% cover
1.0	Species represented by many (> 5%) short shoots, <5% cover
2.0	Species represented by many (> 5%) short shoots, 5% - 25% cover
3.0	Species represented by many (> 5%) short shoots, 25%- 50% cover
4.0	Species represented by many (> 5%) short shoots, 50%- 75% cover
5.0	Species represented by many (> 5%) short shoots 75%-100% cover

Abundance values for *H. johnsonii* ranged from 0.1 to 1.38 among transects. The average abundance for *H. johnsonii* was 0.6 (< 5% cover). *H. johnsonii* had the lowest abundance values of all species over all transects. Density for *H. johnsonii* was the highest of all species in the study area, with an average value of 0.17. The range of density values for *H. johnsonii* was 0 to 0.57.

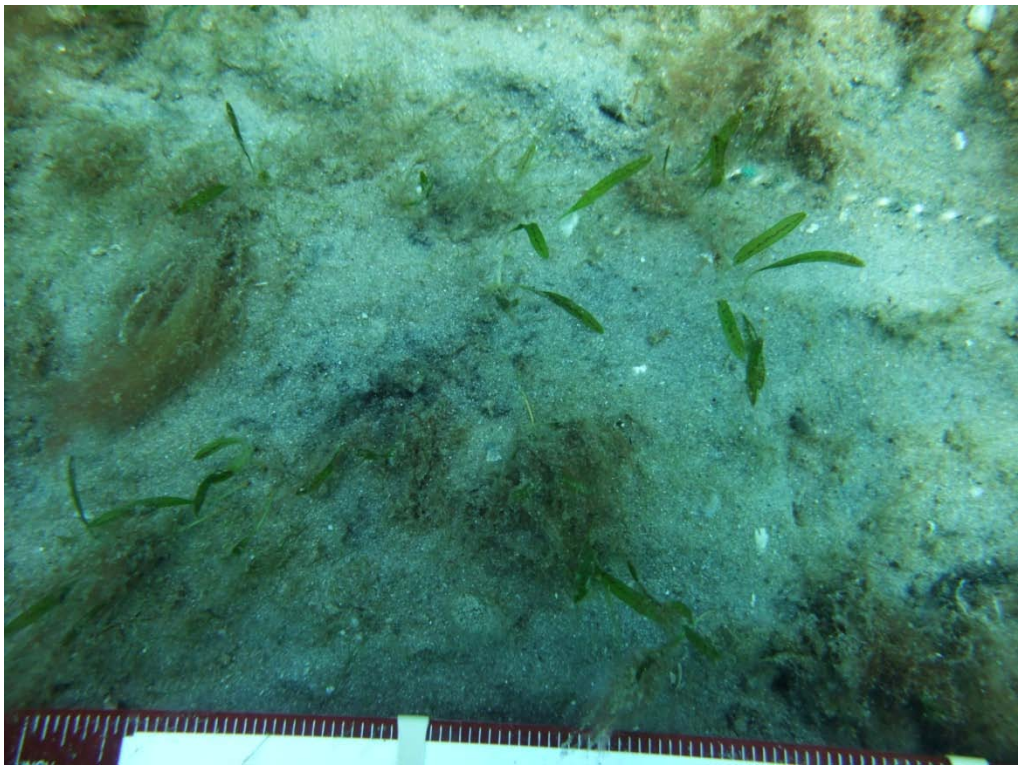


Figure 4. *Halophila johnsonii* (Braun Blanquet score 1 (<5% cover).

Smalltooth sawfish

This species inhabits softbottom estuarine habitats in depths generally less than 30 feet. Its former range in U.S. waters extended from Texas through Maryland. Currently, few are observed outside peninsular Florida. At least one recorded observation has occurred within the vicinity of Palm Beach County (NMFS, 2000). Populations likely decreased due to a low intrinsic rate of natural increase, the long interval to time of reproduction, and human impacts, most notably overfishing, incidental take in nets (due in part to its body size and unusual morphology), and habitat loss (development of shoreline and nearshore habitats).

Humpback and Sperm Whales

These species are found offshore of the project area in deepwater beyond the third reef line. Sperm whales may be found year round near the project area, while humpbacks are found seasonally during their migration to and from breeding grounds in the Caribbean.

Protective Measures Taken in the Project Area as Part of the Proposed Action

Consideration of Plans and Methods to Minimize/Avoid Environmental Impacts. Conservation measures were a major focus during the plan formulation phase for the proposed project. Avoiding and minimizing some potential impact areas significantly decreased the risk of indirect effects on managed and protected species, and a great deal of consideration was given to the utilization of rock removal methods to decrease the likelihood of incidental take, injury, and behavioral modification of protected species. While efforts to reduce impacts to habitats were fruitful, it was determined that if rock removal was needed, options not involving blasting were

possibly more detrimental to populations and individuals of protected species. One alternative option was the use of a punchbarge/piledriver to break rock. However, it was determined that the punchbarge, which would work for 12-hour periods, strikes the rock approximately once every 60-seconds. This constant pounding would serve to disrupt animal behavior in the area. Using the punchbarge would also extend the length of the project, thus increasing any potential impacts to all fish and wildlife resources in the area. The Corps believes that blasting is actually the least environmentally damaging method for removing the rock from within the project. Each blast will last no longer than five (5) seconds in duration, and may even be as short as 2 seconds each. Additionally, the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set, and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast (see discussion below).

Development of Protective Measures. The proposed project includes measures to conserve sperm and humpback whale, sea turtles and smalltooth sawfish. Foremost among the measures are protective actions to ensure that sea turtles and smalltooth sawfish are not killed and whales are not harassed due to blasting activities, if in fact such methods are required as a part of the overall dredging operation. Development of the measures involved consideration of past practices and operations, anecdotal observations, and the most current scientific data. The discussion below summarizes the development of the conservation measures, which, although developed for marine mammals, will also be utilized to protect such species as sea turtles and smalltooth sawfish.

Blasting

To achieve the deepening of the Lake Worth Iinlet pretreatment of the rock areas may be required. Blasting is anticipated to be required for some or all of the deepening and extension of the channel, where standard construction methods are unsuccessful. Current geotechnical investigations have shown the majority of rock to be inside the harbor in the turning basin, not in the entrance channel. The work may be completed in the following manner:

1. Contour dredging with either bucket, hydraulic or excavator dredges to remove material that can be dredged conventionally and determine what areas require blasting.

2. Pre-treating (blasting) the remaining above grade rock, drilling and blasting the "Site Specific" areas where rock could not be conventionally removed by the dredges.

3. Excavating with bucket, hydraulic or excavator dredges to remove the pre-treated rock areas to grade.

All drilling and blasting will be conducted in strict accordance with local, state and federal safety procedures. Marine Wildlife Protection, Protection of Existing Structures, and Blasting Programs coordinated with federal and state agencies.

Based upon industry standards and USACE, Safety & Health Regulations, the blasting program may consist of the following:

The weight of explosives to be used in each blast will be limited to the lowest poundage of explosives that can adequately break the rock. The blasting would consist of up to 3 blasts per day, preparing for removal of approximately 1500 cubic yards per blast.

The following safety conditions are standard in conducting underwater blasting:

- Drill patterns are restricted to a minimum of 8 ft separation from a loaded hole.
- Hours of blasting are restricted from 2 hours after sunrise to 1 hour before sunset to allow for adequate observation of the project area for protected species.
- Selection of explosive products and their practical application method must address vibration and air blast (overpressure) control for protection of existing structures and marine wildlife.
- Loaded blast holes will be individually delayed to reduce the maximum pounds per delay at point detonation, which in turn will reduce the mortality radius.
- The blast design will consider matching the energy in the "work effort" of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock.

Because of the potential duration of the blasting and the project area as habitat for listed and threatened species, a number of issues will need to be addressed. One of the key issues is the extent of a safety radius for the protection of marine wildlife. This is the distance from the blast site which any protected species must be in order to commence blasting operations. Ideally the safety radius is large enough to offer a wide buffer of protection for marine animals while still remaining small enough that the area can be intensely surveyed

There are a number of methods that can be used to calculate a safety radius. Little published data exists for actual measurements of sub aqueous blasts confined to a rock layer and their impacts to marine mammals or turtles. There is some information on the impacts to fish from similar blasts. Both literature searches and actual observations from similar blasting events will be used as a guide in establishing a safety radius that affords the best protection from lethal harm to marine wildlife. The following will be considered in establishing the radius for blasting inshore of the outer reef:

The U.S. Navy Dive Manual and the FFWCC Endangered Species Watch Manual the safety formula for an uncontrolled blast suspended in the water column, which is as follows:

R = 260 (cube root w)
R = Safety radius
W = Weight of explosives

This formula is a conservative for the blasting being done within Port Everglades, as the blast will be confined within the rock and not suspended in the water column. This formula and plan are consistent with the plans for Miami Harbor Phase II and Miami Harbor GRR that the Corps consulted with NMFS on (I/SER/2002/00178 – September 23, 2002 and F/SER/2002/01094 – February 23, 2003, respectively). In both cases, NMFS found concurred with the Corps' determination that the proposed confined blasting at Miami Harbor "may affect, but is not likely

to adversely affect sea turtles". The Lake Worth Inlet blasting plan will be designed to be consistent with the Miami Harbor projects.

If blasting is required outside the turning basin and into the entrance channel, the Corps proposes to use aerial and passive acoustic surveys to determine if there are sperm or humpback whales within a 1-nautical mile (nm) radius of the project area. In the Biological Opinion for the shock trial of the USS Winston Churchill (DDG-81) (NMFS, 2000b), NMFS required the Navy to establish a zone of 3 nm for acoustic monitoring and 2 nm for aerial monitoring for three 10,000 lb open water unconfined explosions. Blasting for the channel extension will utilize confined blasts drilled into the substrate, and as a result the Corps believes that any acoustic or pressure effects to the project area will be substantially less than those evaluated by NMFS in setting the safety zones for the Churchill tests.

Conservation Measures

It is crucial to balance the demands of the blasting operations with the overall safety of the species. A radius that is excessively large will result in significant delays that prolong the blasting, construction, traffic and overall disturbance to the area. A radius that is too small puts the animals at too great of a risk should one go undetected by the observers and move into the blast area. Because of these factors, the goal is to establish the smallest radius possible without compromising animal safety and provide adequate observer coverage for whatever radius is agreed upon.

Aerial reconnaissance, where feasible and possible, is critical to support the safety radius selected in addition to boat-based and land support reconnaissance. Additionally, an observer will be placed on the drill barge for the best view of the actual blast zone and to be in direct contact with the blaster in charge.

Prior to implementing a blasting program a Test Blast Program will be completed. The purpose of the Test Blast Program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted
- Directional Vibration
- Calibration of the Environment

The Test Blast Program begins with a single range of individually delayed holes and progresses up to the maximum production blast intended for use. Each Test Blast is designed to establish limits of vibration and airblast overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the Test Blast Program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a

completely engineered procedure for Blasting Plan. During the testing the following data will be used to develop a regression analysis:

- Distance
- Pounds Per Delay
- Peak Particle Velocities (TVL)
- Frequencies (TVL)
- Peak Vector Sum
- Air Blast, Overpressure

Effects of the Action on Protected Species.

As previously stated, the Corps believes that the loggerhead turtle, green turtle, smalltooth sawfish and Johnson's seagrass have the potential to be effected by the proposed dredging project. The project may have the following adverse impacts on listed/protected species are:

- direct effect of blasting in the turning basin.
- direct effect of dredging activities
- indirect effects

Direct Effects

Blasting

Sea turtles

Specific information regarding the likely direct impact of explosives on sea turtles is not available. Studies regarding the impacts of relatively minuscule explosives on humans noted that minor injuries such as small bruises or perforations of the intestinal tract occasionally occur well beyond ranges in which human lung damage could occur (Christian and Gaspin, 1974). Christian and Gaspin (1974) note that these minor injuries could become serious if left unattended. Sea turtles with untreated internal injuries would have increased vulnerability to predators and disease. In the Environmental Impact Statement prepared by the Navy to consider the effects of explosives used in shipshock tests, nervous system damage was cited as a possible impact to sea turtles caused by blasting. Damage of the nervous system could kill sea turtles through disorientation and subsequent drowning. The Navy=s review of previous studies suggested that rigid masses such as bone (or carapace and plastron) could protect tissues beneath them; however, there are no observations available to determine whether the turtles= shells would indeed afford such protection.

Studies conducted by Klima *et al*., (1988) evaluated blasts of only approximately 42 lbs on sea turtles (4 ridleys, 4 loggerheads) placed in surface cages at varying distances from the explosion. Christian and Gaspin=s (1974) estimates of safety zones for swimmers found that, beyond a cavitation area, waves reflected off a surface have reduced pressure pulses; therefore, an animal at shallow depths would be exposed to a reduced impulse. This finding, which considered only very small explosive weights, implies that the turtles in the Klima *et al*. (1988) study would be under reduced effects of the shock wave. Despite this possible lowered level of impact, 5 of 8

turtles were rendered unconscious at distances of 229 to 915 m from the detonation site. Unconscious sea turtles that are not detected, removed and rehabilitated likely have low survival rates.

Blasting will affect nearby finfish and invertebrates and cause short-term changes to the physical characteristics of the benthos. Fish and invertebrates killed or injured by the blasting may provide a short-term enhancement of foraging opportunities for green and loggerhead sea turtles. Through new recruitment and local migrations, finfish and benthic invertebrates are expected eventually to repopulate the affected area. Any modifications of the local area=s environment, as far as sea turtle habitat, are not expected to be significant in the long term.

Smalltooth Sawfish
Blasting rock underwater produces a pressure wave in water that can produce fish mortality. Different types of fish have different mortality thresholds. This depends on whether the fish dwell near the surface, on the bottom, or in between.

The magnitude of the pressure wave generated in greatly affected by the stemming of the blastholes, distance between holes, and the delay time of the holes.

Normally, mortality occurs in the range of 150-psi overpressure for fish. In practice this is a 75-foot to 100-foot radius around the blasting area.

Dredging

Sea Turtles
The effects of hopper dredging on sea turtles on the Atlantic coast were analyzed by NMFS in the 1997 biological opinion entitled "The continued hopper dredging of channels and borrow areas in the southeastern United States". If it is determined that a hopper dredge will be used, the Terms and Conditions of this opinion will be applied to the project. If a cutterhead or clamshell dredge is used, based on a finding in the November 25, 1991 biological opinion between NMFS and the Corps that states:

> "Pipeline dredges are relatively stationary and only influence small areas at any given time. For a turtle to be taken with a pipeline dredge, it would have to approach the cutterhead and be caught in the suction. This type of behavior would appear unlikely, but may be possible. Presently, NMFS has determined that pipeline dredges are unlikely to adversely affect sea turtles".

Based on this determination, the Corps finds that use of a cutterhead dredge may effect, but is not likely to adversely affect sea turtles. If a clamshell dredge is used, there is no suction to capture a sea turtle and the turtle would have to be caught between the two halved of the clamshell. While this is not impossible, it is improbable. The Corps has also determined that use of a clamshell dredge may effect, but is not likely to adversely affect sea turtles.

Smalltooth sawfish
The smalltooth sawfish may be affected by dredging nearshore areas in channels that are currently suitable habitats (areas of sand and/or mud bottoms less than 30 feet in depth) and by blasting if there is an animal present in the blast zone at time of detonations, a stunned or damaged animal may be captured by the clamshell dredge if it could not move out of the way.

Johnson's Seagrass
Dredging will result in the removal of approximately 4 acres of seagrass beds where *H. johnsonii* is the sole constituent or associate of other seagrass species in the areas surrounding the turning basin. This impact will include the direct removal of *H. johnsonii*. Changes in bottom depth through deepening and widening efforts within the Port is expected to make resulting habitats unsuitable for re-colonization of *H. johnsonii*.

Indirect Effects

Sea Turtles
Since beaches of Palm Beach County provide important nesting areas for three sea turtle species, the project area comprises important resources for turtles. Removal of sections of hardbottom and seagrass habitats will eliminate potential foraging habitat for juvenile sea turtles. The reduction in such habitat may slightly decrease the carrying capacity of the region for turtles. Also, since these habitats are also utilized as refugia for hatchling turtles, an increase in predation may be anticipated. Finally, dredge activities and associated disturbances (noise, lights, etc.) may interrupt the movement of turtles swimming toward or away from nesting beaches. In fact, the highest potential impact to sea turtles may be the use of explosives to remove areas of rock within the turning basin or entrance channel. It is extremely likely that both the pressure and noise associated with blasting will physically damage sensory mechanisms and other physiological functions of individual sea turtles.

Johnson's seagrass
Areas of Johnson's seagrass adjacent to construction activities may be temporarily affected by increased turbidity and lower water clarity during construction.

Effect Determination
The Corps has determined that the proposed expansion of Lake Worth Inlet may adversely affect Johnson's seagrass within the action area and requests initiation of formal consultation with NMFS. The proposed project may affect, but not likely to adversely affect; the green turtle, loggerhead turtle, Kemp's ridley turtle, Hawksbill turtle, leatherback turtle, humpback whale, sperm whale, and smalltooth sawfish.

Literature Cited

Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, *Caretta caretta*, population in the western Mediterranean. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-361:1-6.

Bass, A.L., S.P. Epperly, J. Braun, D.W. Owens, and R.M. Patterson. 1998. Natal origin and sex ratios of foraging sea turtles in Pamlico-Albemarle Estuarine Complex. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-415:137-138.

Bass, A.L. 1999. Genetic analysis of juvenile loggerheads captured at the St. Lucie Power Plant. A report to National Marine Fisheries Service and Quantum Resources, Inc.

Bellmund, S. A.; Musick, J. A.; Klinger, R. C.; Byles, R. A.; Keinath, J. A. and Barnard, D. E., 1987. Ecology of sea turtles in Virginia. The Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA; 1987, Special Scientific Report No. 119, 48p.

Bigelow, H.B. and W.C. Schroeder. 1953. Sawfishes, guitarfishes, skates and rays, pp. 1-514. *In:* Tee-Van, J., C.M Breder, A.E. Parr, W.C. Schroeder and L.P. Schultz (eds). Fishes of the Western North Atlantic, Part Two. Mem. Sears Found. Mar. Res. I.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. Pages 199-233 *In*: Lutz, P.L. and J.A. Musick, eds., The Biology of Sea Turtles. CRC Press, New York. 432 pp.

Bjorndal, K.A., A.B. Bolten, J. Gordon, and J.A. Camiñas. 1994. *Caretta caretta* (loggerhead) growth and pelagic movement. Herp. Rev. 25:23-24.

Bolten, A.B., K.A. Bjorndal, and H.R. Martins. 1994. Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SWFSC-201:48-55.

Bolten, A.B., K.A. Bjorndal, H.R. Martins, T. Dellinger, M.J. Biscoito, S.E. Encalada, and B.W. Bowen. 1998. Transatlantic development migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. Ecol. Applic. 8:1-7.

Bowen, B.W., J.C. Avise, J.I. Richardson, A.B. Meylan, D. Margaritoulis, and S.R. Hopkins-Murphy. 1993. Population structure of loggerhead sea turtles (*Caretta caretta*) as indicated by mitochondrial DNA haplotypes. Evol. 48:1820-1828.

Carr, A. 1987. New perspectives on the pelagic stage of sea turtle development. Conserv. Biol. 1: 103-121.

Carr, A.F., M.H. Carr, and A.B. Meylan. 1978. The ecology and migrations of sea turtles. The western Caribbean green turtle colony. Bull. Amer. Mus. Nat. Hist. 162(1): 1-46.

Carr, A.F. and L. Ogren. 1960. The ecology and migrations of sea turtles. The green turtle in the Caribbean Sea. Bull. Amer. Mus. Nat. Hist. 131(1): 1-48.

Christian, E.A., and J.B. Gaspin. 1974. Swimmer safe standards from underwater explosions. Navy Science Assistance Program Project no. PHP-11-73.

Crouse, D.T. 1999. The consequences of delayed maturity in a human-dominated world. In: Musick, J. A. Editor, Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals, American Fisheries Society Symposium 23. American Fisheries Society, Bethesda, MD. 260 pp.; 1999, p. 195-202.

Crouse, D.T., L.B. Crowder, and H. Caswell. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. Ecol. 68:1412-1423.

Crowder, L.B., D.T. Crouse, S.S. Heppell. and T.H. Martin. 1994. Predicting the impact of turtle excluder devices on loggerhead sea turtle populations. Ecol. Applic. 4:437-445.

Department of the Navy, 2001. Final Environmental Impact Statement – Shock Trail of the Winston S. Churchill (DDG 81). Feb 2001.

Ehrhart, L.M. 1979. A survey of marine turtle nesting at Kennedy Space Center, Cape Canaveral Air Force Station, North Brevard County, Florida, 1-122. Unpublished report to the Division of Marine Fisheries, St. Petersburg, Florida, Florida Department of Natural Resources.

Epperly, S.P., J. Braun, A.J. Chester, F.A. Cross, J. Merriner, and P.A. Tester. 1995. Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bull. Mar. Sci. 56(2): 519-540.

Ernst, L.H. and R.W. Barbour. 1972. Turtles of the United States. Univ. Kentucky Press, Lexington, Kentucky.

Finneran, J.J., Schlundt, C.E., Dear, R., Carder, D.A., & Ridgway, S.H. 2000. Masked temporary thresholdshift - MTTS - in odontocetes after exposure to singe underwater impulses from a seismic watergun. Journal of the Acoustical Society of America. 108:2515.

Florida Marine Research Institute (FMRI). 2002a. Green Turtle Nesting Data for Southeast Florida. Website accessed 9 May 2002: http://floridamarine.org/features/view_article.asp?id=7630.

Florida Marine Research Institute (FMRI). 2002b. Loggerhead Nesting Data for Southeast Florida. Website accessed 9 May 2002: http://floridamarine.org/features/view_article.asp?id=8242.

Frazer, N.B., and L.M. Ehrhart. 1985. Preliminary growth models for green, *Chelonia mydas*, and loggerhead, *Caretta caretta*, turtles in the wild. Copeia 1985:73-79.

Frazer, N.B., C.J. Limpus, and J.L. Greene. 1994. Growth and age at maturity of Queensland loggerheads. U.S. Dep. of Commer. NOAA Tech. Mem. NMFS-SEFSC-351: 42-45.

Hirth, H.F. 1971. Synopsis of biological data on the green sea turtle, *Chelonia mydas*. FAO Fisheries Synopsis No. 85: 1-77.

Jewett-Smith, J., C. McMillan, W.J. Kenworthy, and K. Bird. 1997. Flowering and genetic banding patterns of *Halophila johnsonii* and conspecifics. Aquatic Botany 59 (1997) 323-331.

Keevin, T.M. and G.L. Hempen. 1997. The Environmental Effects of Underwater Explosions with Methods to Mitigate Impacts. U.S. Army Corps of Engineers; St. Louis District. https://www.denix.osd.mil/denix/Public/ES-Programs/Conservation/WaterX/water1.html#3

Keinath, J.A. 1993. Movements and behavior of wild and head-started sea turtles. Ph.D. Diss. College of William and Mary, Gloucester Point, VA., 206 pp.

Keinath, J.A; Musick, J. A.; Byles, R. A. 1987. Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia J. Sci.; 1987, v. 38, no. 2, p. 81

Kenworthy, W.J. 1999. Demography, Population Dynamics, and Genetic Variability of Natural and Transplanted Populations of *Halophila johnstoni*, a Threatened Seagrass. Annual Progress Report, July, 1999.

Kenworthy, W.J. 1997. An Updated Biological Status Review and Summary of the Proceedings of a Workshop to Review the Biological Status of the Seagrass, *Halophila johnstoni* Eiseman. Report submitted to the NMFS Office of Protected Resources, October 15, 1997. 24 pp.

Kenworthy, W.J. 1993. The distribution, abundance and ecology of Halophila johnstoni Eiseman in the lower Indian River, Florida. Final Report to the NMFS Office of Protected Resources, 72 pp.

Klima, E.F., G.R. Gitschlag, and M.L. Renaud. 1988. Impacts of the explosive removal of offshore petroleum platforms on sea turtles and dolphins. Marine Fisheries Review, 50(3) pp 33-42.

Klinger, R. C.; Musick, J. A. 1985. Age and growth of loggerhead turtles (Caretta caretta) from Chesapeake Bay. Copeia; 1995, v. 1995, no. 1, p. 204-209.

Konya, C. J. 2001. Recommendations for blasting at Port Everglades Harbor. Prepared for US Army Corps of Engineers, Jacksonville District. Precision Blasting Services. Montville, Ohio. 45 pp.

Last, P.R. and J.D. Stevens. 1994. Sharks and Rays of Australia. CSIRO Australia, East Melbourne, Australia, 513 p. + 84 pl.

Laurent, L.; P. Casale; M.N. Bradai; B.J. Godley; G. Gerosa, A.C. Broderick, W. Schroth, B. Schierwater, A.M. Levy, D. Freggii, E.M. Abd El-Mawla, D.A. Hadoud, H.E. Gomati, M. Domingo, M. Hadjichristophorou, L. Kornaraky, F. Demirayak, and Ch. Gautier. 1998. Molecular resolution of marine turtle stock composition in fishery bycatch: a case study in the Mediterranean. Molecular Ecol. 7:1529-1542.

Lenhardt, M. L.; Bellmund, S.; Byles, R. A.; Harkins, S. W.; Musick, J. A.1983. Marine Turtle Reception of bone-conducted sound. J.AUD RES.; 1983, 23(2): 119-126

Lenhardt, M. L.; Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (Caretta caretta). Bjorndal, K. A. ,Bolten, A. B. ,Johnson, D. A. ,Eliazar, P. J. Compilers, Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, 323 pp.; 1994, p. 238-241.

Lutcavage, M.; Musick, J. A. 1985. Aspects of the biology of sea turtles in Virginia. COPEIA; (1985), no. 2, pp. 449-456

Márquez-M., R. 1990. FAO Species Catalogue, Vol. 11. Sea Turtles of the World, An Annotated and Illustrated Catalogue of Sea Turtle Species Known to Date. FAO Fisheries Synopsis, 125(11): 81 pp.

Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the state of Florida. Fla. Mar. Res. Publ. 52:1-51.

Milton, S. L.; Leone-Kabler, S.; Schulman, A. A.; Lutz, P. L. 1994. Effects of Hurricane Andrew on the sea turtle nesting beaches of South Florida. Bulletin of Marine Science; v. 54, no. 3, p. 974-981.

Moein, S. E.; Lenhardt, M. L.; Barnard, D. E.; Keinath, J. A.; Musick, J. A. 1993. Marine turtle auditory behavior. Journal of the Acoustic Society of America; v. 93, 4 Pt.2, p. 2378.

Morreale, S.J., and E.A. Standora. 1998. Vying for the same resources: potential conflict along migratory corridors. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-415:69.

Musick, J.A. and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pp. 137-164 *In*: Lutz, P.L., and J.A. Musick, eds., The Biology of Sea Turtles. CRC Press, New York. 432 pp.

National Research Council (NRC). 1990. Decline of the Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation. Natl. Academy Press, Washington, D.C. 259 pp.

National Ocean Service. 2000. http://www.sanctuaries.nos.gov/natprogram/natprogram.html.

Nelson, J. S. 1994. Fishes of the World, 3rd edition. John Wiley & Sons, Inc. New York, New York. p. 58.

NMFS. 1991a. Recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD.

NMFS. 1991b. Recovery plan for the northern right whale (*Eubalaena glacialis*). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD.

NMFS. 1997. Endangered Species Act Section 7 Consultation on the Continued Hopper Dredging of Channels and Borrow Areas in the Southeastern United States. Biological Opinion. September 25.

NMFS. 1998. Endangered Species Act section 7 consultation on COE permits to Kerr-McGee Oil and Gas Corporation for explosive rig removals off of Plaquemines Parish, Louisiana. Draft Biological Opinion. September 22.

NMFS. 2000. Status Review of Smalltooth Sawfish (*Pristis pectinata*). December 2000.

NMFS. 2000a. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. Viewed at http://www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_Program/sars.html

NMFS 2000b. Biological Opinion to the Department of the Navy on the Shock Trail of the Winston Churchill (DDG 81). Issued May 17, 2000.

NMFS, 2002. Biological Opinion to the Department of the Navy for the Proposed Employment of Surveillance Towed Array Sonar System Low Frequency Active Sonar. Issued May 30, 2002.

NMFS Southeast Fisheries Science Center (SEFSC). 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, National Marine Fisheries Service, Miami, FL, SEFSC Contribution PRD-00/01-08; Parts I-III and Appendices I-V1.

NMFS and U.S. Fish and Wildlife Service (USFWS). 1991. Recovery plan for U.S. population of loggerhead turtle. National Marine Fisheries Service, Washington, D.C. 64 pp.

NMFS and USFWS. 1991a. Recovery Plan for U.S. Population of Atlantic Green Sea Turtle (*Chelonia mydas*). National Marine Fisheries Service, Washington, D.C. 52pp.

NMFS and USFWS. 1992. Recovery Plan for Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). National Marine Fisheries Service, Washington, D.C. 40pp.

NMFS and USFWS. 1992. Recovery Plan for Leatherback Sea Turtle (Dermochelys coriacea). National Marine Fisheries Service, Washington, D.C. 66pp.

NMFS and USFWS. 1993. Recovery Plan for Hawksbill Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico. National Marine Fisheries Service, Washington, D.C. 52pp.

NMFS and USFWS. 1995. Status Reviews for Sea Turtles Listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland.

Norrgard, J. 1995. Determination of stock composition and natal origin of a juvenile loggerhead sea turtle population (*Caretta caretta*) in Chesapeake Bay using mitochondrial DNA analysis. M.A. Thesis. College of WIlliam and Mary, Williamsburg, Va., 47pp.

O'Hara, J. and Wilcox, J. R. 1990. Avoidance responses of loggerhead turtles, *Caretta caretta*, to low frequency sound. Copeia; v. 1990, no. 2, p. 564-567

Peters, J.A. 1954. The amphibians and reptiles of the coast and coastal sierra of Michoacan, Mexico. Occ. Pap. Mus. Zool. 554:1-37.

Pritchard, P.C.H. 1997. Evolution, phylogeny and current status. Pp. 1-28 *In*: The Biology of Sea Turtles. Lutz, P., and J.A. Musick, eds. CRC Press, New York. 432 pp.

Rankin-Baransky, K.C. 1997. Origin of loggerhead turtles (*Caretta caretta*) in the western North Atlantic as determined by mt DNA analysis. M.S. Thesis, Drexel University, Philadelphia Pa.

Rebel, T.P. 1974. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico. Univ. Miami Press, Coral Gables, Florida.

Richardson, J.I., L.A. Corliss, C. Ryder, and R. Bell. 1989. Demographic patterns of Caribbean hawksbill, Jumby Bay, Antigua. Pages 253-256. *In*: S.A. Eckert, K.L. Rckert, and T.H. Richardson (compilers). Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFC-232. National Marine Fisheries Service; Miami, Florida.

Robins, C. R. and G. C. Ray. 1986. Atlantic Coast Fishes. Houghton Mifflin Company. Boston, Massachusettes. 354 pp.

Ross, J.P., and M.A. Barwani. 1982. Historical decline of loggerhead, ridley, and leatherback sea turtles. In K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles. Smithsonian Inst. Press, Washington, D.C. 583 pp.

Schroeder, B.A., A.M. Foley, B.E. Witherington, and A.E. Mosier. 1998. Ecology of marine turtles in Florida Bay: Population structure, distribution, and occurrence of fibropapilloma U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-415:265-267.

Sears, C.J. 1994. Preliminary genetic analysis of the population structure of Georgia loggerhead sea turtles. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-351:135-139.

Sears, C.J., B.W. Bowen, R.W. Chapman, S. B. Galloway, S.R. Hopkins-Murohy, and C.M. Woodley. 1995. Demographic composition of the feeding population of juvenile loggerhead sea turtles (*Caretta caretta*) off Charleston, South Carolina: Evidence from mitochondrial DNA markers. Mar. Biol. 123:869-874.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundance of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetol. Monogr. 6: 43-67.

Simpfendorfer, C. A. 2000(a). Predicting population recovery rates for endangered western Atlantic sawfishes using demographic analysis. Environmental Biology of Fishes 58:371-377

SAFMC 1998. Final Habitat Plan for the South Atlantic Region; Essential Fish Habitat Requirements for the Fishery Management Plans of the South Atlantic Fishery Management Council. Prepared by the South Atlantic Fishery Managmenet Council, October 1998. Available from: SAFMC, 1 Southpark Circle, Suite 306, Charleston, SC 29407.

Smith, K. and R. Mezich. 1999. Comprehensive Assessment of the Effects of Single Family Docks on Seagrass in Palm Beach, County, Florida. Draft Report for the FWC.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 1996. Worldwide Population Decline of *Demochelys coriacea*: Are Leatherback Turtles Going Extinct? Chelonian Conservation and Biology 2(2): 209-222.

Spotila, J.R., P.T. Plotkin, and J.A. Keinath. 1998. In water population survey of sea turtles of Delaware Bay. Unpublished Report. Final Report to NMFS Office of Protected Resources for work conducted under Contract No. 43AANF600211 and NMFWS Permit No. 1007 by Drexel University, Philadelphia, Penna., 21 pp.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Nature (405): 529-530.

Turtle Expert Working Group (TEWG). 1998. An assessment of the Kemp's ridley (*Lepicochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409. 96 pp.

Turtle Expert Working Group (TEWG). 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-444, 115 pp.

United States Army Corps of Engineers (USACE). 2000a. Analysis of Test Blast Results, Wilmington Harbor, NC (Appendix B). Preconstruction Modification of Authorized Improvements, Wilmington Harbor, NC. (February 2000). Wilmington District, Wilmington, North Carolina. 13 pp.

United States Army Corps of Engineers (USACE). 1989. Navigation Study for Miami Harbor Channel, Florida. Feasibility Report and Environmental Impact Statement – 10140. June 1989.

United States Department of the Navy. 1998. Final Environmental Impact Statement, Shock Testing the Seawolf Submarine. Department of the Navy (lead agency), National Marine Fisheries Service (cooperating agency).

Virnstein, R.W., L.J. Morris, J.D. Miller, and Robbyn Miller-Myers. 1997. Distribution and abundance of *Halophila johnsonii* in the Indian River Lagoon. St. Johns River Water Management District Tech Memo #24. November 1997. 14 pp.

Witzell, W.N. 1999. Distribution and relative abundance of sea turtles caught incidentally by the U.S. pelagic longline fleet in the western North Atlantic Ocean, 1992-1995. Fisheries Bulletin. 97:200-211.

Wynne, K. and M. Schwartz. 1999. Guide to marine mammals and turtles of the U.S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant, Narragansett. 115pp.

Zug, G.R., and J.F. Parham. 1996. Age and growth in leatherback turtles, *Dermochelys coriacea* (Testudines: Dermochelyidae): a skeletochronological analysis. Chel. Conserv. Biol. 2(2):244-249.

Planning Division
Environmental Branch

Mr. Larry Williams, Field Supervisor
South Florida Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

JUN 2 6 2012

Dear Mr. Williams:

Pursuant to Section 7(a) of the Endangered Species Act, please find enclosed the Biological Assessment for the Lake Worth Inlet widening and deepening, addressing the concerns of the Florida manatee (*Trichecus manatus*) which is under the purview of the U.S. Fish and Wildlife Service (FWS). Based on the enclosed Biological Assessment, the U.S. Army Corps of Engineers has determined that the proposed action may affect, not likely to adversely affect, the Florida manatee. The Corps also has determined that the proposed project will not adversely affect designated critical habitat for the Florida manatee. The Corps requests that the FWS concur with the determination regarding this species.

The USACE has determined that consultation of nesting sea turtles is covered under the Statewide Programmatic Biological Opinion (SPBO) and will not be discussed in the enclosed Biological Assessment. This letter also constitutes the notification required under the SPBO for placement of material on or near the shoreline as described on the enclosed form.

If you have any questions or need further information, please contact Mr. Pat Griffin at 904-232-2286, email Patrick.M.Griffin@usace.army.mil

Sincerely,

Kenneth R Quigley

Eric P. Summa
Chief, Environmental Branch

Enclosure

PROJECT INFORMATION SHEET
Programmatic Biological Opinion (PBO)
Beach Placement and Shore Protection
Coast of Florida
U.S. Fish and Wildlife Service (FWS)

Prepared by: Pat Griffin

Date: Jun 26, 2012

Project Name: Lake Worth Inlet Widening and Deepening

Project Number: 131356 Application #:

Sponsor / Applicant: Port of Palm Beach

Quantity, Length: total dredge quantites estimated at 1.4 million yards, 250 thousand will be beach quality and go on the beach already covered under the palm beach O&M project.

County(ies) Palm Beach Location, R-Monuments: R76-R79

Latitude: ° ' " Longitude: - ° ' "

Borrow or Dredge Site(s): Lake worth entrance channel and turning basin

Beach Placement from Navigation Dredging: ☐ O&M ☒ Deepen, Widen, or Expand

Beach Nourishment / Shore Protection Project: ☐ Initial Nourishment ☐ Renourishment

Nature of Activity: ☒ Beach Placement ☒ Beach Placement Below Mean Low Water

☐ Dune Placement / Planting ☒ Nearshore Placement (all material remains below mean low water)

☐ Sand Bypassing ☐ Sand Back-passing ☐ Sand Transfer ☐ Groin Repair/Replace

☐ Jetty Repair/Replace ☐ *Other (list in comment box)

Area with Sea Turtle Window: ☒ SE FL (Broward through Brevard Counties) ☐ Sarasota Co (Manasota Key)

☐ Gulf Co (St Joe Peninsula St Pk, St. Joe Peninsula, Cape San Blas) ☐ Franklin Co (St. George Is)

*Piping Plover Critical Habitat (below) ☒ *Other Piping Plover Habitat ☐ *30-day Coordination with FWS Still Pending

1.

2.

Beach Mouse Habitat (use drop-down box below): ☐ Other Beach Mouse Habitat (list in comment box)

☒ *Important Manatee Area ☐ *Beach Jacquemontia Habitat (including pipeline/access, storage/staging areas)

☐ *Roseate Tern Nesting Colony, May-June (Pelican Shoal, Vaca Rock, Truman Annex, Marathon Gov Center)

Responsible for Post Construction Monitoring and Corrective Measures:

Sponsor (condition of DEP or Corps Permit issued to Sponsor)

Comment (1) Piping plover other habitat. Within 1 mile of inlet with beach placement

Comment (2)

* These items may be outside the scope of the PBO and/or require additional coordination/consultation with FWS.

Biological Assessment to
U.S. Fish and Wildlife Service for
Lake Worth Inlet Widening and Deepening
Palm Beach County, Florida

Description of the Project Area – Palm Beach Harbor is on the Atlantic coast of Florida, approximately 53 miles south of Fort Pierce Harbor, and 71 miles north of Miami Harbor. The harbor entrance (also known as Lake Worth Inlet) is an artificial cut through the barrier beach and limestone formation connecting Lake Worth, a coastal lagoon, with the Atlantic Ocean. Communities bordering Palm Beach Harbor are Palm Beach Shores on the barrier beach to the north, Riviera Beach on the west shore of Lake Worth, and the town of Palm Beach to the south. West Palm Beach is located immediately south of Riviera Beach and is the largest community in the area. Lake Worth Inlet is a federally maintained inlet and deepwater port located on the Atlantic Ocean in Palm Beach County, Florida.

Lake Worth is an estuary that exhibits characteristics typical of estuarine systems in southeast Florida. Much of the beach and dune ecosystem in this vicinity has been altered by development. Structures such as seawalls and bulkheads have reduced a significant amount of the vegetation that would naturally occur here (Applied Technology and Management Inc. 1995).

The existing channel sediments in the Inlet are predominantly sand and shell and are subject to considerable shifting by wave and tidal action. Limestone rock outcrops are found on either side of the Federal channel at the interface between the Inlet channel and the Intracoastal Waterway (IWW). Littoral drift in the area is predominantly north to south. The mean tidal range is 2.8 feet and the spring tidal range is 3.3 feet. Shoaling continues to be a recurring problem in Palm Beach Harbor.

A sand transfer plant is located on the north jetty of the inlet. The sand transfer plant takes the sand that accumulates on the north jetty, slurries the material with sea water, and passes it under the inlet and to the beach south of the south jetty. Sand continues to accumulate at a rapid rate in this area. The areas to be dredged are located within the Federal project limits.

Action Area

The project proposes to widen and deepen Lake Worth Inlet navigation channel (Figure 1). The authorized project depths are as follows: entrance channel to a depth of 37 feet (from STA 30+00 to STA 47+00); from the inner channel to a depth of 33 feet; from the turning basin to a depth of 33 feet; and to a depth of 25 feet in the extended turning basin located north of the existing project basin. The existing settling basin and the extended settling basin are maintained at 35 feet and are located adjacent to the entrance channel and north jetty.

Deepening will occur within the entrance channel from the current 37 feet to 47 feet,

with depths within the turning basin increasing from 33 feet to 43 feet deep. Widening is needed in certain areas of the project for safe navigation of larger vessels. The entrance channel requires a flare to the south as prevailing currents cause navigation hazards entering the channel as currently configured. The flare starts at the south jetty and extends approximately 2500 feet to the southeast. Within the entrance channel, the northern channel wall would be widened by 60 feet from the north jetty to the beginning of the turn to the southwest. At the turn, the northern side of the channel would be widened 150 feet to ensure a 400 foot channel width throughout. The area at the southern edge of Peanut Island would be deepened to 43 feet. Finally, the southern edge of the turning basin would be widened 150 feet to the south.

Based on geotechnical boring data from the entrance channel and turning basin, sand and rock of varying hardness are expected to be encountered during widening and deepening. Sand, soft rock and rock fragments will be removed via traditional dredging methods. Where hard rock is encountered, the Corps anticipates that contractors could utilize other methods, including confined blasting or large cutterhead dredge equipment to pre-treat the rock prior to removal. Dredged material would be deposited at up to four locations. All beach quality sand material shall be placed on the existing beach disposal template just south of the inlet (figure 2). Sandy material not considered beach quality under the existing permit will be placed in the authorized nearshore placement site south of the inlet. Other rock/coarse materials would likely be placed in a previously dredged depression within Lake Worth as part of construction to create seagrass habitat as compensatory mitigation for seagrass impacts. Dredged rock and other materials that cannot be beneficially utilized for mitigation may be transported to the Ocean Dredged Materials Disposal Site (ODMDS) or placed in a permitted, upland disposal site on Peanut Island.

Figure 1: Current project and proposed changes in yellow

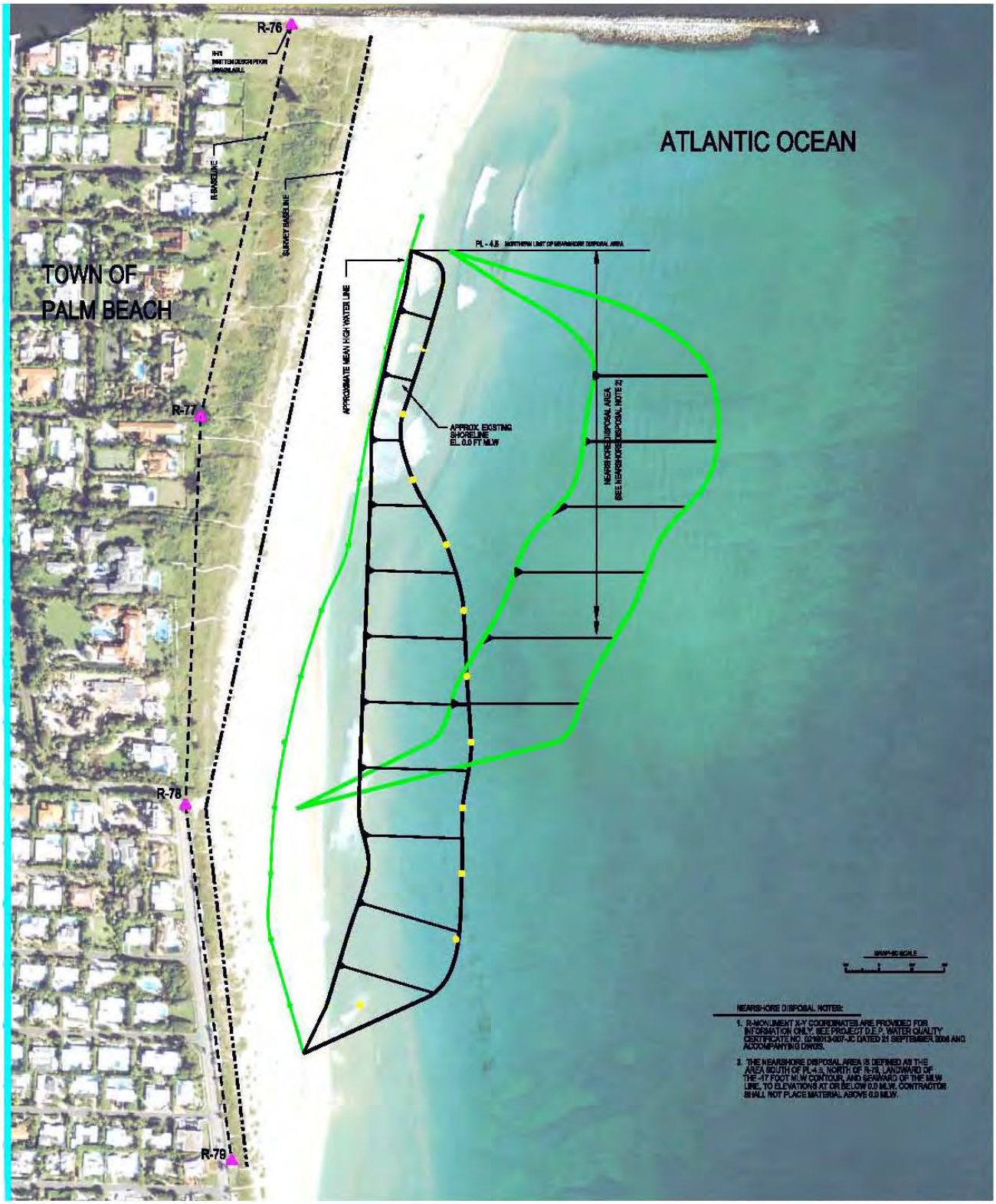


Figure 2. Beach placement site south of inlet

Protected Species Included in this Assessment

Of the listed and protected species under U.S. Fish and Wildlife Service (FWS) jurisdiction occurring in the action area, the Corps believes that the Florida manatee (*Trichecus manatus*) occurs with the project area. The USACE has determined that consultation of nesting sea turtles is covered under the Statewide Programmatic Biological Opinion (SPBO) and will not be discussed in this Biological Assessment.

The Federal government has recognized the threats to the continued existence of the Florida manatee, a subspecies of the West Indian manatee, for more than 30 years. The West Indian manatee was first listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (16 U.S.C. 668aa(c)) (32 FR 48:4001). The Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa(c)) continued to recognize the West Indian manatee as an endangered species (35 FR 16047), and the West Indian manatee was also among the original species listed as endangered pursuant to the Endangered Species Act of 1973. Critical habitat was designated for the manatee in 1976, and includes the project area (50 CFR 17.95). The justification for listing as endangered included impacts to the population from harvesting for flesh, oil, and skins as well as for sport, loss of coastal feeding grounds from siltation, and the volume of injuries and deaths resulting from collisions with the keels and propellers of powerboats. Manatees are also protected under the provisions of the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq*.) and have been protected by Florida law since 1892. Florida provided further protection in 1978 by passing the Florida Marine Sanctuary Act designating the state as a manatee sanctuary and providing signage and speed zones in Florida's waterways.

Species and Suitable Habitat Descriptions

Florida Manatee *(Trichecus manatus)*

All manatees belong to the order Sirenia. The living sirenians consist of one species of dugong and three species of manatee. A fifth species, the Steller's sea cow, was hunted to extinction by 1768. All living sirenians are found in warm tropical and subtropical waters. The West Indian manatee was once abundant throughout the tropical and subtropical western North and South Atlantic and Caribbean waters. The Florida manatee occurs throughout the southeastern United States. However, the only year-round populations of manatees occur throughout the coastal and inland waterways of peninsular Florida and Georgia (Hartman, 1974). During the summer months, manatees may range as far north along the East Coast of the U.S. as Rhode Island, west to Texas, and, rarely, east to the Bahamas (FWS, 1996, Lefebvre et al., 1989). There are reports of occasional manatee sightings from Louisiana, southeastern Texas, and the Rio Grande River mouth (Gunter, 1941, Lowery,1974).

Preferred Habitats

Manatees occur in fresh, brackish, and salt water and move freely between environments of salinity extremes. They inhabit rivers, bays, canals, estuaries, and coastal areas that provide seagrasses and macroalgae. Freshwater sources, either natural or human-influenced/created, are especially important for manatees that spend

time in estuarine and brackish waters (FWS, 1996). Because they prefer water above 70 ºF (21 ºC), they depend on areas with access to natural springs or water effluents warmed by human activities, particularly in areas outside their native range.

Manatees often seek out quiet areas in canals, lagoons or rivers. These areas provide habitat not only for feeding, but also for resting, cavorting, mating, and calving. Manatees may be found in any waterway over 3.3 ft. (1 m) deep and connected to the coast. Deeper inshore channels and nearshore zones are often used as migratory routes (Kinnaird, 1983). Although there are reports of manatees in locations as far offshore as the Dry Tortugas Islands, approximately 50 mi. (81 km) west of Key West, Florida, manatees rarely venture into deep ocean waters.

Habits

Manatees use secluded canals, creeks, embayments, and lagoons for resting, cavorting, mating, calving and nurturing their young; and open waterways and channels as travel corridors. Within marine, estuarine, and freshwater habitats they are found in turbid and clear water in depths of at least 3 ft. In coastal areas, they tend to travel in water up to 20 ft deep. Manatees occupy different habitats during various times of the year, with a focus on warm-water sites during winter.

Florida manatees are herbivores that feed opportunistically on a wide variety of submerged, floating and emergent vegetation. Shallow grass beds with ready access to deep channels are the preferred feeding areas in coastal and riverine habitats. A complete review of manatee biology is included in the manatee section of the South Florida Multi-species Recovery Plan (FWS, 1999).

In general, manatees feed primarily on freshwater plants, submerged sea grasses, and plants along shorelines.

Migration Patterns

The overall geographic distribution of manatees within Florida has changed since the 1950s and 60s (Lefebvre et al., 1989), and prominent shifts in seasonal distribution are also evident. Specifically, the introduction of power plants and paper mills in Texas, Louisiana, southern Georgia, and northern Florida has given manatees the opportunity to expand their winter range to areas not previously frequented (Hartman, 1979). Florida manatees move into warmer waters when the water temperature drops below about 68 ºF (20 ºC). Before warm effluents from power plants became available in the early 1950s, the winter range of the manatee in Florida was most likely limited on its northern bounds by the Sebastian River on the east coast and Charlotte Harbor on the west coast (Moore, 1951). Since that time, manatees altered their normal migration patterns, and appreciable numbers of manatees began aggregating at new sites. As new power plants became operational, more and more manatees began taking advantage of the sites even though it required traveling great distances. Among the most important of the warm-water discharges are the Florida Power and Light Company's power plants at Cape Canaveral, Fort Lauderdale, Port Everglades, Riviera Beach, and Fort Myers, and the Tampa Electric Company's Apollo Beach power plant in Tampa Bay. During cold

weather, more than 200 manatees have been reported at some power plants. These anthropogenically heated aquatic habitats have allowed manatees to remain north of their historic wintering grounds. Although seemingly conducive for survival, warm-water industrial discharges alone cannot furnish suitable habitats for manatees, as they may not be associated with forage that is typically found near natural warm-water refugia of natural springs.

Population Trends

Determining exact population estimates or trends is difficult for this species. The best indicator of population trends is derived from mortality data and aerial surveys (Ackerman et al., 1992, Ackerman et al., 1995, Lefebvre et al., 1995). Increases in the number of recovered dead manatees have been interpreted as evidence of increasing mortality rates (Ackerman et al., 1992, Ackerman et al., 1995). Because manatees have low reproductive rates, these increases in mortality may lead to a decline in the population (O'Shea et al., 1992 and Beeler and O'Shea, 1988). Aerial surveys, which represent the minimum number of manatees in Florida waters (not the total population size), have been conducted for more than 20 years, and may indicate population growth. However, because survey methods were inconsistent, conclusions are tentative. O'Shea (1988) found no firm evidence of a decrease or increase between the 1970s and 1980s, even though aerial survey counts increased. Over the last decade, aerial counts have varied from 1,267 (in 1991) to 3,807 (in 2012) (FMRI, 2012). The mean number observed during all counts (January, February, and/or March of all years since 1991 except 2008) is 2,332 (std dev = 672).

Boat traffic and development are the main causes for decline in the population. Other causes of injury or death include ingestion of debris, entanglement in fishing gear, cold stress, red tide, and entrapment or crushing in water control structures and navigational locks (USFWS, 2001). Even though manatees are vulnerable in their current environment, recent surveys have shown increases in three of the four population stocks. A 5-year review prepared by USFWS concluded that the manatee no longer fits the ESA definition of endangered and made a recommendation to reclassify it as threatened (USFWS, 2007).

Mortality

Human activities have likely affected manatees by eliminating or modifying suitable habitat; causing alteration of, or limiting access to historic migratory routes; and killing or injuring individuals through incidental or negligent activities. To understand manatee mortality trends in Florida, Ackerman et al. (1995) evaluated the number of recovered carcasses between 1974 and 1992 and categorized the causes of death. The number of manatees killed in collisions with watercraft increased each year by 9.3%. The number of manatees killed in collisions with watercraft each year correlated with the total number of pleasure and commercial watercraft registered in Florida (Ackerman et al., 1995). Other deaths or injuries were incurred due to flood-control structures and navigational locks, entanglement in fishing line, entrapment in culverts, and poaching, which together accounted for 162 known mortalities between 1974 and 1993 (FMRI, 2002a).

Table 1: Manatee deaths in Florida (statewide) from 1974 through 2011(source: FMRI)

Year	Water-craft	Flood Gate / Canal Lock	Other Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
1974	3	0	2	0	0	0	2	0	7
1975	6	1	1	7	0	1	10	3	29
1976	10	4	0	14	0	2	22	10	62
1977	13	6	5	9	0	1	64	16	114
1978	21	9	1	10	0	3	34	6	84
1979	24	8	9	9	0	4	18	5	77
1980	16	8	2	13	0	5	15	4	63
1981	24	2	4	13	0	9	62	2	116
1982	20	3	1	14	0	41	29	6	114
1983	15	7	5	18	0	6	28	2	81
1984	34	3	1	25	0	24	40	1	128
1985	33	3	3	23	0	19	32	6	119
1986	33	3	1	27	12	1	39	6	122
1987	39	5	2	30	6	10	22	0	114
1988	43	7	4	30	9	15	23	2	133
1989	50	3	5	38	14	18	39	1	168
1990	47	3	4	44	46	21	40	1	206

1991	53	9	6	53	1	13	39	0	174
1992	38	5	6	48	0	20	45	1	163
1993	35	5	6	39	2	22	34	2	145
1994	49	16	5	46	4	33	37	3	193
1995	42	8	5	56	0	35	53	2	201
1996	60	10	0	61	17	101	154	12	415
1997	54	8	8	61	4	42	61	4	242
1998	66	9	6	53	9	12	72	4	231
1999	82	15	8	53	5	37	69	0	269
2000	78	8	8	58	14	37	62	8	273
2001	81	1	7	61	32	33	108	2	325
2002	95	5	9	53	17	59	65	2	305
2003	73	3	7	71	47	102	67	10	380
2004	69	3	4	72	50	24	51	3	276
2005	79	6	8	89	31	89	90	4	396
2006	92	3	6	70	22	81	116	27	417
2007	73	2	5	59	18	82	66	12	317
2008	90	3	6	101	25	33	72	7	337
2009	97	5	7	114	56	37	103	10	429
2010	83	1	5	97	282	23	208	67	756
2011	87	2	3	77	113	41	116	14	453

Of interest is the increase in the number of perinatal deaths. The frequency of perinatal deaths (stillborn and newborn calves) has been consistently high over the past several

years. The cause of the increase in perinatal deaths is uncertain, but may result from a combination of factors that includes pollution, disease, or environmental change (Marine Mammal Commission, 1992). It may also result from the increase in collisions between manatees and watercraft because some newborn calves may die when their mothers are killed or seriously injured by boat collisions, when they become separated from their mothers while dodging boat traffic, or when stress from vessel noise or traffic induces premature births (Marine Mammal Commission, 1992).

The greatest present threat to manatees is the high rate of manatee mortalities caused by watercraft collisions. Between 1974 and 1997, there were 3,270 known manatee mortalities in Florida. Of these, 749 were watercraft-related. Since 1974, an average of 31 manatees have died from watercraft-related injuries each year. Between 1983 and 1993, manatee mortalities resulting from collisions with watercraft reached record levels (DEP, 1994). Between 1986 and 1992, watercraft collisions accounted for 37.3% of all manatee deaths where the cause of death could be determined (Ackerman *et al.,* 1995).

The significance of manatee mortalities related to watercraft appears to be the result of dramatic increases in vessel traffic (O'Shea *et al*., 1985). Ackerman *et al.* (1995) showed a strong correlation between the increase in recorded manatee mortality and increasing boat registrations. In 1960, there were approximately 100,000 registered boats in Florida; by 1990, there were more than 700,000 registered vessels in Florida (Marine Mammal Commission, 1992, Wright *et al.*, 1995). Approximately 97 percent of these boats are registered for recreational use. The most abundant number of registered boats is in the 16-foot to 26-foot size class. Watercraft-related mortalities were most significant in the southwest and northeast regions of Florida; deaths from watercraft increased from 11 to 25 percent in southwestern Florida. In all of the counties that had high watercraft-related manatee deaths, high numbers of watercraft were combined with high seasonal abundance of manatees (Ackerman *et al.*, 1995).

Approximately twice as many manatees died from impacts suffered during collisions with watercraft than from propeller cuts; this has been a consistent trend over the last several years. Medium or large-sized boats cause most lethal propeller wounds, while impact injuries are caused by fast, small to medium-sized boats (Wright *et al.*, 1992). The Florida Marine Research Institute (FMRI) conducts carcass recovery and necropsy activities throughout the state to attempt to assess the cause of death for each carcass recovered.

Designated Critical Habitat for Species Included in this Assessment

Florida Manatee *(Trichecus manatus)*

Critical habitat is defined under the ESA as specific areas within and/or outside a geographical area that are occupied by a species at the time of listing, that contain physical or biological features essential to the conservation of the species and therefore require special management considerations or protection for the benefit of the species. Critical habitat was designated for the manatee in 1976 (50 Code of Federal Regulations [CFR] Part 17.95(a)). It encompasses the all of Lake Worth and includes the action area. Although no specific primary constituent elements (PCEs) were

included in the initial critical habitat designation, requirements of the habitat to sustain essential life history functions of manatees can be derived from current literature (USFWS, 2007) which likely include the following:

1. shallow, secluded water areas for resting, mating, and calving (i.e., canals, creeks, lagoons);
2. submerged, emergent, and floating vegetation for foraging;
3. freshwater source for drinking (natural or artificial sources); and
4. unobstructed transiting corridors to warm-water refugia due to manatees' sensitivity to low water temperatures.

Several of these elements are present within Lake Worth and the project area. Resting, mating, and calving are less likely to occur within the deeper federal navigation channel outside of the channel and turning basin than secluded shallower waters located further North and South of the project area. They are more likely to use the shallow edges of the navigation channel as a travel corridor to a freshwater drinking source. There are currently no obstructions within the federal navigation channel, allowing unobstructed transit for the manatees to warm water refuges near the Florida Power and Light Riviera plant.

<u>Project Area Specific Information for Species Included in this Assessment</u>
Florida Manatee *(Trichecus manatus)*

Local Distribution and Status
Manatees are found in marine, brackish and freshwater habitats, including throughout Palm Beach County (PBC), Florida. They can be found along the beaches as well throughout the lagoons and the various natural and man-made waterways of the County (Figure 1). In PBC where the water is relatively clear and shallow, aerial surveys of marine species combined with observations of environmental changes and anthropogenic activities can be particularly effective for evaluating resources and identifying potential or existing threats (PBC 2011). Aerial surveys are flown monthly throughout the year as part of the Palm Beach County Manatee Protection Plan.

In a 2010-11 aerial surveys by Florida Power and Light (FPL), manatees were sighted in Lake Worth on both surveys, with the highest count (554) occurring on 16 December. Calves represented 5.2% of the sightings. The mean count per survey was 449 manatees. Survey conditions were generally excellent in the vicinity of FPL warm water outfall, although visibility elsewhere in Lake Worth was sometimes only good. In 2009, the plant was placed in long-term reserve shutdown, as plans to modernize the plant were promulgated. During the plant shut-down a massive water heater was installed by FPL to ensure that warm water was provided for manatees. The heater discharged warm water when ambient water temperatures dropped to less than 61 degrees F; the location of that discharge was the same as in past years when the plant operated, namely in the so-called "manatee embayment" at the old Units 1 and 2 discharge site. This situation re-occurred in winter 2010-2011, as the power plant will soon be

modernized to a more energy-efficient plant, called the Riviera Beach Energy Center (RBEC).

Most manatees observed were located near, but not inside the manatee embayment at the warm water outfall. Individuals were scattered around Lake Worth, especially lining the western shore to the south of the plant. Most manatees at PRV bottom rested, although some fed in the nearby grass beds. A few animals occupied deep-water slips in the Port of Palm Beach. Sea grass distribution and density continue to appear to be sparse around Peanut Island, located just north of the outfall.

Local Mortality

Manatees are subjected to a variety of threats, both natural and human-related. In Florida, there has been a clear increase in the number of manatee deaths over the last quarter-century. Palm Beach County ranks 10th among the 13 key counties, accounting for approximately 3.7 percent of the total State mortality from all causes between 1974 and 2003. The largest single cause (39%) of documented mortality in the County results from collisions with watercraft. Palm Beach County ranks 6th among the 13 key counties in the number of documented watercraft-related mortalities. Manatees are most likely to be struck by boats in areas where there is an overlap between high levels of manatee abundance and boat traffic. Watercraft-related mortalities were highest in the north Lake Worth Lagoon, Jupiter Sound, and the section of Intracoastal Waterway between Delray Beach and Boca Raton. Not surprisingly, 55 percent of all watercraft-related mortalities occurred during January and February, a period of peak manatee abundance. Although watercraft-related mortality has increased within the County since the posting of regulatory speed zones in 1991, the percent of watercraft-related mortality compared to total mortality has remained relatively stable.

Table 2: Manatee deaths in Palm Beach County from 1976 through Oct 31, 2011 (source: FMRI)

Year	Water-craft	Human, Other	Perinatal	Cold stress	Natural	Undetermined	Unrecovered	Total
1976	1	0	0	0	0	0	0	1
1977	4	0	0	0	0	1	2	7
1978	1	0	1	1	0	0	0	3
1979	1	0	1	0	0	1	0	3
1980	0	0	0	0	0	0	0	0
1981	1	0	0	0	0	2	0	3
1982	0	0	1	0	0	1	0	2
1983	2	0	0	0	0	1	0	3
1984	2	0	0	0	1	2	0	5
1985	3	0	0	0	0	0	0	3
1986	1	0	0	2	0	0	3	6
1987	1	0	1	0	1	0	0	3

1988	2	0	1	0	1	0	0	4
1989	0	0	1	0	0	0	0	1
1990	3	0	0	0	1	2	0	6
1991	1	1	0	0	1	3	0	6
1992	0	0	1	0	2	0	0	3
1993	3	1	0	0	1	0	0	5
1994	2	0	1	0	0	0	0	3
1995	2	0	0	0	3	1	0	6
1996	3	0	0	0	2	2	0	7
1997	1	2	1	0	2	0	0	6
1998	2	0	1	0	1	1	0	5
1999	2	2	1	0	1	1	0	7
2000	3	0	2	2	1	1	0	9
2001	3	0	0	0	1	2	0	8
2002	6	0	3	1	1	2	0	13
2003	5	0	2	2	0	3	0	12
2004	3	1	0	2	1	2	0	9
2005	6	0	1	1	0	0	0	8
2006	0	0	1	1	1	4	0	7
2007	0	0	0	2	1	1	0	4
2008	6	0	0	2	0	0	0	8
2009	4	1	1	3	1	6	0	16
2010	2	0	2	6	1	6	1	18
2011	3	0	0	5	0	3	0	11
Totals	79	8	31	30	25	48	6	227

Direct Effects

As previously stated, during winter months a large population of manatees uses the warm water refuge at the FP&L Riviera Power Plant and shallow areas throughout Lake Worth.

The highest potential to directly affect endangered manatees may be the use of explosives to remove areas of rock within the Entrance Channel and Southport Access Channel. Both the pressure and noise associated with blasting can injure marine mammals. Noise and pressure effects to manatees have not been well documented, however, it is assumed that manatees will be impacted similar to dolphins, where documentation is available.

The other highest potential to directly affect manatees would be the use of clamshell dredges. While no documentation is available to substantiate the higher potential

impacts, the Corps has agreed to no night time clamshell dredging to further reduce the chance to impact manatees.

Protective Measures Taken in the Project Area as Part of the Proposed Action

Consideration of Plans and Methods to Minimize/Avoid Environmental Impacts. Conservation measures were a major focus during the plan formulation phase for the proposed project. Avoiding and minimizing some potential impact areas significantly decreased the risk of indirect effects on managed and protected species, and a great deal of consideration was given to the utilization of rock removal methods to decrease the likelihood of incidental take, injury, and behavioral modification of protected species. It was determined that rock removal options not involving blasting were possibly more detrimental to populations and individuals of protected species. One alternative option was the use of a punchbarge/piledriver to break rock. However, it was determined that the punchbarge, which would work for 12-hour periods, strikes the rock approximately once every 60-seconds. This constant pounding would serve to disrupt animal behavior in the area, and result in adverse effects on the mission. Using the punchbarge would also extend the length of the project, thus increasing any potential impacts to all fish and wildlife resources in the area. The Corps believes that if rock exists that needs to be pre-treated prior to excavation, blasting is actually the least environmentally impactful method for removing the rock. Each blast will last no longer than five (5) seconds in duration, and may even be as short as 2 seconds each. Additionally, the blasts are confined in the rock/ substrate. Boreholes are drilled into the rock below, the blasting charge is set, and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects is reduced as compared to an unconfined blast (see discussion below).

Development of Protective Measures. The proposed project includes measures to conserve and protect Florida manatees. Foremost among the measures are protective actions to ensure that manatees are not killed if in fact such methods are required as a part of the overall dredging operation. Development of the measures involved consideration of past practices and operations, anecdotal observations, and the most current scientific data. The discussion below summarizes the development of the conservation measures.

Standard Manatee Conditions:

The Corps will incorporate the standard manatee protection construction conditions into our plans and specifications for this project. These standard conditions are:

1. The contractor instructs all personnel associated with the project of the potential presence of manatees and the need to avoid collisions with manatees. All construction personnel are responsible for observing water-related activities for the presence of manatee(s), and shall implement appropriate precautions to ensure protection of the manatee(s).

2. All construction personnel are advised that there are civil and criminal penalties for

harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act. The permittee and/or contractor may be held responsible for any manatee harmed, harassed, or killed as a result of construction activities.

3. Prior to commencement of construction, the prime contractor involved in the construction activities shall construct and display at least two temporary signs (placard) concerning manatees. For all vessels, a temporary sign (at least 8 1/2" x 11") reading "Manatee Habitat/Idle Speed In Construction Area" will be placed in a prominent location visible to employees operating the vessels. A second temporary sign (at least 8 1/2" x 11") reading "Warning, Manatee Habitat: Operation of any equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment. Any collision with and/or injury to a manatee shall be reported immediately to the Florida Marine Patrol at 1-800-DIAL-FMP" will be located prominently adjacent to the displayed issued construction permit. Temporary notices are to be removed by the permittee upon completion of construction.

4. All vessels associated with the project operate at "idle speed/no wake" at all times while in the construction area and while in waters where the draft of the vessel provides less than a four foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

5. If manatees are seen within 100 yards of the active daily construction/dredging operation, all appropriate precautions shall be implemented to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet of a manatee. Operation of any equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment.

6. Any collision with and/or injury to a manatee shall be reported immediately to the Florida Marine Patrol (1-800-DIALFMP) and to the Florida Department of Protection, Office of Protected Species Management at (904)922-4330.

7. The contractor maintains a log detailing sightings, collisions, or injuries to manatees should they occur during the contract period. A report summarizing incidents and sightings shall be submitted to the Florida Department of Protection, Office of Protected Species Management, Mail Station 245, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399 and to the U.S. Fish and Wildlife Service, 3100 University Boulevard, Jacksonville, FL 32216. This report must be submitted annually or following the completion of the project if the contract period is less than a year.

Confined Blasting

To achieve the widening and deepening of Lake Worth Inlet from the existing depth of -35 feet to project depth of -43 feet, pretreatment of some of the rock areas may be required. The use of confined underwater blasting as a pre-treatment technique is

anticipated to be required for some of the deepening and widening of the authorized Federal project, where standard construction methods are unsuccessful due to the hardness of the rock. The following analysis of potential blasting needs for the current project performed by the USACE Engineering Division staff is based on evaluations of core boring logs.

Methods

The focus of the proposed blasting work at Lake Worth is to pre-treat bedrock prior to removal by a dredge utilizing confined blasting, meaning the shots would be "confined" in the rock. In confined blasting, each charge is placed in a hole drilled in the rock approximately 5-10 feet deep below the desired depth (see Figure 4) depending on how much rock needs to be broken and the intended project depth. The hole is then capped with an inert material, such as crushed rock (Figure 5; each bag as shown contains approximate volume of material used per discharge). This process is referred to as "stemming the hole." The blasting charge is set and then the chain of explosives within the rock is detonated.

For the Port of Miami Phase II expansion in 2005, which used blasting as a pre-treatment technique, the stemming material was angular crushed rock. The optimum size of stemming material is material that has an average diameter of approximately 0.05 times the diameter of the blast hole. Material must be angular to perform properly (Konya 2003). For the USACE project, project-specific specification will be prepared by the geotechnical branch of the District. In the Miami Harbor Phase II project, the following requirements were in the specifications regarding stemming material:

> "*Stemming.* All blast holes shall be stemmed. The Blaster or Blasting Specialist shall determine the thickness of stemming using blasting industry conventional stemming calculation. The minimum stemming shall be 2 feet thick. Stemming shall be placed in the blast hole in a zone encompassed by competent rock. Measures shall be taken to prevent bridging of explosive materials and stemming within the hole. Stemming shall be clean, angular to subangular, hard stone chips without fines having an approximate diameter of 1/2-inch to 3/8-inch. A barrier shall be placed between the stemming and explosive product, if necessary, to prevent the stemming from settling into the explosive product. Anything contradicting the effectiveness of stemming shall not extend through the stemming."

It is expected that the specifications for any construction utilizing blasting at Lake Worth would have similar stemming requirements as those that were used for the Miami Harbor Phase II project. The length of stemming material will vary based on the length of the hole drilled, however minimum lengths will be included in the project specific specifications. Studies have shown that stemmed blasts have up to a 60-90% decrease in the strength of the pressure wave released, compared to open water blasts of the same charge weight (Nedwell and Thandavamoorthy, 1992; Hempen *et al*. 2005;

Hempen *et al*. 2007). However, unlike open-water, i.e., unconfined blasts (Figure 6), very little peer-reviewed research exists on the effects that confined blasting can have on marine animals near the blast (Keevin *et al*. 1999). The visual evidence from a typical confined blast is shown in Figure 7.

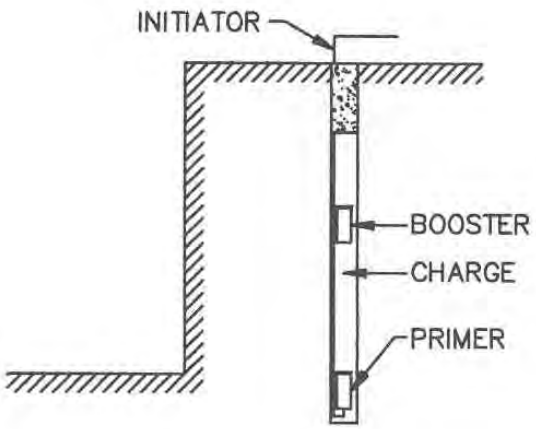


Figure 4 Typical Stemmed Hole for Loading Charges

Figure 5 Stemming Material

Figure 6 <u>Unconfined</u> Blast of <u>Seven</u> Pounds of Explosives

Figure 7 <u>Confined</u> Blast of <u>3,000</u> Pounds of Explosives

To estimate the maximum poundage of explosives that may be utilized for this project, USACE has reviewed previous blasting projects, one at San Juan Harbor, Puerto Rico in 1994 and one at Miami Harbor in 2005. The San Juan Harbor project's heaviest delay was 375 lbs per delay and in Miami it was 376 lbs per delay. Based on discussions with USACE's geotechnical engineers, it is expected that the maximum weight of delays for Lake Worth will be larger since the rock is much harder than what is seen at the Port of Miami. It is unknown at this time what the maximum delay weight will be for Lake Worth. This will be determined during the test blast program.

Minimization of Confined Blasting Impacts to Manatees

Blast specifications. Although the rock at Lake Worth is believed to be softer than Miami or San Juan Harbors, as noted above, USACE biologists, working with senior geologists, concluded that the assumptions set forth concerning minimization of the effects of blasting are applicable and accurate for the Lake Worth project. To that effect, based upon industry standards and USACE Safety & Health Regulations, the blasting program may consist of the following:

1) The weight of explosives to be used in each blast will be limited to the lowest poundage of explosives that can adequately break the rock.
2) Drill patterns are restricted to a minimum of 8-foot separation from a loaded hole.
3) Hours of blasting are restricted from two hours after sunrise to one hour before sunset to allow for adequate observation of the project area for protected species.
4) Selection of explosive products and their practical application method must address vibration and air blast (overpressure) control for protection of existing structures and marine wildlife.
5) Loaded blast holes will be individually delayed to reduce the maximum pounds per delay at point detonation, which in turn will reduce the mortality radius.
6) The blast design will consider matching the energy in the "work effort" of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock.
7) Delay timing adjustments to a minimum of 8 ms between delay detonations to stagger the blast pressures and prevent cumulative addition of pressures in the water.

Safety radii. Furthermore, the confined blasting program will incorporate the use of three safety radii (Figure 8) typically utilized for projects involving unconfined blasts. This conservative use of an *unconfined* blast in development of the safety radii for a *confined* blast will increase the protections afforded marine species in the area. These three zones are referred to as the "Danger zone" – which is the inner most zone, located closest to the blast; the "Safety zone" – which is the middle zone and the "Watch zone"

the outer most zone.

The danger zone radius will be calculated to determine the maximum distance from the blast at which mortality to protected marine species is likely to occur. The danger zone was determined by the amount of explosives used within each delay (which can contain multiple boreholes). These calculations are based on impacts to terrestrial animals in water when exposed to a detonation suspended in the water column (unconfined blast) as researched by the U.S. Navy in the 1970s (Yelverton *et al*. 1973; Richmond *et al.* 1973) as well as observations of sea turtle injury and mortality associated with unconfined blasts for the cutting of oil rig structures in the Gulf of Mexico (Young 1991; Young and O'Keefe 1994). The reduction of impact by confining the shots would more than compensate for the presumed higher sensitivity of marine species. USACE believes that the danger zone radius, coupled with a strong protected species observation and protection plan is a conservative, but prudent, approach to the protection of marine wildlife species. Based on a review by NMFS-OPR for the Miami Harbor phase II project, NMFS and FWS found these protective measures sufficient to protect marine mammals under their respective jurisdictions (NMFS 2005; FWS 2002).

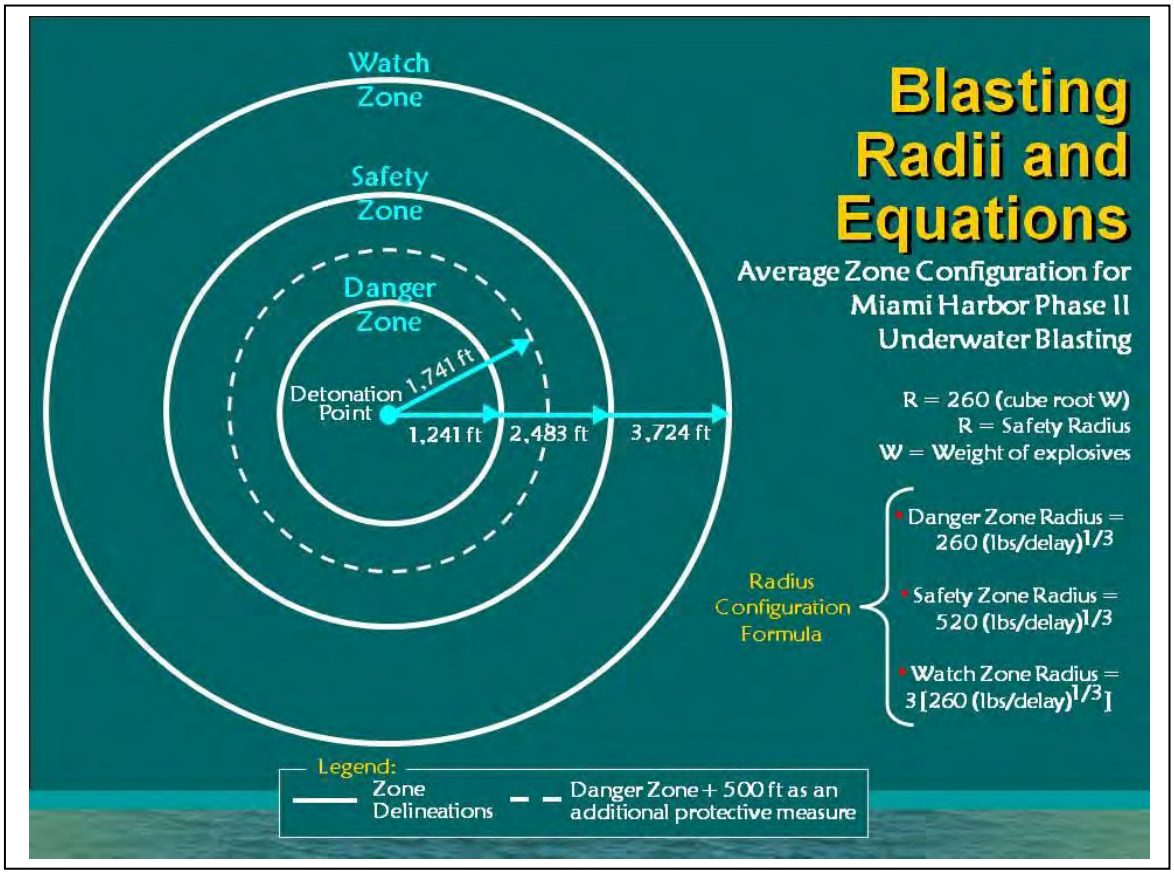


Figure 8 Blast Zone Radii and Equations

These zone calculations will be included as part of the specifications package that the contractors will bid on before the project is awarded. Ideally the safety radius should be large enough to offer a wide buffer of protection for marine animals while still remaining small enough that the area can be intensely surveyed.

Radii specifications are as follows:

1) Danger Zone (NMFS refers to this as the Caution Zone): The radius in feet from the detonation beyond which no expected mortality or injury from an open water explosion is likely to occur (NMFS 2005). The danger zone (ft) = 260 [79.25 m] X the cube root of weight of explosives in lbs per delay (equivalent weight of TNT).

2) The Safety Zone is the approximate distance in feet beyond which injury (Level A harassment as defined in the MMPA) is unlikely to occur from an open water explosion (NMFS 2005). The safety zone (ft) = 520 [158.50 m] X cube root of weight of explosives in lbs per delay (equivalent weight of TNT).

3) The Watch Zone is three times the radius of the Danger Zone to ensure that animals entering to traveling close to the Exclusion Zone are spotted and appropriate actions can be implemented before or as they enter any impact areas (i.e., a delay in blasting activities).

4) Exclusion Zone extends to 500 feet outside the Danger Zone radius. Detonation will not occur if a marine mammal or reptile may be within that zone (based on observational data).

Because of the potential duration of the blasting and the proximity of the inshore blasting to a seasonal manatee high use area (Lake Worth FPL discharge canal), a number of issues will need to be addressed. Due to the likelihood of a large number of manatees in the area during the winter months, USACE has agreed as part of the ESA consultation with USFWS not to blast between November 15 and March 15 of each year. Other dredging and construction activities may take place inside the Port during this period of time, but blasting will not be utilized during this period.

It is crucial to balance the demands of the blasting operations with the overall safety of protected species in the project area. A radius that is excessively large will result in significant delays that prolong the blasting, construction, traffic and overall disturbance to the area. A radius that is too small puts the animals at too great of a risk should one go undetected by the observers and move into the blast area. Because of these factors, the goal is to establish the smallest radius possible without compromising animal safety and provide adequate observer coverage for whatever radius is agreed upon.

Monitoring/watch plan. A watch plan will be formulated based on the required monitoring radii and optimal observation locations. The watch plan will be consistent

with the program that was utilized successfully at Miami Harbor in 2005 and will consist of at least five observers including at least one (1) aerial observer, two (2) boat-based observers, and two (2) observers stationed on the drill barge (Figures 9,10,11,12). The 6th observer will be placed in the most optimal observation location (boat, barge or aircraft) on a day-by-day basis depending on the location of the blast and the placement of dredging equipment. This process will insure complete coverage of the three zones as well as any critical areas. The watch will begin at least one-hour prior to each blast and continue for one-half hour after each blast (Jordan *et al*. 2007).

Specific flight and observing plans will be coordinated with the FAA and Palm Beach County Aviation Department to determine if aerial overflights are authorized throughout the entire project. If any conflicts develop that would prevent overflights of specific areas of the project that have been determined to require blasting, alternative monitoring methodologies will be investigated and coordinated with the resource agencies with jurisdiction for those issues.

Figure 9 Typical observer helicopter

Figure 10 View of typical altitude of aerial observer operations

Figure 11 Typical vessel for boat-based observer

Figure 12 Observer on Drill Barge

Vibration and Pressure Monitoring

Vibration. In an urban environment such as the Port, which is surrounded by commercial properties, utilities, and residential communities, protection of structures must be considered. Once the areas of the project requiring blasting have been identified, critical structures within the blast zones would be determined. Where vibration damage may occur, energy ratios and peak particle velocities shall be limited in accordance with state or county requirements, whichever is more stringent. Furthermore, vibration-monitoring devices will be installed to ensure that established vibration limits are not exceeded. If the energy ratio or peak particle velocity limits are exceeded, blasting will be stopped until the probable cause has been determined and corrective measures taken. Critical monitoring locations may include structures such as bulkheads, hazardous materials storage areas, and buried utilities.

Ground-borne vibration can be generated by a number of sources, including road and railways, construction activities such as piling, blasting and tunneling. Vibration can be defined as regularly repeated movement of a physical object about a fixed point. The parameter normally used to assess the ground vibration is the peak particle velocity (PPV) expressed in millimeters per second (mm/s). In order to completely define ground vibration, the amplitude and frequency of the motion are measured in the three orthogonal directions generally in terms of velocity which is considered to be the best descriptor for assessing human comfort and the potential damage response of structures. The vibration velocity signals are summed (in real time) and the maximum

amplitude of this vector sum is defined as the Peak Vector Sum (PVS). Vibration can cause varying degrees of damage in buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance or annoyance or, at higher levels, to affect a person's ability to work.

USACE reviewed data from the two most recent blasting projects completed by the district: the deepening of San Juan Harbor in 2000 and of Miami Harbor in 2005. Both used confined underwater blasting. Both projects had significant structural resources located near the blast that were of concern (the San Juan site included the National Park Service's Castillo San Felipe del Morro**,** a 400+ year old fortress overlooking the harbor and 30 additional historic sites within boundaries of the National Monument). In Miami, the harbor is bounded on the north by the port facilities and on the south by Fisher Island, a residential island. In both cases, a network of monitoring locations was established by the blasting contractor to capture vibration associated with the detonation of each blast. Additionally, at El Morro, the contractor installed monitoring devices on each crack in the stucco that covers the structure's interior walls, and a photo was taken after installation to serve as a pre-construction baseline. During construction, the crack was monitored throughout the blasting project to ensure that crack's width or length had not increased (Figure 13).

At Miami the maximum PVS allowed for the project was 1.0 mm/s. The average maximum PVS for the Miami Harbor deepening in 2005 was 0.3828mm/s with a range of 0.0819mm/s - 1.08mm/s during the 40 blast detonations. During both projects, no adverse impacts were reported to any of the surrounding structures by either the vibration monitoring contractor, or the building's owners/trustees.

Air Pressure. The USACE Safety and Health Requirements Manual (EM 385-1-1 3, September 1996) limits of "air blast pressure exerted on structures resulting from blasting shall not exceed 133 dB (0.013 psi)" and industry standard vibration limitations would be incorporated into the design process. A conservative regression analysis of similar projects may be used to develop the design and then continually updated with calibration of the environment. The contractor will also be required to abide by state and local blasting requirements in addition to the USACE Safety Manual previously referenced in this paragraph.

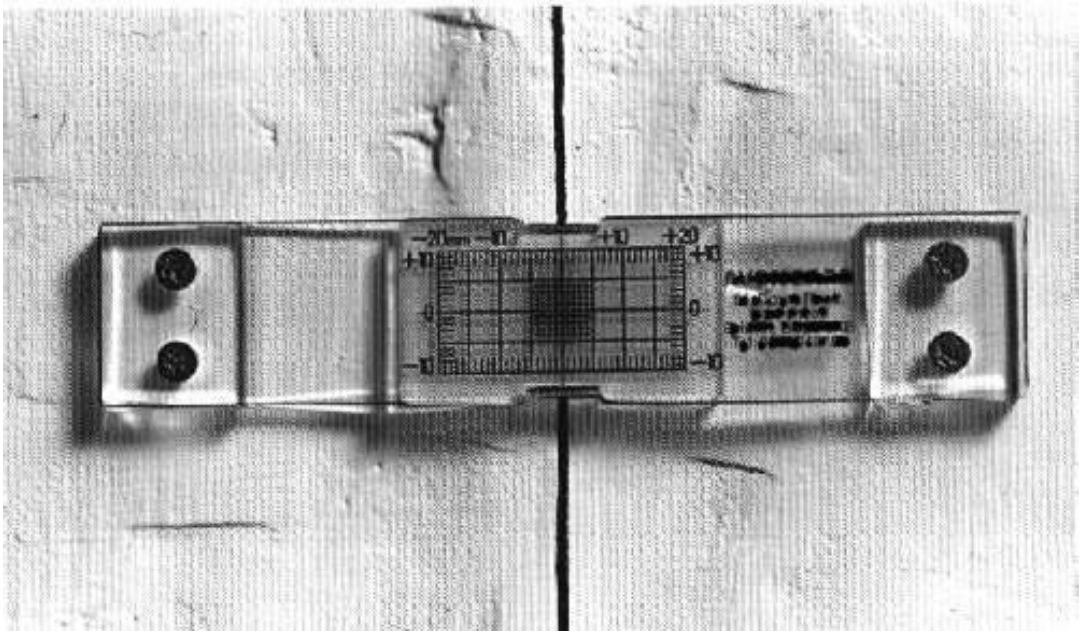


Figure 1 Typical Crack Monitor Device

Duration of Confined Blasting During Construction

The duration of the blasting (pre-treatment) is dependent upon a number of factors including hardness of rock, how close the drill holes are placed, and the type of equipment that will be used to remove the pretreated rock. For comparison, the harbor deepening project at Miami Harbor in 2005-2006 estimated between 200-250 days of blasting with one-shot per day (a blast-day) to pre-treat the rock associated with that project. However the contractor completed the project in 38 days with 40 blasts. The upcoming expansion at Miami Harbor scheduled to begin in summer/fall of 2012 currently estimates 600 blast-days for the entire project footprint. However, the actual number of blast days may be reduced by the contractors, based on the previously mentioned factors. This estimate of how many days of blasting would be needed to complete the work will be estimated with detailed geotechnical analysis during the preconstruction, engineering and design (PE&D) phase of the project.

Adaptive Improvement of Blasting Specifications and Methods

Test Blast Program. Prior to implementing a construction blasting program a test blast program will be completed. The test blast program will have all the same protection measures in place for protected species monitoring and protection as blasting for construction purposes. The purpose of the test blast program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted
- Directional Vibration
- Calibration of the Environment

The test blast program begins with a single range of individually delayed holes and progresses up to the maximum production blast intended for use. The test blast program will take place in the project area and will count toward the pre-treatment of material, since the blasts of the test blast program will be cracking rock. Each test blast is designed to establish limits of vibration and air blast overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the test blast program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a completely engineered procedure for construction blasting plan. During the testing the following data will be used to develop a regression analysis:

- Distance
- Pounds Per Delay
- Peak Particle Velocities (TVL)
- Frequencies (TVL)
- Peak Vector Sum
- Air Blast, Overpressure

In order to provide dependable verification of presence of manatees within the blast zone, a detection system was designed which included the following three provisions:

- Provision 7: A trained observer will be stationed on the sighting tower or catwalk of the dynamite drill barge.

- Provision 8: An observer in a boat will make a systematic survey of the danger zone prior to blasting.

- Provision 9: An electronic color enhanced fathometer will be utilized to monitor underwater manatee movement.

Additionally, special conditions will be placed into the specifications for the project to

protect manatees in the area.

1. A marine mammal watch will be conducted by no less than 2 qualified observers from a small watercraft, at least ½ hour before and after the time of each detonation, in a circular area at least three times the radius of the above described danger zone (this is called the watch zone).
2. Any marine mammal(s) in the danger zone or the watch zone shall not be forced to move out of those zones by human intervention. Detonation shall not occur until the animals(s) move(s) out of the danger zone on its own volition.
3. No blasting will occur during the “manatee season”.
4. In the event a marine mammal or marine turtle is injured or killed during blasting, the Contractor shall immediately notify the Contracting Officer as well as the following agencies:
    a. Florida Marine Patrol "Marine Mammal Stranding Hotline" 1-800-342-5367
    b. FWS – Vero Beach Office
    c. National Marine Fisheries Service – Protected Resources Division, St. Petersburg

Take Analysis

Due to the restrictions and special conditions placed in our construction specifications the Corps does not anticipate any take of the endangered Florida manatee.

Determination

The Corps has determined that the proposed widening and deepening Lake Worth Inlet is likely to affect, but not likely to adversely affect listed species within the action area. The Corps believes that the restrictions placed on the blasting previously discussed in this assessment will diminish the effect of the project on protected species within the action area. The Corps has also determined that the project will not adversely modify critical habitat for the Florida manatee.

LITERATURE CITED

Ackerman, B.B., S.D. Wright, R.K. Bonde, C.A. Beck, and D.J. Banowetz. 1995. Analysis of watercraft-related mortality of manatees in Florida, 1979-1991. Pages 259-268 *in* T.J. O’Shea, B.B. Ackerman, and H.F. Percival, eds. Population biology of the Florida manatee: Information and technology report I. U.S.

Department of the Interior, National Biological Service; Washington, D.C.

Ackerman, B.B, S.D. Wright, R.K. Bonde, D.K. Dell, and D. Banowetz. 1992. Trends and patterns in manatee mortality in Florida, 1974-1991. Page 22 *in* T.J. O'Shea, B.B. Ackerman, and H.F. Percival, eds. Interim report of the technical workshop on manatee population biology. Manatee population research report no. 10. Florida Cooperative Fish and Wildlife Research Unit, University of Florida; Gainesville, Florida.

Beeler, I.E. and T.J. O' Shea. 1988. Distribution and mortality of the West Indian manatee *(Trichechus manatu*s) in the southeastern United States: a compilation and review of recent information. Report prepared by the U.S. Fish and Wildlife Service for the U.S. Army Corps of Engineers. PB 88-207 980/AS. National Technical Information Service; Springfield, Virginia.

Florida Department of Environmental Protection [DEP]. 1998. Manatee salvage database: Summary report. Florida Marine Research Institute; St. Petersburg, Florida.

Florida Department of Natural Resources [DEP]. 1994. Manatee salvage database: Summary report. Florida Department of Natural Resources, Florida Marine Research Institute; St. Petersburg, Florida.

Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute [FRMI]. 2009 - http://research.myfwc.com/manatees/ visited on January 15, 2009.

Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute [FRMI]. 2002 – http://www.floridamarine.org/features/view_article.asp?id=15246 visited on March 6, 2002.

Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute [FRMI]. 2002a – http://www.floridamarine.org/features/category_sub.asp?id=2241 visited on Feb 25, 2002.

Florida Power and Light. 2011. Distribution and Abundance of Florida Manatees Around Selected Power Plants Following Winter Cold Fronts 2010-11.

Gunter, G. 1941. Occurrence of the manatee in the United States, with records from Texas. Journal of Mammalogy 22: 60-64.

Hartman, D.S. 1974. Distribution, status, and conservation of the manatee in the United States. U.S. Fish and Wildlife Service, National Fish and Wildlife Laboratory contract report No. 14-16-0008-748. NTIS publication No. PB81-140725, pp. 1-246.

Hartman, D.S. 1979. Ecology and behavior of the manatee (Trichechus manatus) in Florida. Am. Soc. Mammal. Spec. Publ. Ser. 5. 153pp.

Hempen, G. L., T. M. Keevin, and H. J. Ruben. 2005. Underwater blast pressures from confined rock removal shots: The Kill Van Kull Deepening Project. Pp. 91-100. In: Proceedings of the Thirty-first Annual Conference on Explosives and Blasting Technique, Orlando, Florida. International Society of Explosive Engineers, Cleveland, OH.

Hempen, G.L., T.M. Keevin and T.L. Jordan 2007. Underwater Blast Pressure from a Confined Rock Removal. In: Proceedings of the Twenty-first Annual Conference on Explosives and blasting Technique (Volume 1), Nashville, Tennessee. International Society of Explosive Engineers, Cleveland, OH.

Jordan, T.L., K.R. Hollingshead and M.J. Barkaszi. 2007. Port of Miami Project – Protecting Marine Species During Underwater Blasting. In: Proceedings of the Twenty-first Annual Conference on Explosives and blasting Technique (Volume 1), Nashville, Tennessee. International Society of Explosive Engineers, Cleveland, OH.

Keevin, T.M. and G.L. Hempen. 1997. The Environmental Effects of Underwater Explosions with Methods to Mitigate Impacts. U.S. Army Corps of Engineers; St. Louis District. https://www.denix.osd.mil/denix/Public/ES-Programs/Conservation/WaterX/water1.html#3

Kinnaird, M.F. 1983. Evaluation of potential management strategies for the reduction of boat-related mortality of manatees. Research report number 3, Florida Cooperative Fish and Wildlife Research Unit, U.S. Fish and Wildllife Service.

Koelsch, J. and J.A. Powell. 2011 Palm Beach County Manatee Aerial Surveys.

Konya, C.J. 2003. Rock blasting and overbreak control. Prepared for U.S. Department of Transportation. National Highway Institute. Contract # DTFH 61-90-R-00058. 400 pg.

Lefebvre, L.W., B.B. Ackerman, K.M. Portier, and K.H. Pollock. 1995. Aerial survey as a technique for estimating trends in manatee population size-problems and prospects. Pages 63-74 *in* T.J. O'Shea, B.B. Ackerman, and H.F. Percival, eds. Population biology of the Florida manatee: Information and technology report I. U.S. Department of the Interior, National Biological Service; Washington, D.C.

Lefebvre, L.W., T.J. O'Shea, G.B. Rathbun, and R.C. Best. 1989. Distribution, status, and biogeography of the West Indian manatee. Pages 567-610 *in* C.A. Wood, ed. Biogeography of the West Indies. Sandhill Crane Press; Gainesville, Florida.

Lowery, J.H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana University Press.

Marine Mammal Commission [MMC]. 1998. Preliminary assessment of habitat protection needs for the West Indian manatee on the East coast of Florida and Georgia. Report of the Marine Mammal Commission in Consultation with its Committee of Scientific Advisors on Marine Mammals. Pp 107.

Marine Mammal Commission [MMC]. 1992. Annual report to Congress, 1991. Marine Mammal Commission; Washington, D.C.

Moore, J.C. 1951. The Range of the Florida manatee. The Quarterly Journal of the Florida Academy of Sciences. Volume 14, No.1. pp. 18.

Moore, J.C. 1956. Observations of Manatees in Aggregations. American Museum Novitates. Number 1811. pp.24.

Nedwell, J.R. and T.S. Thandavamoorthy, 1992. The waterborne pressure wave from buried explosive charges: an experimental investigation. Journal of Applied Acoustics. 37 (1992) 1-14.

NMFS. 2005. Taking Marine Mammals Incidental to Specified Activities; Port of Miami Construction Project (Phase II). 70 FR 21174. April 25, 2005.

O'Keeffe, D. J., and G. A. Young. 1984. Handbook on the environmental effects of underwater explosions. NSWC TR 83-240. Naval Surface Weapons Center, Dahlgren, VA.

O'Shea, T.J., B.B. Ackerman, and H.F. Percival, eds. 1992. Interim report of the technical workshop on manatee population biology. Manatee population research report no. 10. Florida Cooperative Fish and Wildlife Research Unit, University of Florida; Gainesville, Florida.

O' Shea, T.J., C.A. Beck, R.K. Bonde, H.I. Kochman, and D.K. Odell. 1985. An analysis of manatee mortality patterns in Florida 1976-1981. Journal of Wildlife Management 49: 1-11.

O'Shea, T.J. 1988. The past, present, and future of manatees in the southeastern United States: Realities, misunderstandings, and enigmas. Pages 184-204 *in* R.R. Odum, K.A. Riddleberger, and J.C. Ozier, eds. Proceedings of the third southeastern nongame and endangered wildlife symposium. Georgia Department of Natural Resources, Game and Fish Division; Atlanta, Georgia.

Palm Beach County Manatee Protection Plan. 2007.

Richmond, D. R., J. T. Yelverton, and E. R. Fletcher. 1973. Far-field underwater-blast

injuries produced by small charges. Defense Nuclear Agency, Department of Defense, Washington, D. C. Technical Progress Report, DNA 3081 T..

USACE. 2000. Analysis of Test Blast Results, Wilmington Harbor, NC. (February 2000). 13 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. ESA Consultation on Miami Harbor Phase II. FWS Service Log #4-1-02-F-4334. Dated June 19,2002.

U.S. Fish and Wildlife Service (USFWS). 2003. ESA Consultation on Miami Harbor GRR. FWS Service Log #4-1-03-I-786. Dated June 17, 2003.

U.S. Fish and Wildlife Service (USFWS). 2001. Florida Manatee Recovery Plan, Third Revision.

U.S. Fish and Wildlife Service (USFWS). 1999. South Florida Multi-species Recovery Plan.

U.S. Fish and Wildlife Service (USFWS). 1996. Florida Manatee Recovery Plan, Second Revision.

USN, 2008. Final EIS for the Proposed Homeporting of Additional Surface Ships at Naval Station Mayport, Florida. November 2008.

Wright, S.D., B.B. Ackerman, R.K. Bonde, C.A. Beck, and D.J. Banowetz. 1995. Analysis of watercraft-related mortality of manatees in Florida, 1979-1991. Pages 259-268 *in* T.J. O'Shea, B.B. Ackerman, and H.F. Percival, eds. Population biology of the Florida manatee: Information and technology report I. U.S. Department of the Interior, National Biological Service, Washington, D.C.

Wright, S.D., B.B. Ackerman, R.K. Bonde, C.A. Beck, and D.J. Banowetz. 1992. Analysis of watercraft-related mortality of manatees in Florida, 1979-1991. Page 23 *in* T.J. O'Shea, B.B. Ackerman, and H.F. Percival eds. Interim report of the technical workshop on manatee population biology. Manatee population research report no. 10. Florida Cooperative Fish and Wildlife Research Unit, University of Florida; Gainesville, Florida.

Yelverton, J. T., D. R. Richmond, E. R. Fletcher, and R. K. Jones. 1973. Safe distance from underwater explosions for mammals and birds. Technical Report DNA 3114 T. Defense Nuclear Agency, Department of Defense, Washington, D. C.

Young, G.A. 1991. Concise methods for predicting the effects of underwater explosions on marine life. NAVSWC MP 91-220. Research & Technology Department, Naval Surface Warfare Center.

ATTACHMENT 7: ESSENTIAL FISH HABITAT (AFFECTED ENVIRONMENT)

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) require regional fishery management councils and federal agencies to promote protection, conservation, and enhancement of essential fish habitat (EFH). The EFH provisions of the Magnuson-Stevens Act support one of the Nation's overall marine resource management goals - maintaining sustainable fisheries. Achieving this goal requires maintenance of the quality and quantity of habitats necessary for fishery resources.

The Magnuson-Stevens Act defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Rules promulgated by NMFS in 2002 further clarify EFH with the following definitions: **waters** - aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; **substrate** - sediment, hardbottom, structures underlying the waters, and associated biological communities; **necessary** - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and **spawning, breeding, feeding, or growth to maturity** - stages representing a species' full life cycle. EFH may be a subset of all areas occupied by a species. Acknowledging that the amount of information available for EFH determinations will vary for the different life stages of each species, the rule directs the fishery management councils and the National Marine Fisheries Service (NMFS) to use the best information available, to take a risk averse approach to designations, and to be increasingly specific and narrow in the delineations of EFH as more refined information becomes available.

The rules also provide for fishery management councils and NMFS to consider more limited designations for each species. Habitat Areas of Particular Concern (HAPCs) are subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. In general, HAPCs include habitats important for the migration, spawning, and rearing of fish or shellfish. Actions with potential adverse impacts to HAPCs are more carefully scrutinized and subject to more stringent conservation recommendations.

The South Atlantic Fishery Management Council (SAFMC) designates mangrove; seagrass; hardbottom, coral, and coral reefs; intertidal flats; coastal inlets; and other bottom habitats within the Lake Worth Inlet project area as EFH (SAFMC 1998). In addition the Mid-Atlantic Fishery Management Council designates coastal inlets as EFH for bluefish and the NMFS designates coastal inlets as EFH for a variety of sharks.

Within southeast Florida, including the Lake Worth Inlet project area, nearshore bottom, live/hardbottom, seagrass, and coastal inlets are HAPCs (SAFMC 1998). Managed species that commonly inhabit the study area include pink shrimp (*Farfantepenaeus duorarum*); spiny lobster (*Panulirus argus*); and members of the 73-species snapper-grouper complex, including blue stripe grunts (*Haemulon sciurus*), yellowtail snapper (*Ocyurus chysurus*), and red grouper (*Epinephelus morio*). These species use inshore habitats as juveniles and sub-adults, and they use hardbottom and reef communities offshore as adults. Other species of the snapper-grouper complex commonly seen offshore in the study area include gray triggerfish (*Balistes capriscus*) and hogfish (*Lachnolaimus maximus*). Coastal migratory pelagic species also commonly utilize the offshore area adjacent to the study area, including cero mackerel (*Scomberomorus regalis*) and Spanish mackerel (*S. maculatus*).

Table 1: Federally Managed Species of Fish that May Occur within the Project Area.

Species	Life Stage	Substrate Preference[1]	
		Unconsolidated Sediment	Seagrass
Brown shrimp *Farfantepenaeus aztecus*	A, J, L	A, J, L	J, L
Pink shrimp *Farfantepenaeus duorarum*	A, J	A, J	J
White Shrimp *Litopenaeus setiferus*	A, J	A, J	J, L
Spiny Lobster *Panulirus argus*	A, J	A, J	A, J
Black seabass *Centropristis striata*	A, J	A, J	
Gag *Mycteroperca microlepis*	A, J	A, J	
Cobia *Rachycentron canadum*	J	J	
Mutton snapper *Lutjanus analis*	A, J	J	J
Gray snapper *Lutjanus griseus*	A, J, L	A, J, L	A, J, L
Lane snapper *Lutjanus synagris*	A, J	A, J	J
Yellowtail snapper *Lutjanus chrysurus*	A, J	J	J
White grunt *Haemulon plumieri*	A, J	A, J	A, J
Sheepshead *Archosargus probatocephalus*	A, J, L	A, J	J, L
Red drum *Sciaenops ocellatus*	A, J, L	A, J, L	J, L
Hogfish *Lachnolaimus maximus*	A, J	J	J
Spanish mackerel *Scomberomorus maculatus*	A, J	A, J	
Black drum *Pogonias cromis*	A, J	A, J	A, J
Southern flounder *Paralichthys lethostigma*	A, J	A, J	J

[1] Substrate preference, unconsolidated sediment and seagrass habitats occur in or near the project area. A=adult; J=juvenile; L=larvae

Table 2: Prey Species that May Occur within the Project Area.

Species	Life Stage	Substrate Preference[2]	
		Unconsolidated Sediment	Seagrass
Thinstripe hermit crab *Clibanarius vittatus*	A, J	A, J	
Horse conch *Pleuroploca gigantea*	A, J	A, J	A, J
Bay anchovy *Anchoa mitchilli*	A, J, L	A, J, L	L
Sheepshead minnow *Cyprinodon variegatus*	A, J, L	A, J, L	
Atlantic menhaden *Brevoortia tyrannus*	A, J, L	A	J, L
Bay scallop *Argopecten irradians*	A, J, L	A, J	A, J, L
Atlantic rangia *Rangia cuneata*	A, J, L	A, J, L	
Quahog *Mercenaria mercenaria*	A, J	A, J	
Grass shrimp *Palaemonetes pugio*	A, J		A, J
Striped mullet *Mugil cephalus*	A, J	A, J	A, J
Spot *Leiostomus xanthurus*	A, J	A	J
Atlantic croaker *Micropogonias undulates*	A, J	A, J	
Silversides *Menidia menidia*	A, J, L	A, J, L	A, J, L
American eel *Anguilla rostrata*	A, J, L	J, L	A, J, L

[1] Substrate preference, unconsolidated sediment and seagrass habitats occur in or near the project area. A=adult; J=juvenile; L=larvae

[2] Substrate preference, unconsolidated sediment and seagrass habitats occur in or near the project area. A=adult; J=juvenile; L=larvae

SEAGRASS

Review of literature, related information, and views of recognized experts on the habitat or species that may be affected

Community Composition of Seagrass in the Lake Worth Inlet Area

The seagrass community in the Lake Worth Inlet area has included *Halophila decipiens, H. johnsonii,* and *Halodule wrightii*. The seagrass habitats are spatially and temporally dynamic, but persistently present in areas around the turning basin. Seagrass communities were dominated by sparse cover of *H. johnsonii* in single species and mixed beds in shallow to mid-water depth (0-4m), while *H. decipiens* predominated in water depth greater than 4m. *Halodule wrightii* was also found in shallow water, primarily less than 2m. Frequency of occurrence, cover abundance scores, and density were relatively low for all seagrass beds documented. Frequency of occurrence across an entire transect was highest for *H. johnsonii* along Transect 18, with a value of 0.36 out of a possible 1.0. Cover abundance scores for all species, *H. johsonii*, *H. decipiens* and *Halodule wrightii* were less than 26% cover (maximum of 2.33; Table 4) across all transects; which means that seagrasses covered less than 26% of the bottom where they were found. The highest density score, which is the sum of cover abundance scores for a species, divided by the total number of quadrats within a transect, was 0.72.

Regardless of species composition or developmental stage, seagrass patches and entire beds can move, the rate of which may vary on scales of weeks to decades (SAFMC 2009). The expansion and contraction of seagrass beds, also referred to as "pulsating patches" may be a long-term survival strategy of *H. johnsonii* (Virnstein et al. 2009) and other seagrass species. For impact assessment purposes, it is important to consider the broader seagrass habitat and not just the currently vegetated portions. Seagrass habitats include not only continuous vegetated beds, but also patchy environments with unvegetated areas between the patches as part of the habitat (SAFMC 2009). Available data show that patchy habitats provide ecological functions similar to continuous meadows (Murphey and Fonseca 1995). The absence of seagrass in a particular location during an isolated survey event does not necessarily mean that the location is not viable seagrass habitat and could be considered as potential habitat if the environmental conditions are suitable. It could merely mean that the present conditions are unfavorable for growth at that moment in time, and the duration of this condition could vary from months to years (SAFMC 2009).

Virnstein et al. (2006) observed seagrass coverage expansion within a year and concluded that seagrass responds rapidly to changing environmental conditions. Because seagrass coverage and density in the Lake Worth Inlet area is dynamic, this may also indicate high resilience to changing environmental conditions. However, the consequences of human development and other anthropogenic pressures in a coastal basin and the loss of natural hydrologic buffers, can compromise an estuary's resilience to rapidly recover from natural pressures, e.g., hurricanes and seasonal salinity fluctuations (Steward et al. 2006).

Halophila decipiens

H. decipiens had the highest abundance score for all seagrasses within the 2011 study area, but the lowest density. This species is highly fecund and cosmopolitan, occupying niches that larger-sized perennial species cannot utilize (Hammerstrom and Kenworthy 2003). The short life history of *H. decipiens* and the apparent existence of a buried, but moveable seed bank means that spatial organization of this community is dictated by first large-scale dispersal of plant propagules (hundreds of

meters) and then, within a growing season, by physical perturbation, bioturbation, and clonal organization of the seagrass operating over very small distances (Fonseca et al. 2008). This species can contribute to a more clumped distribution early in the growing season with subsequent vegetative extension. Fonseca et al. (2008) point out that large-scale disturbance events, such as hurricanes, act to redistribute *H. decipiens* propagules, whereupon clonal organization of the plants in their spring to fall existence likely dictates the pattern of seafloor occupation. Furthermore, bioturbation plays an important role in either burying seeds or bringing seeds to the sediment surface where they can germinate. They further note that this species appears to have the facility for resiliency of natural disturbances (e.g., hurricanes) of its community that appear to be able to move the seed bank hundreds, if not thousands of meters, leading to tremendous seasonal changes in the spatial distribution of the plants. The small seed size and the burial of unvegetated substrate by sediments, coupled with movement along with sediment is a plausible mechanism to explain the inter-annual patterns of seagrass distribution (*sensu* Josselyn et al. 1986). Thus, the definition of "seagrass habitat" for the *Halophila* genera can be highly misleading if presently vacant spaces among patches are not properly considered as requisite space for persistence of the community (*sensu* Fonseca et al. 1998).

Although *H. decipiens* is small and present only through a few months of the year, the species provides significant sediment stabilization (Fonseca 1989). Despite a smaller size and a relatively low rate of production, *H. decipiens* makes an important contribution to primary production in an ecosystem (Iverson and Bittaker 1986). It is important to note that *H. decipiens* communities are a mosaic of seasonally ephemeral seagrass patches that provide the valuable ecological functions recognized for the larger seagrasses (Hammerstrom et al. 2006), therefore the patchy abundance of *Halophila* is a function of the genus dynamics and should be recognized as the ambient condition. Rapid growth, high turnover rates, and labile tissues make *Halophila* spp. a good source of nutrition for several marine herbivores and detritivores (Kenworthy et al. 1989).

Halodule wrightii

Halodule wrightii had the lowest frequency of occurance and abundance of the three seagrasses, but the second highest density. *Halodule wrightii* is a highly productive seagrass under a variety of light, nutrient, and salinity conditions and because of this it is known to have ubiquitous distribution and an opportunistic strategy as a colonizing species (Dunton 1996). This species can persist under diminishing environmental conditions by reclamation of nutrients and stored reserves from senescing shoots and rhizomes (Onuf 1996). Rhizome growth and branch rate for *H. wrightii* is high compared to climax seagrass species (e.g., *Thalassia testudinum*) which allows it to rapidly occupy the space they colonize, however they have a high shoot mortality and low life expectancy which implies they may not occupy the space for long (Gallegos et al. 1994).

Heidelbaugh (1999) conducted a study within a 372 square meter (0.09 acres) study area that examined benthic fauna associated with seagrass and unvegetated bottoms and collected 117 species and 690 macrofaunal organisms from *H. wrightii* beds. The most abundant infaunal organisms belonged to the phylum Nematoda while the most abundant epifaunal species were amphipods and tanaids. The majority of macrofaunal organisms consisted of decapod crustaceans (*Callinectes sapidus*), fishes (*Eucinostomus* sp.), and some gastropods (especially *Bursatella leachii*). An additional study compared nekton densities among *H. engelmannii*, *H. wrightii*, and nonvegetated habitats and, similar to the results of the Heidelbaugh (1999) study, found higher densities in the seagrass habitats (King and Sheridan 2006). These studies and others (Sheridan and Livingston 1983; Stoner 1983; Lewis 1984) conclude that on a per plant biomass basis, *Halodule* provides as much fish and infaunal habitat value as other species with higher above-ground biomass, such as *Thalassia testuninum*.

Halophila johnsonii

Under the Endangered Species Act, the Jacksonville District will separately consult with NMFS on potential effects to threatened *H. johnsonii* from the proposed action, however it is important to note that Johnson's seagrass, like other seagrass species, is also designated as EFH.

Halophila johnsonii was the most frequently occurring seagrass in the 2011 survey, but like all seagrasses, density and abundance was sparse. The expansion and contraction of *H. johnsonii*, also referred to as "pulsating patches" may be a long-term survival strategy (Virnstein et al. 2009). The persistent presence of high density elevated patches of *H. johnsonii* on flood tidal deltas near inlets suggests that it is capable of sediment stabilization (NMFS 2007). Given the similarities between the morphology of other *Halophila* spp. and *H. johnsonii,* it is reasonable to assume that *H. johnsonii* has the same capabilities as these other species to provide important ecological functions and services to the coastal ecosystem of southeastern Florida (NMFS 2007).

Ecological Functions of Seagrass and Seagrass as EFH

The SAFMC designated seagrass as EFH for species managed under the snapper-grouper, spiny lobster, and coastal migratory pelagics Fishery Management Plans. See Table 1 for a list of species associated with these seagrass habitat and documented in the project area. Other studies from Florida have reported that young gray snapper are frequently collected by shrimp trawlers in seagrass beds at night (Serafy et al. 2007). Other species managed under the snapper-grouper fishery management plan that show an affinity with seagrass habitat include juvenile dog snapper (*L. jocu*), goliath grouper (*Epinephelus itajara*), bluestripe grunt, spiny lobster, and pink shrimp. Additionally, species managed under the highly migratory species fishery management plan, such as tiger (*Galeocerdo cuvier*) and Atlantic sharpnose (*Rhizoprionodon terraenovae*) sharks have an affinity for seagrass habitats.

Many ecological functions are associated with seagrass, including nutrient recycling, detrital production and export, sediment stabilization, and provision of food and habitat for many life stages of numerous marine species. The most well-known function of seagrass is the role as habitat for numerous fishes and invertebrates. Some species spend their entire lives within seagrass beds and others utilize them only during certain stages of their life cycle (usually the postlarval and juvenile stages). Seagrass beds are one of the primary nursery habitats for coastal marine fauna because of their abundance of prey items as well as the protection they provide from predators. Like many of the larger species, *Halophila* species provide organic matter, habitat structure, and food for benthic feeding organisms (Valentine and Heck 1999). In addition, *Halophila* based ecosystems are important food for herbivorous reptiles (Ross 1985).

Seagrass habitats perform numerous important functions in coastal ecosystems that aid in successful spawning, feeding, and growth of several seasonal and resident fishery species, thus serving as EFH. SAFMC (2009) provides a review of several studies have concluded that, although juvenile fish and shellfish can use other types of habitat, many estuarine species rely on seagrass for either part of their life history or some aspect of their nutrition, and that the loss or reduction of this habitat will produce concomitant declines in juvenile fish settlement. Seagrass habitat type is essential to many species of commercial, recreational and ecologically important shellfish and finfish (SAFMC 2009). *Halophila* based ecosystems, like the habitats within the Lake Worth Inlet project area, are particularity important habitats for penaeid shrimp (Ross 1985). Scientific evidence also indicates other species have a strong reliance on seagrass habitats as well including, blue crabs and spiny lobster (SAFMC 2009).

One of the more important functions of seagrass as EFH is the nursery role. Seagrass habitats serve as nurseries for juvenile fish and their food sources. Seagrass habitats also affect ecological processes which enable fish to grow and mature to different ontogenetic stages, eventually reaching adult forms and emigrating to other habitats (Orth et al. 1984; Koenig and Coleman 1998; Beck et al. 2001). Several studies indicate that juvenile fishes are the most abundant age group in seagrass beds, especially in more temperate waters (SAFMC 2009). In particular, juvenile yellowtail snapper and French grunt are highly associated with seagrass beds (Cocheret de la Moriniere et al. 2002). Seagrass functions as a nursery is critical for many estuarine dependent fishery species in the South Atlantic region such as gag groupers (*Mycteroperca microlepis*), flounders (family Pleuronectidae), red drum (*Sciaenops ocellatus*), weakfish (*Cynoscion regalis*), and striped mullet (*Mugil cephalus*) (Thayer et al. 1984).

The same ecological characteristics of seagrass beds that make the habitat favorable for juveniles should also benefit larval fish and invertebrates. There have been a few studies dealing with larval fish settlement and use of seagrass habitats. Parish (1989) documented that seagrass provides habitat for settling postlarvae and developing juvenile reef fishes. Seagrass beds are important for the brooding of eggs (for example, silverstripe halfbeak, *Hyporhamphus unifasciatus*) and for fishes with demersal eggs (e.g., rough silverside, *Membras martinica*). Larvae of spring-summer spawners such as anchovies (*Anchoa* spp.), gobies, (*Gobiosoma* spp.), pipefish (*Syngnathus fuscus*), weakfish, southern kingfish (*Menticirrhus americanus*), red drum, silver perch (*Bairdiella chrysoura*), rough silverside, feather blenny (*Hypsoblennius hentzi*), and halfbeaks are present and use seagrass beds (SAFMC 2009).

A large proportion of the seasonal residents of seagrass habitats in the South Atlantic region spawn offshore on continental shelves and reefs, enter the estuaries in late winter and early spring and take up residency until fall or until they reach a certain ontogenetic stage when they move to other habitats or offshore to renew this cycle.

In addition, seagrass habitats pass on unique biological, physical and chemical characteristics to water bodies which both directly and indirectly contribute to the necessary attributes of EFH (Zieman 1982; Thayer et al. 1984). Seagrass habitats play an important role as EFH by influencing the environment they grow in as well as adjacent environments. Essentially, seagrass habitat affects flow, velocity, and turbulence, thereby creating an environment favorable to settlement of fish and fish food. Organic and inorganic particles settle into the seagrass beds providing nutrients and food, enriching the environment and enhancing secondary production. In turn, the substrate is stabilized, nutrients are temporarily conserved within the meadows and water quality is improved by the presence of seagrass. These ecological services enhance the environmental conditions favoring high rates of primary and secondary production in support of healthy and abundant fish communities (SAFMC 2009).

SOFTBOTTOM HABITATS AS EFH

Softbottom habitat is the area with unconsolidated sediment that lacks vascular plants (i.e., no seagrass is present, but marcoalgae may be present). Within the interior portions of Lake Worth Inlet, the unconsolidated sediment is usually sand, silty sand with sandy material occurring more commonly in shallow waters and near the inlet and silty sediments occurring in deepwater waters of the turning basin. Although soft bottom habitat lacks visible structural features, many microscopic plants occur at the sediment surface and burrowing animals commonly occur below the surface (Peterson and Peterson 1979, Alongi 1990); the dominant taxa of macroinfauna are usually polychaetes, crustaceans, mollusks, and echinoderms. One of the more interesting features of soft bottom communities is that the species

within this habitat can significantly structure the habitat thorough processes, such as bioturbation, enhancing water flow through sediments, and tube building, that affect community as a whole. Similarly, soft bottom habitat provides important ecological services to coastal ecosystems (Peterson and Lubchenco 1997). For example, soft bottom areas serve as a storage reservoir of chemicals and microbes. Intense biogeochemical processing and recycling establish a filter to trap and reprocess watershed-derived natural and human-induced nutrients and toxic substances.

One of the more important services provided by soft bottom habitat is foraging habitat for fishery species and their prey. For example, adult white grunts, which are a federally managed fishery species as well as an important food source for species managed within the snapper-grouper complex, are generalized carnivores that feed mainly on benthic invertebrates (Bowman et al. 2000; Potts and Manooch 2001). The high forage value of soft bottom habitat results from the high concentrations of organic matter transported to and produced on soft bottom and the numerically abundant, diverse invertebrate fauna associated with this habitat. While the forage value of soft bottom habitat can vary greatly with position in the landscape, proximity to physical disturbance (such as dredging and wave scour) and chemical disturbances (such as stormwater runoff and low concentrations of dissolved oxygen) can be overriding factors (Pearson and Rosenberg 1978; Diaz and Rosenberg 1995).

Soft bottom habitat also can provide refuge to smaller organisms, such as juvenile fish, because predators are unable to maneuver effectively in shallow waters. Consequently, juvenile fish typically first recruit to the shallowest portions of an estuary or lagoon. Flounder, rays (e.g., *Urobatis jamaicensis* or *Dasyatis americana*), and small cryptic species, such as pink shrimp and blue crabs, can bury in the sediment, camouflaging themselves from predators. Smaller predators in shallow water and larger predators in deeper water also bury themselves in soft bottom habitats relying upon ambush tactics for feeding (Walsh et al. 1999). Consequently, many fish, crabs, and shrimp in subtidal, soft bottom habitats forage nocturnally (Summerson and Peterson 1984).

The SAFMC designated soft bottoms as EFH for species managed under the snapper-grouper, shrimp, and spiny lobster fishery management plans. Federally managed species documented in the Lake Worth Inlet expansion area and associated with soft bottom habitat include white grunt, pink shrimp, and spiny lobster. Additionally, species managed by NMFS under the highly migratory species fishery management plan, such as Atlantic sharpnose, bonnethead (*Sphyrna tiburo*), and finetooth (*Carcharhinus isodon*) sharks have an affinity for soft bottom habitats. See table 1 for a list of species associated with soft bottom habitat and documented in or near the project area.

LAKE WORTH INLET AS EFH

Tidal inlets are HAPCs because of the unique role they play as migratory corridors connecting ocean and estuarine waters that serve as spawning and nursery areas for shrimp, red drum, mackerels, and other species (Hettler and Chester 1990; Lindeman et al. 2000; Faunce and Serafy 2007).

Movement of larval and juvenile fish and shrimp through inlets can vary greatly between inlets and over time with some species migrating nocturnally, within portions of the tidal stream, phases of the lunar cycle or interaction of these factors (Forward et al. 1999). The major point being that migration through inlets rarely is a passive process and, instead, reflect behaviors of the migrants. While modeling studies conducted for this project and summarized in this Draft EIS conclude that changes in the physical characteristics of Lake Worth Inlet Inlet as a result of dredging will be minor, these studies do not

examine the response of fish and other organisms to those changes, and such examinations would be difficult to do. Most larval and juvenile fish that utilize the inlet to access their inshore nurseries respond to a variety of environmental factors once they reach the inlet (Boehlert and Mundy 1988). Dredging of inlets, including their ebb and flood tide shoals, may result in unanticipated changes to the cues used by migrants to the estuary. Species that orient to cues associated with the sea bottom may be affected by a deepened channel. Channel dredging also may change flow of long-shore currents. These currents not only affect the transport of sediments along the beach but also influence the recruitment of early life history stages of fish and invertebrates into the estuary. In short, complex modeling and empirical studies would be needed to examine how fish would respond to the modified inlet.

The SAFMC designated coastal inlets as EFH for species managed under the snapper-grouper and shrimp fishery management plans. Additionally, the Mid-Atlantic Fishery Management Council designated coastal inlets as EFH for the bluefish (*Pomatomus saltatrix*) fishery management plan.

HARDBOTTOM HABITATS AS EFH

Channel Wall, Channel Shelf and Nearshore

Expansion zones B-1 and B-2 included the excavated rock walls of Lake Worth Inlet and short shelf sections extending away from the existing Federal Channel. Hardbottom habitat within these areas tended to be vertically oriented; however, the shelf portion of B-1 did support a measurable percentage of consolidated substrate. Throughout zones B-1 and B-2, the predominant space occupiers were of suspension and filter-feeding species from Hydrozoa and Porifera. At least 3 species of thecate hydroid (unidentified) and 8 species of sponge (*Siphonodictyon* sp., *Agelas* sp., *Niphates* sp., *Amphimedon* sp., *Cliona* sp., *Monanchora* sp., *Ircinia* spp., and *Spirastrella* sp.) typically comprised the benthic assemblage.

Eastern portions of C represented a westward continuation of the same sponge and hydroid communities found on the northern face of the Inlet. *Siphonodictyon* sp., *Agelas* sp., *Niphates* sp., *Amphimedon* sp., *Cliona* sp., *Monanchora* sp., *Ircinia* spp., *Spirastrella* sp., and several species of thecate hydroid were found to dominate the southerly-facing wall and slope regions with diminishing coverage on the shelf and flats to the north. Diver and towed-video surveys also suggested a gradual decrease in hardbottom coverage moving westward through Zone C, with an increasing percentage of sand and shell hash.

Hardbottom in expansion Zone D consisted of intermittent rock outcroppings along the ~20-ft contour of the channel slope. A variety of hydroids, sponges (*Amphimedon* sp., *Niphates* sp., *Ircinia* sp., boring, etc.), and fish (including bandtail pufferfish, sergeant major, juvenile porkfish, and juvenile cocoa damselfish) were observed

Continuous hardbottom, sand with scattered hardbottom and hardbottom ledge habitat included a number of benthic organisms unique to hardbottom habitat which were not found in seagrass habitats. Hardbottom benthic organisms were documented to the lowest taxonomic level and are listed in Table 5. Fish populations associated with hardbottom habitat were also documented (Table 6).

Table 3: List of benthic invertebrates and macroalgae documented along transects.

Common Name	Species Name
Sponge	
Black ball sponge	*Ircinia strobilina*
Orange boring sponge	*Cliona delitrix*
Lumpy overgrowing sponge	*Holopsamma helwegi*
Hard Corals	
Lesser starlet coral	*Siderastrea siderea*
Greater starlet coral	*Siderastrea radians*
Hydroids	
Feather bush hydroids	*Dentitheca dendritica*
Macroalgae	
Geen feather algae	*Caulerpa sertularoides*
Y branched algae	*Dictyota* sp.
Oval Blade algae*	*Caulerpa prolifera*

*Documented in seagrass habitat and hardbottom habitat.

Table 4: Fish species documented within project area.

Fish Common Name	Fish Species
Porkfish	*Anisotremus virgincus*
Gray Angelfish	*Pomacanthus arcuatus*
Stoplight Parrotfish	*Sparisoma viride*
Tomtates	*Haemulon aurolineatum*
Grunts (j)	*Haemulon* (spp.)
Blue tang	*Acanthurus coeruleus*
Bluehead wrasse (j,a)	*Thalassoma bifasciatum*

The relative abundance of benthic organisms to each other and the percent cover of hardbottom benthic organisms along transects is described in Table 7 (DCA 2011). Benthic organisms were identified to the lowest taxonomic level and categorized by functional group for analysis. Values are percent cover averages over the entire transect, so lower values represent less hardbottom habitat along the entire transect. Hard corals were noted along transects, whether or not they fell within $1m^2$ quadrats. A total of five hard corals were documented along all transects surveyed and included *Siderastrea siderea* and *S. radians*. Noteably, no soft corals were documented during this survey.

Table 5: Percent cover of hardbottom constituents including hydroids, sponge, hard coral, macroalgae, tunicates and bare space along each transect where hardbottom was documented. Transect totals add to 100% only if the entire transect consisted of hardbottom.

Transect	Hydroid	Sponge	Hard Coral	Macroalgae	Tunicate	Bare	Total
T14	0	2.3	0	0.5	0.01	2.3	5.11
T15	3.3	3.3	0	0	0	6.6	13.2
T16	4.6	2	0	1.2	0.23	12.8	20.83
T17	0.8	0.8	0	0	0	1.6	3.2
T20	9.4	3.8	0	0	0.38	24.0	37.58
T21	0	6.6	0	0	0	10	16.6
T22	1.6	2	0	0	0	4.4	8
T25	17.0	1.4	0.05	0	0.05	34.1	52.6
T26	16.8	0.66	0.06	1.33	0	33.4	52.25
T27	15.7	3.9	0.04	0	0	71.5	91.14
T28	18.7	0.83	0	0	0	76.3	95.83

LITERATURE CITED

Alongi, D. M. 1990. The ecology of tropical soft-bottom benthic ecosystems. *Oceanography and Marine Biology: An Annual Review* 28: 381-496.

Beck, M.W., Heck, K.L., Able, K.W. Jr., Childers, D.L., Eggleston, D.B. Gillanders, B.L. Halpern, Hays, C.G., Hoshino, K., Minello, T.J., Orth, R.J., Sheridan, P.F., and Weinstein, M.P. 2001. The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates. *Bioscience* 51: 633-641.

Boehlert, G.W., and Mundy, B.C. 1988. Roles of behavioral and physical factors in larval and juvenile fish recruitment to estuarine nursery areas, *In* M.P. Weinstein [editor] Larval fish and shellfish transport through inlets. American Fisheries Symposium 3. pp 51-67. American Fisheries Society, Bethesda, Md.

Bowman R.E., Stillwell C.E., Michaels W.L. and Grosslein M.D. 2000. Food of Northwest Atlantic fishes and two common species of squid. NOAA's National Marine Fisheries Service, NMFS-NE-155.

Cocheret de la Moriniere, E., Pollux, B.J.A., Nagelkerken, I., and van der Velde, G. 2002. Post-settlement life cycle migration patterns and habitat preference of coral reef fish that use seagrass and mangrove habitats as nurseries. *Estuarine, Coastal and Shelf Science* 55: 309-321.

Dial Cordy and Associates Inc (DCA). 1999. Marine Seagrass Survey of Lake Worth Inlet. Revised Final Report to U.S. Army Corps of Engineers Jacksonville District, Jacksonville, FL 26pp. (Do not have)

DCA. 2001. Environmental Baseline Study and Impact Assessment for Lake Worth Inlet Harbor - Final Report. Prepared for U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL. 83pp.

DCA. 2006. Seagrass Mapping and Assessment for Lake Worth Inlet Harbor, Final Report, October 5, 2006. Prepared for U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL. 18 pp.

Diaz, R. J. and Rosenberg, R. 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioural responses of benthic macrofauna. *Oceanography and Marine Biology: An Annual Review* 33: 245-303.

Dunton, K.H. 1996. Photosynthetic production and biomass of the subtropical seagrass *Halodule wrightii* along an estuarine gradient. *Estuaries* 19: 436-447.

Faunce, C.H., and Serafy, J.E. 2007. Nearshore habitat use by gray snapper (*Lutjanus griseus*) and bluestripted grunt (*Haemulon sciurus*): environmental gradients and ontogenetic shifts. *Bulletin of Marine Science:* 80: 473-495.

FDEP. 2007. Field Notes Florida Department of Environmental Protection. Field inspection of hardbottom sites in the area of Lake Worth Inlet Expansion in 2006 and 2007. Updated in September 2007.

FDEP. 2008. Lake Worth Inlet Seagrass Verification Survey Maps. 5 pp.

Florida Department of Environmental Protection. 2006. Field inspection of hardbottom sites in the area of Lake Worth Inlet Expansion. Updated in September 2007.

Fonseca, M.S. 1989. Sediment stabilization by *Halophila decipiens* in comparison to other seagrasses. *Estuarine, Coastal and Shelf Science* 29: 501-507.

Fonseca, M.S., Kenworthy, J.W., Griffin, E., Hall, M.O, Finkbeiner, M., and Bell, S.S. 2007. Factors influencing landscape pattern of the seagrass *Halophila decipiens* in an oceanic setting. *Estuarine, Coastal and Shelf Science:* 1-12.

Fonseca, M.S., Kenworthy, W.J., and Thayer, G.W. 1998. Guidelines for the conservation and restoration of seagrass in the United States and adjacent waters. NOAA COP/Decision Analysis Series. 222p.

Forward, Jr., R.B., Reinsel, K.A., Peters, D. S., Tankersley, R. A., Churchill, J. H., Crowder, L. B. Hettler, W. F. Warlen, S. M. and Green, M. D. 1999. Transport of fish larvae through a tilde inlet. *Fisheries Oceanography 8* (Suppl. 2): 153-172.

Gallegos, M.E., Merino, M., Rodriguez, A., Marba, N., and Duarte C. 1994. Growth patterns and demography of pioneer Caribbean seagrass *Halodule wrightii* and *Syringodium filiforme*. *Marine Biology Progress Series* 109: 99-104.

Hammerstrom, K.K., and Kenworthy, J.W. 2003. A new method for estimation of *Halophila decipiens* Ostenfeld seed banks using density separation. *Aquatic Botany* 76: 79-86.

Hammerstrom, K.K., Kenworthy, W.J., Fonseca, M.S., and Whitfield, P.E. 2006. Seed bank, biomass, and productivity of *Halophila decipiens*, a deep water seagrass on the west Florida continental shelf. *Aquatic Botany* 84: 110-120

Heidelbaugh, W.S. 1999. Determination of the ecological role of the seagrass *Halophila johnsonii*; a threatened species in southeast Florida. Ph.D., Florida Institute of Technology, Melbourne, FL, 127 pp.

Hettler, Jr., W.F. and Chester, A.J. 1990. Temporal distribution of ichthyoplankton near Beaufort Inlet, North Carolina. *Marine Ecology Progress Series* 68: 157-168.

Iverson, R.L. and Bittaker, H.F. 1986. Seagrass distribution and abundance in Eastern Gulf of Mexico coastal waters, *Estuarine, Coastal Shelf Science* 22: 577–602.

Josselyn, M., Fonseca, M., and Niesen, T., and Larson, R. 1986. Biomass, production and decomposition of a deep water seagrass, *Halophila decipiens* Ostenf. *Aquatic Botany* 25: 47–61.

Kenworthy, W.J., Currin, C.A., Fonseca, M.S., and Smith, G. 1989. Production, decomposition, and heterotrophic utilization of the seagrass *Halophila decipiens* in a submarine canyon. *Marine Ecology Progress Series* 51: 277-290.

King, S.P., and Sheridan, P. 2006. Nekton of new seagrass habitats colonizing a subsided salt marsh in Galveston Bay, Texas. *Estuaries* 29: 286-296.

Koenig, C.C., and Coleman, F.C. 1998. Absolute abundance and survival of juvenile gag, *Myctoperca microlepis*, in seagrass beds of the N.E. Gulf of Mexico. *Transaction American Fisheries Society* 127(1): 44-55.

Lewis, F.G. 1984. Distribution of macrobenthic crustaceans associated with *Thalassia, Halodule* and bare sand substrata. *Marine Ecology Progress Series* 19: 101-113. (Have a copy)

Lindeman, K.C., R. Pugliese, G.T. Waugh, and J.S. Ault. 2000. Developmental patterns within a multispecies reef fishery: Management applications for essential fish habitats and protected areas. *Bulletin of Marine Science* 66(3): 929-956. (Have a copy)

Murphey, P.L., and Fonseca, M.S. 1995. Role of high and low energy seagrass beds as nursery areas for *Penaeus duorarum* in North Carolina. *Marine Ecology Progress Series*. 121: 91-98.

National Marine Fisheries Service (NMFS). 2007. Endangered Species Act 5-Year Review Johnson's Seagrass. Available on-line: http://www.nmfs.noaa.gov/pr/pdfs/species/johnsonsseagrass_5yearreview.pdf

NMFS. 2009. Amendment 1 to the Consolidated Highly Migratory Species Fishery Management Plan, Chapter 5: Essential Fish Habitat. Available on-line at: http://www.nmfs.noaa.gov/sfa/hms/EFH/Final/FEIS_Amendment_1_Chapter5.pdf

Onuf, C.P. 1996. Seagrass response to long-term light reduction by brown tide in upper Laguna Madra, Texas: distribution and biomass patterns. *Marine Ecology Progress Series* 138: 219-231.

Orth, R.J., Heck, K.L., and van Montifrans, J. 1984. Faunal communities in seagrass beds: A review of the influence of plant structure and prey characteristics on predator-prey relationships. *Estuaries* 7: 339-350.

Parrish, J. D. 1989. Fish communities of interacting shallow-water habitats in tropical oceanic regions. *Marine Ecology Progress Series.* 58: 143–160.

Pearson, T.H., and Rosenberg, R. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanography and Marine Biology: An Annual* Review 16: 229-311

Peterson, C.H., and Lubchenco, J. 1997. Marine ecosystem services. In G.C. Daily (editor), Nature's Services: Societal Dependence on Natural Ecosystems, pp 177-194. Island Press, Washington, DC.

Peterson, C.H., and Peterson, N.M. 1979. The ecology of intertidal flats of North Carolina: a community profile. US Fish and Wildlife Service Biological Services Program FWS/OBS-79/39. 73 pp.

Potts, J.C., and Manooch, III, C.S. 2001. Differences in the age and growth of white grunt (*Haemulon plumieri*) from North Carolina and South Carolina compared with southeast Florida. *Bulletin of Marine Science* 68: 1-12.

Ross, J.P. 1985. Biology of the green turtle *Chelonia mydas* on an Arabian feeding ground. *Journal of Herpetology* 19: 459-468.

South Atlantic Fishery Management Council (SAFMC). 1998. Final Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region. Charleston, SC. 142 pp. Available on-line: http://www.safmc.net/Default.aspx?tabid=80

SAFMC. 2009. Fishery Ecosystem Plan of the South Atlantic Region. Available on-line: www.safmc.net/ecosystem/Home/EcosystemHome/tabid/435/Default.aspx

Serafy, J.E., Valle, M., Faunce, C.H. and Luo, J. 2007. Species-specific patterns of fish abundance and size along a subtropical mangrove shoreline: an application of the delta approach. *Bulletin of Marine Science* 80(3): 609-624.

Sheridan, P.F., and R.J. Livingston. 1983. Epifauna inhabiting a *Halodule wrightii* meadow in Apalachicola Bay, Florida. *Estuaries* 6(4): 407-419. (Have a copy)

Smantz, A.M. 1989. Reproductive ecology of Caribbean corals. *Coral Reefs* 5: 43-54.

Steward, J.S., Virnstein, R.W., Lasi, M.A., Morris, L.J., Miller, J.D., Hall, L.M., and Tweedale, W.A. 2006. The impacts of the 2004 hurricanes on hydrology, water quality, and seagrass in the Central Indian River Lagoon. *Estuaries and Coast* 29(6): 954-965.

Stoner, A.W. 1983. Distributional ecology of amphipods and tanaidaceans associated with three sea grass species. *Journal of Crustacean Biology* 3(4): 505-518. (Have a copy)

Summerson, H.C. and Peterson, C.H. 1984. Role of predation in organizing benthic communities of a temperate-zone seagrass bed. *Marine Ecology Progress Series* 15: 63-77.

Thayer, G.W., Fonseca, M.S., and Kenworthy, W.J. 1997. Ecological value of seagrasses: a brief summary for the ASMFC Habitat Committee's SAV subcommittee. Pp. 5–10 *in* Stephan, C.D. and T. E.Bigford (eds.), *Atlantic Coastal Submerged Aquatic Vegetation: A Review of its Ecological Role, Anthropogenic Impacts, State Regulation and Value to Atlantic Coastal Fisheries.* ASMFC Habitat Management Series, No. 1. Atlantic States Marine Fisheries Commission, Washington, D.C. Available on-line at: http://www.asmfc.org/

Thayer, G.W., Bjorgo, K.A., Ogden, J.C., Williams, S.L., and Zieman, J.C. 1984. Role of larger herbivores in seagrass communities. *Estuaries* 7: 351-376.

Valentine, J.F., and Heck, J.L. 1999. Seagrass herbivory, evidence fotr the continued grazing of marine grasses. *Marine Ecology Progress Series* 176: 291-302.

Virnstein, R.W., Hayek, L.C., and Morris, L.J. 2009. Pulsating Patches: A model for the spatial and temporal dynamics of the threatened seagrass species *Halophila johnsonii*. Marine Ecology Progress Series 385: 97-109.

Virnstein, R.W., Steward, J.S., and Morris, L.J. 2006. Seagrass coverage trends in the Indian River Lagoon System. 25th Anniversary Inidan River Lagoon Symposium. 6 pp.

Walsh, H.J., Peters, D.S. and Cyrus, D.P. 1999. Habitat utilization by small flatfishes in a North Carolina estuary. *Estuaries* 22: 803-813.

Zieman, J.C. 1982. The ecology of the seagrasses of south Florida: a community profile. FWS/OBS-82/25. U.S. Fish and Wildlife Services, Washington, D.C. 158 pp. [cited in DCA 2001, so no need to send to CESAJ]

APPENDIX E

LAKE WORTH INLET

Palm Beach Harbor

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

JAN 23 2008

To Participants and Attendees:

Thank you for your attendance and participation in the Public Scoping Meeting held on January 9, 2008, to explore expansion alternatives for Lake Worth Inlet – Palm Beach Harbor, Palm Beach County, Florida. As discussed during the scoping meeting, the "scoping process" is used to determine the breadth of issues that should be considered during preparation of the Draft Environmental Impact Statement (DEIS), as required by the National Environmental Policy Act and associated regulations (40 CFR 1501.7).

The January 9th scoping meeting produced a broad range of views and issues with noteworthy potential for analysis under the DEIS evaluation process. The information obtained from the public meeting has been incorporated into the administrative record, in the form of a recorded transcript and written submittals. You may obtain a copy of the recorded meeting (i.e., transcript or written submittals), after February 1, 2008 from website: http://planning.saj.usace.army.mil/envdocs/envdocsb.htm#Palm-Beach-County under Palm Beach County, Lake Worth Inlet (Palm Beach Harbor), Florida. Please note this website will not contain information that is already publicly available or copyrighted. If you have any additional information that you would like to see incorporated into the DEIS and the information is relevant to the proposal, please submit to the Chief, Planning Division, at the above letterhead address within 15-days from the date of this letter.

Please be advised that your name and mailing information have been made part of the project's mailing list. Unless you indicate otherwise, this list will be used to inform when the DEIS is available for public review and comment in addition to providing notice for the public meeting to be scheduled on the DEIS.

I would like to thank you for taking the time to attend the scoping meeting and providing input into this process.

Sincerely,

for

Marie G. Burns
Acting Chief, Planning Division

Summary of Public Comments
Lake Worth Inlet (Palm Beach Harbor) Scoping Meeting
January 9, 2007

(Please note that this summary reflects points raised by speakers during the scoping meeting, as recorded on flip charts during the meeting itself. It may not include all points made by speakers. Further, these notes are not a complete record of comments; a transcription of the meeting is available for those wishing to review a verbatim account. Minor edits have been made for clarity when needed or requested by speakers after the meeting conclusion.)

Susan Markin, Town of Palm Beach resident

- Concerned about Port expansion
- House is near Port on Lake Worth
- Safety issues self-imposed due to bringing in large ships
- Area surrounded by small communities
    - Not Miami or Ft Lauderdale
    - Residents expect small Port with small vessels
- Recreational uses important and are economic generators
- Be cautious about Port expansion and impacts on communities
- Manatee impacts are a concern
- Aesthetic impacts are a concern
- Increased surge potential during storm a concern
- Impacts to sand retention in Palm Beach a concern

Peter Elwell, Town of Palm Beach, Town Manager

- Concerned about size and number of ships
    - Study should clearly identify the existing and proposed ship number and sizes and address the impact of larger and increased vessels
- Concerned about impacts to Peanut Island and recreational vessels (especially in Areas C, E and F) (note: Area F added by speaker after meeting)
- Concerned about water quality impacts due to vessels, especially larger vessels
- Change in coastal dynamics are a concern and technical information to address concerns should be included in the study. Concerns include:
    - Tides and tidal surge
    - Flooding
    - Beach erosion

- Blasting – If it becomes a possibility it will need to be studied and the USACE should notify the public immediately and provide expert information to the public
- Beach Erosion/Inlet Management – Want assurances based on extensive study that conditions will not deteriorate
- 100% of beach compatible sand should be placed on the beach

David Rosow, Town of Palm Beach resident

- North Lake Way resident in Palm Beach
- Naval B. G.
- Opposed to Port expansion
- Enjoy watching Port activities
- Should use tugs to guide in ships if needed; don't expand
- Connecticut has spent a lot of money on Port expansion with little result
- Most of Port traffic goes to islands where large ships are not used
- Will not get ships from China
- Plan is over-reaching
- Doesn't want large ships near his moored yacht
- Concerned about impacts to the north end of the island
- Impacts to people environment (recreation) will out-weigh benefits

Royall Victor III – Town of Palm Beach resident

- Shares many of same concerns as prior speakers
- Who wants expended Port? This area is recreational, doesn't understand who wants expansion.
- Is it true that USACE is CEO of Project?
    - Will information be gathered from all parties including federal, state, and local levels?
    - Who is in charge?

John Turner – represents the Teeter Agency

- His client wants expansion, as do most Port users
- Port capacity is connected to regional economy
- Real and immediate problems with existing shipping, not to mention expansion of shipping industry
- This project is about restoration of existing business, not just expansion
- Lost business = increased in consumer goods cost
- Teeter Agency family business impacted by channel constraints
- Hopes USACE takes methodological approach as win/win for business and environmental concerns

Rich Vogel – Vecenergy

- Asphalt and diesel business
- Maintenance and safety concerns with channel
- Favors dredging
- Have to bring in more small vessels instead of less large vessels due to channel constraints
- Problems with doing business caused by channel constraints
- There is a lot of interest in this Port internationally (including in South America)
- Safe, environmental project favorable

Dick Bresee

- This will be another disaster – don't need study to determine this
- More water and energy in intracoastal and more beach erosion will occur if project constructed
- Principals of gravity – more material will move down grade
- Singer Island – increase beach grade, more sand will move off beach, residence time of sand on beach will be longer
- This will make beach problems worse – sand will not reach Town of Palm Beach
- Sand carried by current dependent on velocity – will get more erosion
- West Palm Beach and Palm Beach having problems with retaining walls
    - Increased volumes of water could negatively impact retaining walls
- Bigger ships – more energy to move ships, more prop wash, more material fluidized
- Instead of expanding channel should dredge continuously – this will resolve shoaling and lessen severity of events
- Compare Port income to beach income
    - Will Palm Beach be an industrial county or good place to live and for tourists?

Dr. Kuvin

- Resident of Palm Beach on north end
- Will be impacted by expansion
- Not navigational safety issue – rather consumer issue
- 40 years ago, USACE here
    - Blasting plus dredging impacted surrounding communities
    - History of inlet and dredging should be addressed by study
    - Residents awarded damages
- Significant environmental damages mentioned in scoping letter
    - Need to be sure that impacts to human species addressed
- 2005 El Paso Gas Seafarer Project
    - Was defeated due to small size of Port

    - Other areas more receptive
    - Commerce responded to local interests
- Area still recovering from hurricane damage
    - Residents should not allow another disaster (this project)
- Noise and air pollution
- Vibrations
- Red mite pollution
- Bilge pollution
- Increased flooding threats, particularly in IWW
- Increase in beach erosion
    - Global warming, hurricanes also
- Project will allow bigger and better and larger ships @ 600-900 feet, which can't turn in turning basin
- Increase in homeland security concerns including increase in terrorism threat and more homeland security vessels in channel
- No Action Alternative
    - Residents urge this alternative
    - Will save tax payer dollars
- USACE under pressure – news article quote
    - Need to discipline dysfunctional agency
    - Spend money where reward will out-do risk
- USACE has done good
    - Maintained inlet and placed sand on beach
    - But not done out of charity
    - Is risk worth commercial reward?

Terry Gibson

- Represents recreational fishing interest and Surfrider member
- Doesn't understand what most aggressive option would be
- Alt A – Are these jetty expansions?
- Value of fishing, reefs, diving
- Proceed with lots of stakeholder involvement
- Seagrass locations important to value of habitat
    - Those closest to inlet support more juvenile reef fishes especially snappers
    - Proximity to reefs – shorter migration which equates to greater survival of fish
- Seagrass assessments in D, F and G understated in presentation
    - Has seen Johnson's seagrass in 30 feet of water
    - Robust communities in project area
    - Need to look at area larger than 150 feet to assess turbidity impacts
- Don't undermine excellent habitat restoration efforts in vicinity

- Snook spawning in inlet
    - Need to avoid impacts to this activity
    - No activity (such as dredging) should occur during spawning
- Turbidity concerns
- Do not consider recreational boating in safety analysis – this is a safe inlet
- Sand should not be placed in inlet
- Inlet deepening could impact beaches
- Manatees could be impacted
- Sediment quality and impacts should be assessed
    - Impact to fish communities
- Keep process transparent
- Will help with information

Lynne Purvis – County resident

- Everglades Earth First representative
- Need for project has not been addressed
    - Before study conducted determine if needed – wants cargo statistics
    - Is project most cost effective approach?
    - Is there better way to get needs met locally?
    - Cost sharing not clear
- Supports all other speakers for No Action Alternatives
- Holistic approach needed
    - Oil needed to ship in foreign goods
    - Global warming, pollution and war should be addressed
- More creative alternatives should be considered
    - Spend money effectively
- Everglades
    - Restoration has been languishing
    - Why allow more impact?
- Will business owners participate in mitigation?
- Use less technical term in environmental presentations

Sam Oser

- Before anything done, there will be a study
- His vision – County is going to grow
    - Will have scientific community
    - But also people who need work
- Hopes for win/win situation
- Ports to south are loaded, this Port ideal for expansion
- Growth, progress will happen whether we like it or not
- Meet needs of all people

- Lori Baer best thing to happen to Port
- Quality of life important, but brilliant engineers will study

Dr. Lilja – Town of Palm Beach resident

- Reasons for change
    - 300 ft vessels running aground – valid concern
    - 900 ft vessels in future – concern
- OK to improve channel for existing vessels
    - Dredge before shoaling
- Gulf Stream
    - Not pushing to north
    - Nearshore current flows to south
- Studies on sand differ
    - Get true evaluation of grain size

William Djubin

- In collaboration with Reef Rescue are starting water quality monitoring
- Confused by presentation
    - Is project for existing navigation or to enlarge channel?
    - Are we trying to increase imports or exports?
    - Economic generators in Florida -1 Energy 2 Agriculture and 3 Tourism
    - If expansion is to increase business, has more concerns

Gerald Ward

- Not appropriate to formalize pro or con positions for scoping
- Requests copies of meeting documents and hard copies of DEIS and FEIS (cited rules and regulations)
- Are comments due in next 11 days?
- Study schedule too long, finish by first quarter 2009
    - Same money – citation requires response to this suggestion
- How many pages will EIS be?
    - Should be less than 150 pages to avoid confusing public
- Alternatives
    - 8 alternatives or combinations
    - Need to add "Similar Action Alternatives"
        - Reduce existing depths – do not serve bulk cargo
        - This will open up more berth space
- Between two major Ports – Canaveral and Everglades
- Increase Island trade and containers
- Small ferry and cruise vessels
- Port is niche Port – small Port

- CRA Report almost complete, needs to be incorporated into study
- State comprehensive Plan requires that Port accommodate public needs
    - Use cruise terminal for public
- A1 and A2 don't make sense
- E doesn't make sense – contrary to USACE manuals
- G most economic potential – will use FPL bulkheading
- Ecological impacts minimal
    - It is only because of Port that resources are what they are now today
- Tides and surge
    - 1960's deepening almost doubled tidal range
- Economics should drive study

George Williamson – Cemex (formerly Rinker)

- Construction materials company with two facilities in Palm Beach (cement and aggregate)
- Aggregate business at Port struggling due to channel constraints
- Deeper is better – volumes reduce customer costs
- Supports efforts to deepen
    - 40' good
    - Can substantially increase input
    - Ensure supply to users

1

2 _____

3

PUBLIC MEETING
4 LAKE WORTH INLET FEASIBILITY STUDY

5 _____

6

7

8 Wednesday, January 9, 2008
Port of Palm Beach
9 One East 11th Street, Suite 400
Riviera Beach, Florida 33404
10 3:00 - 5:31 p.m.

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 DAIS:

2 Richard McMillen
Marie Burns
3 Kenneth Dugger
Donald Dies
4

5
Lori Baer, Port Director
6

7

8

9

10 - - -

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

P R O C E E D I N G S

- - -

RICHARD McMILLEN: I want to welcome everybody to the first public meeting of the Lake Worth Inlet Feasibility Study. This is one of our first meetings in a series of meetings. And let me dispel some of the fears that some of you may have right now.

You will not be seeing any construction going on or expansion of the Port or channel widening or dredging in the Port facility for at least four to five years. You won't see it tomorrow, you won't see it next year.

This is the first public meeting related to the Port -- not Port facility, but the channel widening of the federal navigation channel, okay?

The reason for our study is because we have some navigational safety issues surrounding our federal channel out there. The

vessels are getting longer, they're getting wider. Currently we're having a problem getting those vessels in and out of this inlet right now, particularly the oil vessels, the fuel vessels for the power plant. We have some

other cargo that's running into problems.

Our navigation channel is posing some restrictions. It's authorized for 33 feet. It's currently shoaled up to 29 feet. Harbor pilots are restricting the channel to 29 feet and less. And we've continued to experience these types of problems for the last several years, and that's what we're down here for as part of the federal study. And it is a federal study, folks.

The Port Director, Lori Baer, has brought this concern to our table. We have known about it for a while and we've finally been able to get Congress to give us some money and authority to move forward with this study. And that's where we're at right now, starting off with the first public meeting here, okay?

As I mentioned, the reason for looking at this is to address a navigational safety issue getting vessels in and out of the existing

21 projects, okay? In the process of doing so,

22 we'll be looking at deepening, we'll be looking

23 at widening and realigning some of the channel

24 to make it easier and safer for most vessels to

25 get in and out.

The reason for the public meeting is this is part of what we call our NEPA scoping process. NEPA process. NEPA stands for National Environmental Policies Act. It is an act passed by Congress that requires us to go through an exhaustive environmental investigation on any of our federal projects to ensure -- to minimize impact to environments. Okay?

The purpose of the meeting is to solicit your comments. I'd like to say the good, the bad, the ugly, the indifferent, the for, the against, and we'd like all that, but to be more specific as to what your concerns are as we go through this process, okay?

As I mentioned, I once again strongly emphasize that this is a federal process. This isn't a Port process, this isn't a Palm Beach County process, this is the federal process and, as I mentioned, it's very lengthy, trying

and full of tribulations as we get to our ultimate goal; and that is, addressing those navigational issues.

As we get ready to move forward here, before we move forward I'd like to state that

as part of the federal process, as part of these federal projects we have non-federal sponsors. The federal government doesn't pony up one hundred percent of the bucks for these federal projects. We have to have sponsors that initiated or wanted or expressed a need for a federal project. And our sponsor in this case is Lori Baer, the Executive Port Director for the Port of Palm Beach.

And Lori, if you have any comments, now is your time.

MS. BAER: Good afternoon. Welcome to the Port. It's a privilege for me to be able to welcome you here. And we're pleased that this federal study is now underway.

You know, the safe navigation into the Port is critically important. It's a huge responsibility and we're sincerely interested in this study and hearing your input today and throughout the process.

The Port of Palm Beach, as you all know, is a huge economic engine. Many lives and livelihoods depend on it. Many of our tenants are here today, and you'll hear from them as well. Again, we are pleased that this federal

study is now underway, and I thank you all for coming today to be a part of it.

Let me introduce our Port Commissioner, George Mastics, who is here and known to many of you. And I also thank Steve Martino, who is here from Senator Martinez's office. And thank you for being here and thanks to the senator for all his help as well.

Again, welcome to the Port. We look forward to your input.

MR. McMILLEN: Thank you, Lori.

Let me take a moment and introduce the Corps' project delivery team as well as members of the Port's project delivery team, as we are working cooperatively together to reach some solution to address navigational needs out there.

The lady dressed in purple up here, not the lady in red, is our chief of our planning division currently; and that's Marie Burns.

To her right is our navigational technical lead, he's our senior tech, he's been with the Corps as long as I have, if not longer, I'm sure; and that's Dick Powell, upon whom we rely upon heavily for all of our navigational

experience.

The person to his right is a gentleman by the name of Don Dies. He's with the Port's project delivery team. He will be one of the environmental leads investigating environmental resources within the area and within those designs that we came up with.

We also have in the back at the table back here a lady by the name of Samantha Brucker. She's my study manager for this project.

We have -- down here in the front row we have Amy Kimball Murley, with the Four Gates Company. She is working as a consultant for the Port.

Also working as a consultant for the Port is Nancy Case O'Bourke. And I promised I was going to get her company's name right; and that is Dalton, Almsted and Fugelbee (phonetic}. All right. I got it right. Okay.

And back there in the back, I'll just

bring her to attention, from our South Atlantic division office in Atlanta is Angie Primo. She's down here to partake in this public meeting as well.

Have I forgotten anybody?

Oh, right there in the front and center, one of the more critical people, also our environmental lead from the Corps, he will be instrumental working with Don Dies with the Port environmental lead, and that's Ken Dugger. He will be giving a presentation later along with Don Dies.

Okay. Reviewing the agenda, what we're going to talk about today -- break this into two phases: The first is to provide you with some information, information on the federal study process, as I have reiterated several times already. We're going to brief you on what the NEPA process is, the National Environmental Policy Act process, as that's a process we have to go through to develop the federal project. We're going to talk about those study areas of improvement that you saw in your letters or that graphic that showed some of the areas that we're looking at.

I want you to understand, folks, that we're taking a very broad brush stroke as trying to address what these navigational safety issues are out there. We do not know as yet what it is we're going to be doing. But

the last thing we want to do, since it's nothing short of a miracle to go through this federal process, we want to make sure we cover all the bases up front and then start whittling it down to something that's workable. So that's the reason you see the broad brush stroke; all of those alternatives listed on that graphic that you saw.

I will be talking to those alternatives after Ken Dugger does his NEPA process presentation. Then we'll have a presentation from Don Dies on the ecological scoping, some of the resources in those particular areas that we are concerned about, and what he has found to date.

And then what we'll do is I'll close out the first part of our meeting and take a break and we'll set up for Q and A, comments and answers, and we'll do the best we can to answer your questions.

Remember, this is not a debate. We're here to get your comments back. If we do not have an answer to your question, it's not because we can't give it to you, it's because we don't have the information yet. This is a

four to five-year process, remember, and this is the first meeting of a series of meetings to be held on this. I'm trying to solicit your comments so we can begin addressing your concerns as we go through the evaluation of the alternatives and coming to a solution here.

All right. After having said all that, let me tell you about the federal study process, which is nothing short of a miracle that we ever get through it. Those of us who have been in the federal government can attest to that. Even those consultants who work for us can attest to that as well.

The federal process starts with somebody, some entity, some taxing district saying we want a federal project. We have a need. We have an issue down here. That entity -- in this case it's the Port -- goes to the congressman and says we need some help. The congressman turns around and passes a

21 resolution. Truly, it takes an act of Congress

22 for us to do anything. Congress authorizes us

23 to begin a study.

24 Authorization is one thing. We need money

25 to go with it. And that's where the

appropriations come in, all right? Appropriations is the money.

We received funds in 2005 to begin a recon study. We took a broad brush stroke of the inlet of the federal navigation project out there and we found that yes, there are some serious concerns that we had to look at. A recon study was approved by our higher authority in 2005. We ran into funding issues in 2006. Therefore, we did not start the feasibility study in '06, we didn't start it in '07. Actually, let me rephrase it. We started it in July of '07 is when we kicked off the feasibility study. And thanks to the Port, they advanced their funds.

The feasibility study's costs are fifty/fifty and we're looking at about a $2 million type study here. So the Port has ponied up roughly three, four hundred thousand dollars for us to initiate and get moving

21 forward. We're waiting for the federal dollars

22 to come down in this next appropriations bill

23 is where we stand right now.

24 Now, what happens during the feasibility

25 process, feasibility process we begin taking

data, collecting data, environmental data. We go out to take sand samples, core borings, all that physical data we need in order to begin the engineering.

We're going to be looking at the sand out there, we're going to be trying to identify where the top of the rock is out there, we're going to be looking at, as Don Dies will say in his presentation -- I don't want to steal his thunder -- we'll be looking at a number of environmental resource studies to be conducted. We'll be looking along the shoreline across the coastal processes to try to address the shoaling issues within the channel, so we have to take surveys of the beaches as well as the channel itself, looking at historical information.

We're going to be pulling all of this together, trying to identify what information we have, what do we need now. And that's what

we're going to be doing over the first part of this year; is basically collecting a lot of data because we can't do any engineering without the data.

One of the other things we're going to be

doing is running harbor simulation. Ship simulation. Pardon me. Harbor simulation as well, which is running the benefits, finding out what benefits are to deepening, widening to improve navigation.

We're going to be running ship -- taking various sized ships in and out of that Port in a modeling type effort to find out where the currents are, the physical forces on those ships out there currently. What happens if we do this to the inlets, navigation channel, what kind of impacts do these improvements have on that ship? So we're going to be designing it properly. We're going to be running those type of modeling efforts throughout the course of the next two years.

As we go through the engineering, the alternatives that you have seen in that little piece of paper that came out in the scoping meeting that you saw -- and we'll talk to those

here in a minute -- we're going to be looking at every one of those alternatives, not only from an economics perspective and environmental perspective but the engineering perspective and also from a funding perspective, okay?

As to when we go through our feasibility process, the federal government, the federal process, we have to look at national economic development benefits. What's the best -- what's the most bang for the buck? That's the federal government process. What can we get the most bang for the buck? We're going to be looking at all those alternatives individually, combining a few to find out what is going to work the best and get the most bang for the buck as we go through that process.

Now, as we go through that feasibility process there's going to be public meetings along the way, okay? As we go through that, we'll probably have the meetings down here or at some venue. And we're going to be doing the same thing as what we're doing today. We're going to be asking for your concerns, posting information out on a website for you to go look at and comment on, and we'll talk to those type

ideas here in a moment.

As we get through the feasibility process, at the end of that feasibility we have a document that's been approved, it's been coordinated, most everybody has approved it and

likes it, likes the design.

What happens then is it goes up through our review chain up to headquarters for approval and it goes through several independent technical type reviews both inside the Corps as well as outside the Corps.

Once it passes those internal reviews, it goes up to the Assistant Secretary of the Army's office for approval and then basically over to Congress for them to authorize.

Remember, I mentioned authority. Congress -- we do not act on a whim. Congress has to direct us to. Right now all they have done, all the authority they have given us is just the authority to conduct a study. They have not given us approval to construct anything. That approval comes after we have prepared a document, made a recommendation, it's gone through the entire review and approval process and the NEPA process, which

Ken Dugger will explain here in a moment, goes to Congress, then Congress authorizes it.

Congress authorizes federal projects every two years generally speaking, okay? The last authorization Congress made was year 2000,

except for recently. They made an authorization, they passed an authorization bill here a couple months ago, 2007. So it's been seven years since Congress passed an authorization bill authorizing a project, authorizing either a study or authorizing to go to construction. The next window of opportunity for us to get this project or these improvements authorized is 2010. That's the date that we're looking for to complete the study, get it reviewed and approved and get Congress to authorize it.

Once Congress authorizes it, they still have to give us the money to go build it. It comes in the form of an appropriations bill, as I mentioned before. The earliest we're going to probably get appropriation funds and move forward with construction, earliest -- like I said, it will be a miracle if we get there -- but we're shooting at a target on the wall

that's 2012, okay? So that's the federal process as we go through that on just this study. I can get into the whole intricacies of it, but I'm sure that will invite all kinds of questions and confuse you to no end.

Let me back up a moment and clear up a couple things. The study information -- as we go through the study process we're going to be setting up a website with the study information out there on the web for the people that go look at, for the public to go view and take a look at, okay? On the back here you'll see some web sites for you to look at.

Now, we, the Corps, have not officially got our website for this particular project up and established yet. The Port does have a website that we're putting stuff on currently for people to go view, and I believe your website -- yes, it is Port of Palm Beach. So you can go take a look at that.

Also as we go through this public meeting process, we have a court reporter down here that's taking everybody word-for-word. You're on record. Legal and the whole bit.

At the same time as when we get to the Q

and A we're going to be writing your comments on a flip chart and posting them on the wall over there. So before you go, you leave today, make sure you check the flip chart out to see if we captured your concerns correctly because

as we go through this process we want to make sure that we've addressed those concerns. In order to address those concerns we want to make sure we've captured those concerns accurately, okay?

Let's see. Basis for the decision for federal project. What makes a project, what approves a project, how is a federal project justified? Comes down to simple benefit versus cost. The benefits are going to be the cargo that runs in and out of the Port. Also the safety issues; the benefits of a cargo coming in and out safely versus the cost. Those alternatives that you saw, those areas we're concerned about and wanting to look into, what's the cost of expanding into those areas singly or in multiple options there to consider. We start comparing those costs versus the benefits we have, and that's where we get to the most bang for the buck; which is

21 going to give us the best benefits to cost

22 ratio?

23 I think I have covered pretty much the

24 federal process. I'm sure I have confused most

25 of you. It confuses me, and I have been at

this for 18 years, and they continue to change the rules on me from time to time. But without further ado on that part, let me have somebody come up here who's going to confuse you even further with our NEPA process, okay?

Ken, do you want to come up and lead us through the NEPA process?

MR. DUGGER: Yes. I am going to talk a little bit about the scoping process and what is the purpose of the scoping meeting and where it is in the sequence of events.

The purpose of the scoping is to determine the scope of the Environmental Impact Statement. That is, the issues that are to be evaluated in detail or not to be evaluated in detail, alternatives to be evaluated, any studies needed, the various procedures to accomplish the Environmental Impact Statement and other matters relating to the scoping process I won't get into. They're technical

matters.

The Environmental Impact Statement process can be divided into basically six phases. The process formally kicks off with a Notice of Intent that's published in the Federal Register

and also a mailing. This particular Notice of Intent to prepare this draft Environmental Impact Statement was published in the Federal Register on 13 December and was mailed out on 6 December. And in the next step, which is where we are today, is the scoping process, and we're holding a public scoping meeting.

To follow this meeting we would begin preparing a draft Environmental Impact Statement that will accompany the feasibility study, and when it is ready for public release it will be announced in the Federal Register and by mailing and there will be a public meeting on that draft Environmental Impact Statement and feasibility study.

Following that would be the final Environmental Impact Statement and feasibility study. And a record of decision would have to be made by a higher authority before any action is taken on the selected plan, whatever that

21 happens to be.

22 The purpose of the study and the thing

23 that's being evaluated in the Environmental

24 Impact Statement will be the needs and

25 opportunities associated with Port improvements

to accommodate first, future commercial fleet, to more effectively transition the existing fleet, and we will be looking at various alternatives: Widening and deepening, various disposal options, and other alternatives that may become apparent through the process.

We will analyze these alternatives from an engineering perspective. For example, coastal processes, constructability and other issues, economics. That is, what are the economic benefits and what are the economic costs of these proposed alternatives and the environmental impacts of the various alternatives that are being evaluated?

You probably can't see this very well. There's a lot of detail in it. What this shows is the existing channel, and these are some of the limits of the study area. Now, of course, these limits do not mean that's the limits of dredging. That's just the limits of areas that

will be studied and considered.

Some of the issues that will undoubtedly be evaluated in detail will deal with protected species, such as manatees and Johnson's sea grass, any wetlands or other water resources,

such as other types of sea grasses, hard ground, including perhaps coral species, any mangrove or marsh that might be impacted, water quality impacts, turbidity and nutrients, esthetics, recreation, cultural and historic resources and impacts to those, socioeconomic impacts. And we will also look at ways to mitigate those unavoidable impacts and any other issues that we may identify through the scoping and Environmental Impact Statement process.

Alternatives under the National Environmental Policy Act, we have to consider the no action alternative. We will also look at deepening various depths and widening at various locations, and to various extents disposal options of the dredged material. For example, Peanut Island might be a temporary facility for handling dredge material. Might later be off-loaded to somewhere else; ocean

disposal site. There is a designated ocean disposal site for Palm Beach harbor that will probably have to be expanded to accommodate the quantity of material that might come out of the suggested project.

Beach placement. If we have good sand material suitable for beach placement, then we would look at beach placement options and for artificial reef. If we have suitable rock, suitable size and composition, it might be placed on an existing artificial reef or create a new artificial reef.

Other alternatives and measures that might be identified through the scoping process or through the environmental impact process could also come into play.

Studies. There are existing studies: Sea grass survey, natural resources survey and others referenced in the report and in the website, which was referred to earlier. And also we're looking at needed studies. That's also one of the purposes of scoping. Do we need to conduct additional studies?

Mr. Don Dies will speak in more detail about existing and ongoing and proposed

21 studies.

22 This website is on the back of your

23 agenda. You don't have to write it down right

24 now. We're posting information as it becomes

25 available on this website, and there are other

web sites on the back of your agenda.

Procedures. I'll reiterate this real quick. The six steps, Notice of Intent, prepare the Environmental Impact Statement, the scoping meeting, which is where we are here today, the draft Environmental Impact Statement is prepared, then we publish a Notice of Availability and hold a public meeting on the draft Environmental Impact Statement, prepare the final Environmental Impact Statement, do a Notice of Availability of the final Environmental Impact Statement, and prepare a record of decision.

Various agencies will be involved in this process, the Corps of Engineers being the lead federal agency for the Environmental Impact Statement. Other federal agencies would be the Environmental Protection Agency, Fish and Wildlife Service, National Marine Fishery Service.

The Port of Palm Beach is the non-federal cost sharing sponsor. Palm Beach County would be involved, the Florida Department of Environmental Protection and other state agencies and any other roles or agencies that

we identify in the scoping process.

As I mentioned earlier, the U.S. Fish and Wildlife Service, a Fish and Wildlife Coordination Act report would have to be prepared by or for the Fish and Wildlife Service concerning this project and any recommended plans.

The Endangered Species Act would involve the Fish and Wildlife Service as well. The National Marine Fisheries Service would also have some Endangered Species Act listed species involved, and they would be involved with the coordination as well. Also the National Marine Fisheries Service, we will provide to them an Essential Fish Habitat Assessment for their review and comments.

The Environmental Protection Agency is responsible for publishing the notice in the Federal Register of the Environmental Impact Statement, and they also have a responsibility

to review the adequacy of the Environmental Impact Statement. And there may be other roles or agencies identified.

As I mentioned earlier, the Department of Environmental Protection would issue the water

quality certification. They would also be involved in the coastal zone consistency concurrence. The state clearinghouse, which is the clearinghouse for state and regional agencies, would be involved in the coastal zone consistency concurrence as well, and there could be state-owned lands involved. The state historic preservation officer would be involved with respect to any impacts to cultural resources, historic resources.

The Fish and Wildlife Conservation Commission would comment on impacts to fish and wildlife resources. And there could be other state agencies involved as well.

We also involve elected officials, such as the representatives in Congress, the representatives in the Florida legislature, the Town of Palm Beach, Riviera Beach, Palm Beach County, West Palm Beach, Palm Beach Shores and also adjacent property owners, Florida

Power & Light, condo homeowners and various groups, environmental industry or development groups and any other interested or affected parties.

We are developing a mailing list for this

action. If you want to be included in the mailing list, you can submit your name and address. In fact, on your registration card you were given that opportunity. Or you could submit the name of some other interested party or stakeholder to be included on the mailing list.

Oral comments. As Rick mentioned earlier, we will be taking oral comments here and they will be transcribed or you may submit your comments in writing and they will become part of the record. There was a comment sheet provided at the registration table if you would like to use that or any other form that you feel appropriate. And also the mailing address was on one of the sheets that you received when you came through the door. The comment -- and the comments card. The comments sheet.

MR. McMILLEN: Thanks, Ken.

Okay. I might add to what Ken had to say

with regards to the draft EIS or the final EIS.

In the past when we prepared these federal feasibility studies there were two separate segregated type documents. We have the feasibility study and then we have the EIS

running separately, and then they'd come together as one document. Now our policy and procedures are to integrate them so it's only one document. So when you grab the document to read, you will see everything comes together as one. You're not having to jump to Environmental Impact Statement to look at things.

What I mean by that is the feasibility studies, they are at least two to three inches thick and there's always a yellow or a green document in there that was an EIS, and the white part or the feasibility study would refer to the yellow part. Now it's all one document so you can read it as you go along. It should be easier to understand, easier to comprehend.

Another part of the agenda today is for me to describe to you the areas that we're looking to evaluate for consideration and address navigational safety issues, the channel

widening and the deepening areas. Let's start on the outside and work our way in.

We come up with these alternatives from the Port, from our own engineers, from the harbor pilots. We relied heavily on the pilots

since they're the ones that have to navigate the ships in and out. What we found out from the harbor pilots is that area A1, where the ships approach the inlet, they come in from the south because the Gulfstream currents, they use the Gulfstream currents to push them into alignment with the channel. They kind of glide in. Then as soon as they hit the channel, the throat of the channel, they have to goose it and race into, through the throat to the channel. So we're looking at doing this taper on the outside. That's generally deep water. What we see there is just a realignment on paper of what the federal channel is. We'll be investigating those areas. We don't anticipate any serious construction needs, if any at all, in those particular areas.

As we get inside the throat there, we're looking at widening. The ships that are coming in for future vessels are going to be wider.

21 Also, if we can widen those areas, it provides

22 us a better safety issue for the pilots to

23 navigate those ships in there.

24 As we get into the area around C, you can

25 see in the pink where the existing federal

navigation channel takes a dogleg. It not only takes a dogleg, it gets shallower in that area and narrower. It makes it difficult for the pilots coming in. So we're looking at evaluating area C to give those ships an easier approach into the turning basin as it comes through the inlet.

Area D right there, we're looking at area D because the pilots and some of the traffic coming in there, it gives them a better alignment into those berths directly behind Peanut Island in there and it gives them a safer opportunity to approach those berths.

In area E, it's been brought to our attention that we're looking at possibly expanding the turning basin; basically, doing a little widening of the turning basin in there to give the ships an opportunity to turn better and approach the berths as well.

Area G is the same reason. As the ships

21 get longer, they get bigger. Right now we're

22 currently having some problems in our turning

23 basin as the ships get longer and bigger and

24 turning around. So you see, we're looking at

25 those areas from purely a navigational and

safety issue because it only takes one incident of a ship running aground in this area -- you can only envision what a tanker bringing crude oil or fuel oil for the power plant would do, and it creates -- we've got a big mess.

Those are our concerns that we're trying -- one of our major concerns. We have to improve the navigational safety of those ships coming in and out of this inlet.

So with that -- that's a very short synopsis of those areas and why we're looking into those areas. With that, I'm going to turn it over to Don Dies, who's going to explain to you some of the resource issues we're looking at in those areas and what we have to address.

Thanks.

MR. DIES: This effort represents the first stages of understanding the resources from available information and beginning to plan the future field efforts that need to be

21 done. The purpose of our study is to -- within

22 the potential project expansion area -- is to

23 collect the existing community information and

24 create a GIS database and also a literature

25 database and then to plan and conduct resource

surveys to assist in compliance and environmental laws and regulations. We're just now beginning to plan those field surveys.

The location of the project area is within Palm Beach County and North Lake Worth Lagoon, Port of Palm Beach, Lake Worth Inlet and the surrounding communities.

This is the existing federal harbor project. You have already seen that. And the potential expansion zones. Our study will actually go beyond that. 150-foot buffer area around each of the zones also. We will be looking at in-water resources, not going on land, so they'll truncate in the water.

We have already approached federal agencies; Corps of Engineers, National Fishery Service, U.S. Fish and Wildlife Service, state agencies, FDEP, South Florida Water Management District, local agencies. Palm Beach County DERM has been very helpful. And private

21 companies, such as FP&L and NGOs and

22 not-for-profits. Wildlife Trust has given us

23 data also.

24 First starting within the wideners area,

25 A1 and A2 in the offshore environment, I'm

going to go through some of the information we have collected in our GIS database.

This is 2003 Laser Airborne Department sounding data. What this does, this is provided by FDEP. It provides depth and the ability to simulate contours and relief in the offshore environment. And this combined with, just off the press, it is the reef mapping done by Nova Southeastern for the Southeastern Florida Coral Reef Initiative. This is reef mapping, and these different features, this is all sand here, this is the offshore reef, the natural offshore reef, this is an artificial reef signature right here, these are the rock piles. This is former material that was taken out of the channel during the original dredging of the channel, deposited here, boulders in this area, and it is an artificial reef type of environment. There's a little signature up here. I think it's just an artifact. This

data was field verified to some extent, but not too well in this area, so I think that's just an artifact.

If we combine these two layers together into depth contours and also the self-created

data, you can see most of the depths in the reef environment are deeper. They're in the order of 50 feet or greater, 55 feet or greater. And the rock pile is also deeper. In the area of 55 feet. Some of the sand areas are shallow. Thirty-five feet in the southern widener.

Now, moving into the inlet throat proper, these are our survey areas and potential expansion. They're mainly shelf areas, and also the inlet walls themselves. There haven't been any real studies done in this area. We do have the 2003 Laser Airborne Department sounding data that does penetrate. It was intended to be an offshore study, but it did penetrate into the inlet, and it provides us a depth contouring where you can see the inlet walls themselves in the shelf area behind it and the riprap of the inlet. Same on the south side.

Just initial surveys have shown this is a definite rock area here that was cut. These are cut through rock area also, north and south.

Into Area C, this area is mostly a hard

bottom area between the marker 8 and the range finder here.

We do have several survey studies that have been done in the past. This is a 2001 sea grass mapping done by Palm Beach County DERM. It does have field verification associated with it. And you can see some sea grass areas coming into this southern area around Peanut Island.

We also have a 1992 statewide sea grass survey done by Florida Marine Research Institute. This was less field verification, mostly done by aerial imagery interpretation. You can see a continuous sea grass area coming into the soft bottom area behind the range finder.

We also have a 1990 Palm Beach County Submerged Natural Resource study. This wasn't done by NGIS, and so what we've had to do here is kind of stretch the information to fit the

GRRIS format. But you can still see features on here. You can see the hard bottom area over here, and you can see this shows up as a hard bottom feature here, and that same sea grass area just continues a sea grass area coming in

right there.

Area D behind marker 12 here, south of Peanut Island, again our survey area will be truncated at land's edge and be concerned with water resources.

We do have the 2001 sea grass data from Palm Beach County DERM, and it shows a continuous sea grass bed in that area and some discontinuous sea grass. That will be mainly be the halophilous species.

1992 shows discontinuous sea grass area beds in that area, and the same is true of the 1990 submerged bottom studies.

In this area is Johnson's's sea grass and Halodule shoal grass.

Area E is actually the northern extension of the Intracoastal waterway, and this is the 2001 sea grass data and also the 1992 combined because there wasn't really anything that really entered the study area at all with

21 those. And then the same is true really with

22 the 1990 submerged aquatic resource data.

23 Area F is south of the Port channel and

24 south of the basin area. The 2001 data, I'd

25 like to point out here, this is actually the

FP&L heated water discharge point right here. They moved it out into Lake Worth Lagoon several years ago and you can see copious and discontinuous sea grass beds in this area.

This is the 1992 Florida Marine Resources Institute data. Discontinuous sea grass beds throughout this area.

And the 1990 data. This pretty much indicates to me a cover of -- summertime cover of halophila decipiens, paddle grass.

This is Area G along with its buffer area. You'll see a signature right here of an algal mat. This is 2007 aerial imagery, by the way, from wintertime 2007. You can see 2001 sea grass imagery sort of follows that.

This is sand down in this area. Follows that pattern with continuous and discontinuous sea grass beds.

The 1992 statewide FMRI data is pretty much discontinuous sea grass beds throughout

that area, and the same is true of the 1990 submerged aquatic resources.

More detailed information about sea grasses just from the literature itself, Lake Worth Lagoon sea grass species dominant are

shoal grass, halophlia wrightii, paddle grass, halophlia decipiens and Johnson's sea grass, which is a listed threatened species. Infrequent species are turtle grass, manatee grass and star grass, another halophlia species. These are found mainly in the northern part of the lagoon north of Blue Heron Boulevard.

Lake Worth Lagoon sea grass coverage, these are the 1941 interpretation of aerial imagery available at that time. You can see a very low point in the lagoon sea grasses in 1975 because of poor management of the lagoon waters, allowing surface water runoff and sewage treatment plant outfalls into the lagoon area.

A clean-up of that and a resurgence of sea grasses in the 1990s back up to about 50 percent of the level. The difference between the 2001 and 1990 is not really

21 significant, the differences between there.

22 This could be mapping error. So about two

23 thousand acres, about 50 percent of what was

24 estimated to be in the 1940s.

25 Most of your sea grasses -- this indicates

most of your sea grasses are in the northern part of the lagoon, and most of your sea grasses are found in six feet of water or less.

This is the 2001 Palm Beach County sea grass mapping effort within the lagoon area, just to give you an overview of that.

Sea grass surveys were conducted in 1975, 1990 and 2001. Since 2000 Palm Beach County has been conducting annual monitoring of nine transects located throughout the lagoon. There's been little change in those surveys except after 2005, and that was really due to the strong 2004/2005 hurricane season with two significant hurricanes in 2004, Jean and Francis, and then also Katrina and Wilma adding a lot of water to the area in 2005.

Moving now to manatee aerial data, this is 2007 surveys done in February; two different dates in February. You can see here between 150 and 300 manatee, and mostly in the area of

the FP&L discharge along the shoreline, and then manatees also in that area around that area in the sea grass beds, resting and feeding. And this really uses that 2007 aerial which was done in February of 2007 to show you

the manatees near the discharge point and then up in some of the algal, macro-algal beds and sea grass beds along the shoreline.

Our basic conclusions are that background information indicates that there are habitat concerns within all potential expanse areas. There's some inconsistencies in the background data. This could be due to the year-to-year changes, major storms, things like that.

We'll begin our actual field certification and validation of resources in 2008 beginning soon in this year. Our surveys will be towing video within the ship channel and the deeper expanse areas at the berths and the ship channel, then in A1 and A2 with some diver spot checking of that data. And then within the shallower areas within sea grass growing season, April to September, we'll be doing surveys in B1 through G and those areas of potential sea grass throats.

Thanks.

MR. McMILLEN: Okay. That concludes our technical presentation at this time. I'd like to take a moment before we take a break and move into the question and answers to recognize

Counselwoman Lynn Hubbard, who is here.

At this time we're going to take a short break and we're going to set up a panel, the folks up here. And the Port has been very gracious to set up some food and beverages for you during this break. What we're going to do is take about a 15-minute break, no more, because we don't want to be here any longer than you guys have to, and then we're going to come back and conduct a question and answer session.

Correct me if I'm wrong, Marie. If they want to go on record to express a concern or ask a question or whatever, please fill in a card so we can get your name and address so we've got a record of that, please. You can do that during the break. So let's take about 15 minutes. Time now is 4:00. How about 4:15? And we'll start it back up then. Thanks, folks.

(Thereupon, a short recess was taken.)

- - -

MS. BURNS: We have to get started on the comments and we do have a short number. I just wanted to reiterate again the Corps of

Engineers is dedicated to making this as transparent a process as possible, so as we go along and we are posting information, et cetera, if you feel that it's not happening, I would very much appreciate it if you would let myself or any of the staff know that. And what can we do to make it more transparent? So again, we're dedicated to doing that, so please, please let us know if you have any suggestions for us.

Okay. I'm just going to go through these and call folks. There's a podium. That way we can make sure we hear everything you have to say. And I was just going to call Miss Markin first.

SPEAKER: Well, I didn't really want to be first, but that's okay.

MS. BURNS: Oh, okay.

SPEAKER: Susan Markin. I live in Palm Beach at 1450 North Lake Way, which is directly

21 across from this Port, and I can tell you I

22 bought the house because I love the Port, I

23 love watching the activity of the Port, and I

24 love this particular environment right here.

25 I'm just very concerned about the expanse of

the Port. And I will also say I'm on Town Council in Palm Beach but I'm speaking as a resident and as a concerned neighbor, as I mentioned earlier the proximity of my house to the Port.

I can tell you that from the plans that you have shown here as far as your potential expanse that the microscope or telescope that I currently have to watch the activity I won't need as much because the boughs of the boat should be coming much closer to my dock.

My concern is this: As much as I can appreciate the economic viability that you speak of relative to the Port and the potential economic growth that you'd like to see at the Port as well as your navigational safety concerns that you're expressing, I would suggest to you that maybe your safety issues are self-imposed by bringing in larger ships than what the Port can physically handle, which

is why you're looking to expand it. And I would suggest also that the image that comes to mind is that you're trying to fit a square peg in a round hole. Or even worse than that, an elephant into a bread box.

The size and the growth of the Port is a concern not only with all the other issues that you bought up as far as species and the recreation areas as well as the other environmental issues, not to mention all the other things that you're going to study, engineering, shipping, doing ship simulations, economics and environmental, but the bigger picture that I'm here to speak of today just on the first glance at this is this area is surrounded by small communities.

You look at Palm Beach Shores, you look at the Island of Palm Beach and Riviera Beach. This is not Miami, it's not a Miami Beach, it's not a Ft. Lauderdale, and I have a very grave concern, and I think it's shared by other residents and other municipalities, that you're trying to enlarge a port in an area where people look at this as a small environment. And the Port certainly has been here and we

have agreed to certain things that have taken place in the Port in the past with the idea that it was within a feasible entity for the surrounding areas.

When I look out my window what I see are

people in kayaks, individuals in kayaks. As of late, you have individuals on surf boards with the long paddles. You have smaller sailboats that are mooring in the lagoon, an area according to your map that will go away. You have small boats going around recreationally. This area is for the residents of this area, the tourists of this area, which is also a very good economic business for this community and for this area, so I'm very concerned that you're trying to do something here that is not befitting of the municipalities in this area or for the surrounding neighborhood and for the surrounding neighbors. And as much as I like the Port and the activity of the Port, I think we should be cautious about the growth capacities that you are looking for and what it is going to do to the other economically viable industries we have, such as tourism and premier community on both sides of the inlet coming

over here.

The other thing in terms of -- you wanted specific issues in light of your comments that you want to be transparent, so I'm kind of hitting you with some very transparent

concerns. I do have some concerns about the protected species; the manatees. I have concerns about the esthetics and the recreation areas that I mentioned before.

One other area that has been brought up, and I would hope that someone's going to study it in a much more technical way than I'm capable of looking at it, but what does this do for increased surge potential during storms by widening and deepening this particular area?

And last but not least, and probably foremost, is what does this do to sand retention south of the inlet, which we're already suffering from in the Town of Palm Beach all the way down to the next inlet down?

So those are my concerns and I hope that you take the time to address all of them.

Thank you.

MS. BURNS: Thank you.

Okay. Mr. Elwell?

SPEAKER: Good afternoon. My name is Peter Elwell. I'm the town manager in Palm Beach. And I'm going to cover a couple of the same things that Counselwoman Markin did and a few others on behalf of her colleagues and

herself on the full Town Council and Mayor McDonald for the Town of Palm Beach.

We're concerned about the size and number of ships that would be coming in after the widening and deepening activities occur and would like to make sure that the study is very clear as to what the goal is in that regard, what this work would be intended to accomplish in terms of creating a greater volume of shipping activity and what size vessels would be intended to be accommodated so that the impact of more shipping traffic and larger vessels can be accurately identified.

One of the concerns in that regard is safety; both the safety of the recreational vessels, since there's so much recreational activity going on with small boats in this area, safety for them; safety also for the Peanut Island area, the park that's been developed by Palm Beach County and the activity

that goes on in that area.

We noticed in some of the diagrams during the presentation that particularly in Area C and E it would be creating the opportunity for shipping activity to come much closer to those

recreational areas. I'm sure Palm Beach County would have something to say. But that's a concern the town would like to see addressed.

And the water quality issue, particularly if the size of vessels, the increased size of vessels that would be able to come in, might also mean a different type of vessel coming in and calling at the Port.

Then we'd like very specific information in the study what type of vessels will be attempted to be accommodated and what additional risk those type of vessels might pose for water quality and other safety concerns.

Counselwoman Markin did mention about the flow in the inlet, and that's something that we do recognize is beyond all of our expertise in coming here to represent the town today, but we have a very great concern, and we know you'll have experts addressing that issue.

We really need to be satisfied that the change in the dynamics of how the twice-a-day tidal activity will occur as well as storm surge when severe weather arrives.

We know from experience from past decades

after previous improvements at the inlet that there were some changes that have caused erosion on the shoreline in the inlet and on the lake side and also concerns about the potential it may have exacerbated the storm surge and flooding from the lake side during storm events, and we'd like to see technical information presented in this study that would address those concerns.

We were happy to see that in the notice that came out there's an intent not to do blasting and an expectation that blasting may not be necessary in order to achieve deepening and widening. We would be especially concerned if blasting is going to be required so we ask simply as you go through the study if at some point blasting becomes a possibility or something that's going to be entertained as a method of proceeding with this project, that that would be not only studied in detail but

21 those of us who have signed on as being

22 interested parties be immediately notified that

23 that has become a consideration. Right now the

24 way the public notice was presented, that was

25 sort of a reducing the fears and doesn't look

like blasting is going to be necessary so we just ask if it becomes part of the study, you let us know right away so that we can then engage more specifically on that issue and see what expertise you're bringing into the study in order to address the impacts blasting might have.

Finally, because of the possibility of the widening and deepening exacerbating the erosion problems that already exist, there are numerous activities going on around the inlet right now, some of which we have been very directly involved between the council and the county and the Port in addressing other areas of inlet management so we know that there's an effort to make sure that we don't do anything in all of this to create further down-drift erosion, but we would ask that you in the study specifically address that and make sure assurances can be made that none of this activity is going to

21 further the historical erosion that has

22 occurred south of the inlet as a result of the

23 inlet existing and that whatever beach quality

24 sand may come from the work that's to be done

25 in this project, one hundred percent of that

beach quality sand needs to go onto the beaches south of the inlet. We can't afford any additional loss. We had years of that material going out to sea.

We have now, between the federal government and local entities, worked out a nice arrangement where the inlet is dredged, the material is going on the island to the south, so we're addressing together that historical erosion. We want to make sure nothing out of this project would create any new erosion or loss of beach quality sand, so we ask that under any circumstances beach quality sand that's identified through the surveying that you're going to be handled, that every grain of that beach quality sand go in on the beach in the Town of Palm Beach.

Thank you.

MS. BURNS: Mr. Russo? I'm going to apologize now if I mess up your names.

SPEAKER: It's David Rosso. I happen to live next to Susan Markin on North Lake Way. I'm a resident of Palm Beach and I have lived on the water and been on the water most of my life. I have owned all sizes and shapes of

boats. I was in the Navy, ran a couple of large vessels there. I have a very close friend who's heavily engaged in the shipping industry, and I can tell you that I'm very much opposed to any growing of the Port of Palm Beach.

As I watch it every day, and I enjoy watching it, it's fun to see the ships come in, it's great when I see the pilots go out, coming in, I know something's going to happen when I see tugs moving around, I have an idea something's going to happen, and I watch that and that's a lot of fun, and I understand some of the navigational issues that pilots might have, but I have also seen them during inclement weather using tugs to get ships in, and it seems to me if you need a tug to help guide a ship into the Port, use one.

I hail from Connecticut and we have two very deep water ports; Bridgeport, Connecticut

and New London, Connecticut. The state of Connecticut has spent untold millions of dollars to make those ports friendly for shipping. I think in New London Connecticut the state spent over $35 million to get the New

London docks rehabilitated and to get that port in action. For the last five or ten years all they do is get a couple ships in who bring in lumber and they store the lumber on the docks. They employ one and a half people. So it's not a great return on the investment.

Here, 99 percent of vessels I believe go to the islands. So to assume that a 600 or 900-foot vessel is going to go to the islands is ludicrous because they can't handle them. Most of the vessels that I see coming in here are much less than 300 feet. They're very small container ships, bulk carriers. And to think that we're going to get 600-foot vessels in here when everybody is going bigger, according to my friends, is silly. We're not going to get ships from China, we're not going to get oil tankers from the Middle East coming in here. I don't think any of us want that. So I think you're trying to look at this the

21 wrong way.

22 If you have navigational issues and you

23 said, somebody said, the depth is 29 feet and

24 it's authorized to be 33 feet, make it 33 feet.

25 That's all. If you need more help getting a

ship in here, use a tug. That's what they are here for. And they are used quite frequently. I appreciate the pilots having their concerns, but the pilots were -- I believe most of them are former tug captains. They know what it's like to have a tug. So I think the whole plan is overreaching.

Like Susan, I think if you have one of these large ships in here, I'm going to see his bough against my boat, and that's not going to be a lot of fun.

I don't know what's going to happen to storm surge. I know -- I have friends who live on the north end of the island who are very concerned about what's going to happen to their properties if you dredge any closer to their property. They have seawall issues already. We don't need any additional seawall issues. So I think you should look at this as a re-dredging of the inlet project and basically

forget the rest. It's not needed. You're
going to impact the environment here of people
more than you're going to improve it for
shipping and commerce.

There are a lot of people that use this

water for recreation. That's why they came here. They're the driving force in Florida. They should be taken care of.

Thank you.

MS. BURNS: Thank you for your comments.

Mr. Royal Victor?

SPEAKER: Yes. Good afternoon. My name is Royal Victor and I'm a resident of Palm Beach. I share much of what the speakers before me have said, and I have two questions. I will confess that they're rhetorical.

Question Number One: Who wants this expanded Port capability? We're essentially a residential -- this area of Florida consists essentially of residential communities and I don't know, we taxpayers and people who make their homes here, I honestly don't know who wants this expanded facility.

Secondly -- and this is not a rhetorical question so much as seeking guidance -- is it

21 true that the Corps of Engineers is the

22 overarching CEO of this project? In other

23 words, will you be gathering information from a

24 whole host of different interested parties and

25 then assemble that information and make a

determination as to the relative merits of the arguments or, indeed, will the process permit all of us concerned citizens to talk at the federal level, which is you, presumably at the state level, which is Tallahassee, at the county level, at presumably the port level, Port Authority level and others? In other words, who's in charge? Who does one go directly to to either express concerns or make a particular plea on behalf of certain interested parties?

MS. BURNS: Thank you for your comments.

Part of what you're doing today is giving the information to us as we go through the federal process, but we certainly do consider the Port one of our partners. They're also the non-fed sponsor. But your comments today will help us flesh out some of the issues that we need to look at from a federal standpoint.

Mr. John Turner.

SPEAKER: Hello. My name is John Turner. I'm an attorney in West Palm Beach. I represent -- I'm here on behalf of Teeter's Agency and Steve Doring (phonetic), a Port tenant and user.

In answer to the gentleman's question who just spoke, my client wants this, and I don't think I would be speaking out of turn to say that everyone who does business here at the Port probably wants this.

The connection between the Port's -- this Port's capacity and the overall economic viability and fluidity of this region is immediate and direct, and I hope that that's observed.

I have used this analogy before and I'll use it again. If every year Mother Nature decided to chew up and overgrow ten to twenty feet off of the end of every runway at the West Palm Beach airport, within a couple years probably everyone within Palm Beach County, probably residents in adjoining counties, would be up in arms about how that would be allowed to continue even though perhaps the residents in the adjoining areas

21 might not mind that large planes could no

22 longer begin to take off or land at that

23 airport. And the same is true for this Port.

24 As Mother Nature essentially tries to do

25 what she's doing at this inlet, there are very

real and immediate effects being felt by my client and every other Port user. And that's before you even consider the direction that the shipping industry has taken with expanding the size of ships.

One significant comment that I want to emphasize is that although the phrase "Port expanse" has been thrown about a lot, for those who have actually done business at this Port for a long time this is just as much about Port restoration or inlet restoration as anything else. Again, Mother Nature is trying to fill something in and probably always will try to fill in this inlet, and my client is losing business because it cannot accept ships and the cargo that those ships bring on them regardless of tug boats and frequently because pilots will refuse to accept business.

Now, it would be shortsighted to react to that and say well, one business losing

business, so what? I respectfully suggest the answer is that we are losing business and it's the cost of our consumer goods that's going up, it's the cost of our steel, our rice, our watermelons, our cars that is being impacted

here.

Anybody who remembers the supply and transportation bottlenecks caused by hurricanes Francis and Jean remember the immediate impact that that type of bottleneck will have on commerce. And that's exactly what's happening, although it's subtle and it's perhaps easy to overlook because to the public in general it's not immediately felt. Well, I'm here to tell you on behalf of Teeter's Agency, which is a family business that makes its living from moving cargo on and off ships and moving that cargo further inland to support construction, commodities, every other type of business that you can imagine, that that bottleneck is having a significant effect. And although the Corps may be looking at this as an expanse project, it is just as much about restoration. That's not to say that Teeter's does not echo many of the environmental concerns.

My client hopes that the Corps will take a methodic approach, find ways to create win/win solutions. We're encouraged to see beach restoration and artificial reef outcomes of this. There's no reason why business and

environmental concerns have to be mutually exclusive; however, environmental concerns should not be a pretext behind which local interests, immediate interests and private interests use to essentially try to prevent this area from growing economically.

Thank you.

MS. BURNS: Thank you for your comment.

I'm looking for the name. Mr. Vogel? For Synergy Resources.

SPEAKER: How are you? My name is Rich Vogel. I work for Synergy Services. We just recently built an asphalt plant in West Palm Beach and most recently opened up a diesel plant in West Palm Beach and we are for the dredging. We don't see it as an expanse as much as a maintenance and safety operation.

I have worked at a lot of ports in my previous life in the petroleum industry. I have worked in several of them. I like the

setup that's in this port. It's very small and nice and contrite. It's not as crazy as all the other ports that I have already worked in. But I do see a good viability and a good possibility of a good, solid, sound business in

this port that does get held back a little bit because of the dredging issues.

Some of the vessels cannot come in because they're too large, so it means we have to come with more frequent vessels, more than we would if it was one big one versus two or three smaller one. A larger vessel with better dredging will sometimes minimize the number of ship trips that come in versus create more, but it gives you better flexibility for the type of vessels that do come in. It also influences some of the costs that's put into what it costs to get in.

There were several times we were trying to bring in asphalt and we couldn't bring it in. We actually had a vessel on its way and it was deemed it couldn't make it, too close, and the pilot said no, you can't bring it in. So that had to get turned and sent someplace else. So it is a problem with doing business with the

dredging that's ongoing.

Also the safety is a very important cog in the shipping business. Everything needs to be safe. There can't be incidents, there can't be accidents. If dredging minimizes or takes that

away, then we're all for it because we want to move things safely.

Recently I was down in Brazil with the Governors Commission, I was down there with Lori, and there's a lot of interest in this port because they see how congested Port Everglades is, Miami is, they see the possibility of something being done here, but there are restraints because of the dredging and those issues. So we are for the safe, environmental, ecological dredging if it can be done. I mean, we think it works. So we're one of the people who are for the dredging operation.

Again, this is a long process. You have a lot of people. I've been involved in Port Everglades' dredging program down there, their massive port plan, and there's a long way to go here. But you have the ability to work together in a finite area to make this work.

So we are for the dredging and we are for the environmental impacts and economic impacts that they could provide.

MS. BURNS: Thank you for your comment.

Mr. Dick Breezy, Breezer?

SPEAKER: Hi, folks. I'm Dick Bresse and I live down south of here in West Palm Beach.

MS. BURNS: Could you get a little closer to the mic, Dick?

SPEAKER: Better?

When I read the story in the paper about this, the first thing that came to my mind is another disaster. And it will be a disaster. And you don't need a two million dollar study to figure that out.

What's proposed? Widen the inlet, deepen the inlet, and enlarge the settlement basin. Will effect will it have? It will allow more water and more energy to enter the Intracoastal and it will steepen the grade, which will cause erosion.

We should look at a few things that we learned in Engineering 101. First, the effect of gravity increases as the grade increases. You have so much gravity here, you increase a

grade, you have more gravity. More effective gravity. And that will give anything on the surface a bigger propensity to slide down that surface. You have a hole this deep; here's land, here's the bottom of the hole. You drop

that -- this is your grade -- you drop that hole five feet, you increase the grade, you're going to get more stuff rolling down that grade.

How will this affect Singer Island? It will reduce the grade along the beach more than it is now, which will give added energy to moving the sand down, and so you will have more sand being moved down off the beach on Singer Island than you have today.

Now, today you may have some sand move south and stop. If you get southeast waves, that will push it back up, and so the residents' time on the beach will be longer. If it goes all the way into the pits, it is going to be gone.

They're already talking about a $30 million breakwater on Singer Island. This would exacerbate their problems.

In Palm Beach island any material that

21 presently moves over shoals will never make it.

22 It will drop down into the deep hole.

23 Secondly, we should look at the formula

24 that the amount of current, the amount of

25 material that a current can carry, varies

directly as its velocity squared. If you double the velocity of the current, it can carry four times as much material. If you cut the current in half, it can carry one-fourth as much. So if you have an increase in current and material that can be fluidized, enough energy to fluidize it, you're going to get erosion. Period. End of story. It is going to happen. And if you have a loaded-up current that drops in velocity, you're going to get it dumping part of its load and you're going to get erosion. Again, period. End of story. That's the way it works.

West Palm Beach is having problems with their retaining walls, and the gentleman said that we're having some problems in Palm Beach with them. Now, as this water, extra water, moves in, it is going to be neck down and it will accelerate. And if you have enough energy there and material that can be fluidized, which

it appears there is because they are having problems, you're going to have more problems with your retaining walls than you're having today. It's gonna happen.

Then the third thing is that you have

increased mass that takes more energy to move it. So if you have bigger ships, you're going to have a bigger wake, you're going to have more energy from prop wash, and when that hits the shore, it's going to fluidize the material there and the grade is going to be steeper. So you fluidize it, gravity is going to do the rest. It is going to carry it down into the bottom.

I think an alternative to this is to have continuous dredging. When I was walking the beach there were two areas that were doing it, and I can't remember, but Dr. Kuvin has at least one of the areas. I can't remember it. But if you had continuous dredging, it would take care of this three-foot fluctuation in sand on the bottom in most cases. And if you have a good, clean bottom there, if you have an event with a bunch of sand moving in, it's not going to be as bad.

Like I said, if this project is done, it's going to be a disaster.

Now, we're talking about the income the Port can generate. We should compare that to the income that the beaches generate and see

how much money the beaches generate compared to what the Port does. The politicians are going to have to make up their mind whether Palm Beach County is going to be an industrial county or if it's going to be a good place to live and a good place to welcome tourists. But if this goes through, it's going to be a disaster.

Thank you.

MS. BURNS: Thank you for your comment.

Dr. Kuvin.

SPEAKER: Thank you, Miss Burns.

My name is Sanford Kuvin, and my wife and I are 44-year residents of the Town of Palm Beach, and our property is located at the northeast extremity of the town, directly in the shadow of the inlet. We live at 149 East Inlet Drive.

Our substantial interest, just like the other 8,000 residents of the Town of Palm

Beach, will be absolutely and directly affected if the Army Corps adopts this project of inlet expanse.

Miss Burns, you stated in your letter of December 6, 2007 that the Army Corps is

gathering information to define issues and concerns associated with the expansion. Mr. McMillan has indicated that this is a navigational safety issue. It's a commercial issue, it's not a navigational safety issue.

And please let me help you define our concerns both personally as a family and speaking for many residents of the Town of Palm Beach. We've lived here for over four decades and we believe that this expanse should absolutely not take place for the following reasons: Over four decades ago -- you indicated that transparency is one of the hallmarks of your current inquiry, and four decades ago the Army Corps was here at that time, only at that time they blasted, they dredged, and yet we have heard nothing about that historical aspect as it impacted on the Town of Palm Beach and the surrounding communities, where damages were afforded and

where inquiries were made. Transparency indicates the past, the present and the future in terms of how it impacts on the residents, and that has not been accomplished in your meeting today nor has been the history of the

inlet, which is absolutely germane to why we're here today.

As you know -- I won't go into the details, but it was built in 1928 and '29, it was deepened, then a few other times in the interim deepened. In 1958 the sand transfer plant was created not out of charity to Palm Beach but because of the harmful effects that the inlet -- even the federal government agreed through the Federal Harbors and Rivers Act -- and mitigated creating that sand transfer plant. But we're not here to discuss the plant, we're here to discuss the impact of further expanse, which has been ongoing since 1928 and 1929 through the '50s.

And by the way, there's documentation about the impact on residents who are still here who were awarded damages at that time.

Miss Burns, you cited significant environmental issues in your letter that went

21 out on December 6th and that were related to

22 what Mr. Dies explained today; a number of

23 endangered species, sea mammals, migratory

24 birds, water quality, but nothing in your

25 letter mentioned the impact of the expanse on

the human species. Everything was relegated to other species, and yet we're here today because of the impact on us; the human species.

In 2005 a paradigm at that time occurred -- which you may be acquainted with, maybe not -- namely, that a company called El Paso Gas initiated the Seafarer Project, which was near to installing a two-foot pressurized gas pipeline coursing through the Lake Worth Inlet. Fortunately, proactive debate took place by a handful of citizens, just like you're hearing comments today, about that particular issue of a gas pipeline being put in the inlet going to Florida Power and Light. That was defeated and they moved elsewhere. Why? Because the port was too small. Florida Power and Light realized that other areas, including Port Everglades in Miami, were more receptive to this natural increase in the necessity for pressurized gas coming to our

region. And that was a paradigm of how commerce failed to local interests, and I would urge you that this is a similar paradigm.

We're still recovering from four hurricanes in Florida, as you know, and they

all paled in comparison to the Asian tsunami, but it caused huge environmental damage to our reef system along the property and coastal damage. The residents of this community should not -- and it's the residents, not the commercial interests, but the residents -- should not allow yet another disaster from this expanse, which will surely bring it, as Mr. Breese just articulated.

There are serious objections coming from a hit list within the airport expanse which include noise pollution, air pollution, the outcome of increased shipping vibrations, garbage in bilge dumping pollution, and even -- you may not be aware of it, but the red mite pollution, which was mentioned in the December 29th issue of the Palm Beach Daily News, a mite coming into our shores which is infesting all of the palm trees. It's obvious that with deepened and widened channels, as you

have heard today, so obvious, there will be an increase to the threat of flooding, particularly in the Lake Worth Intracoastal waterway, which began over four decades ago.

The increased velocity of water, as you

have heard before, will be rushing through the inlet and will cause even greater Intracoastal and beach erosion.

We're consumed in the sand wars today with erosion not only in Palm Beach, not only in Florida, the world over. Beach erosion has entered into a warfare state because of events we know about like global warming, rising tides, putting more concrete on our shores, hurricanes and other things we don't know about; but nevertheless, it's here and it's not going away.

It's been indicated that there will be bigger and better and larger and deeper draft ships coming through this inlet. I have heard figures going anywhere between six and nine hundred feet with sparse room to even turn in the basin.

In addition, on an average day -- we live right at the inlet, we have lived there for

21 over four decades -- you know, what with

22 increasing threats to our homeland, we see on

23 any given day Homeland Security boats,

24 helicopters, the Sheriff's boats, Palm Beach

25 police boats, West Palm Beach police boats,

Customs boats, the Coast Guard, and please accept on faith that all of them have appeared on any given day. It's a traffic jam unto itself. It's hard to imagine what an increased traffic that you're proposing if this were to go through with the deepened port widening will bring, and particularly, particularly with the ongoing threat of terrorism that we are faced with today as a nation. That aspect is not going to go away, it is going to only increase, and we don't want to be a participant to its increase within the confines of this, what used to be a sleepy area which was always a charming area but unfortunately is becoming a slick area.

You stated in your letter that one of the alternatives to be considered is no action. The vast majority of residents who live in this area and who will be impacted by this expanse urge you to carry back the message to

21 Jacksonville and to Washington to do just that;

22 take no action. And in doing so, you'll save

23 the taxpayers millions upon millions of tax-

24 payer dollars.

25 The Corps prides itself on cost

efficiency, and if I ever heard a story in the making for cost efficiency, this is it. The Corps has come under enormous pressure, as you well know, in recent times. It was mentioned in an editorial in the New York Times in November, it's had congressional impact studies on it. This is no secret. And it's no secret because of the Corp, to quote a phrase from the New York Times, which sought reforms to impose discipline on a notoriously dysfunctional agency. Those are the quotes of the New York Times. Diane Feinstein and other senators have voiced this concern about Corps action.

And does the Corps do wonderful things? Absolutely. You have now in your hands, I believe, 22 billion in the Water Resources Act, and I believe some of this money will come from that, but I think all of you will agree that it must be spent with a conscience and where the good -- where the reward will outdo the risk.

The real question -- and let me also add parenthetically we have seen some wonderful things happen with the Corps in our region. They have kept our inlet at 234 feet, they have given us free sand on the shores of Palm Beach,

which that's multiple millions of dollars at about $10 to $13 a cubic yard, and they have benefited the Town of Palm Beach in many, many ways. However, that was done to expedite the commercial interest of the Port of Palm Beach, it wasn't done out of charity to the Town of Palm Beach. We were the beneficiaries of that, quote, free sand and we look forward to more of it coming because it was the Corps and the federal government that caused our problems in the first place, going back historically.

The real question the Corps has to answer is, is the risk of this extremely controversial and environmentally dangerous project with untold unpredictable associated hazards worth the commercial reward? I think not. The vast majority of the residents of this area think not. And I hope the Corps will take no action as its alternative.

Thank you very much.

MS. BURNS: Thank you. Thank you for your comments.

Terry Gibson Gibraltar.

SPEAKER: It's not explicitly clear to me. I understand there's options from zero, do

nothing, to very aggressive options, and from the presentation it wasn't clear to me what the most aggressive option is regarding what you would do from the inlet mouth seaward. Are these jetty extensions or the edges of dredging? Can you answer that question?

MR. McMILLEN: It's already deep water out there. If anything, it would be just a line on a piece of paper. That's all it is.

SPEAKER: Okay. I'm Terry Gibson. I'm the projects editor for Sportsman's Magazine. I grew up here. My family's been here a hundred years. I know these waters and the natural resources here intimately. And I certainly appreciate the Port is an economic engine, but you're not the only economic engine. The engine that I represent, salt water recreational fishing in Florida, is worth about $15 billion a year. Salt and fresh, it's massive in this area. The value of coral reefs

in Palm Beach County are worth hundreds of millions of dollars. The diving and surfing communities are also massive economic engines in this area. Whatever is contemplated here, I encourage the Port to proceed thoroughly and

cautiously and slowly with lots of stake-holders' involvement.

One concern I have inside the lagoon is on the sea grasses. Before contemplating dredging some of those up, we have to realize not all sea grass beds are created equal. The location of these sea grass beds is very important.

Grant Gilmore has oodles of data from the Indian River Lagoon and I think probably from the Lake Worth Lagoon showing sea grass beds close to the inlets are more valuable for fish; furthermore, they're more valuable for reefs. Our reefs are in a lot of problem. Over-population is one of the gravest concerns. So whatever is contemplated, you need to consider the value of those reefs or the sea grass beds near the inlet where the Gulfstream's coming right to the beach and bringing from the Keys and Caribbean -- things are settling out there, and they have a very short ontogenetic highway

with manmade reefs right in the lagoon, shallow reefs right outside the inlet, and lines of reef on out to that.

There's a number of studies, Mumby (phonetic), et al, a few others, that show the

shorter the fish has to migrate throughout its life history in a different kind of habitat as a baby, as a teenager, as an adult, the greater the survival is. Of course, that's confounded by fishing pressure, but that's another story.

Judging from your assessment -- and I understand this is very preliminary -- of the sea grass resources in the area, they seemed a little understated. I spent a lot of time with an underwater videocamera in this area filming for various TV shows, and the sea grass beds to the south of D and around F and G seem -- I was there in November -- they are very robust. Yeah, there's some sand patches in between them, but they also occur at depths I have never seen. I have seen Johnson's's in almost 30 feet of water, which is highly unusual, and it has to do with the incredible quality of water thanks to the Gulfstream. So I hope you all will take a look at sea grasses.

You said something about 150 feet of where you might dig. Dredging, especially if there's carbonated muds in the area, dredging this might cause turbidity issues, could kill those sea grasses or create a light starvation

condition that can create -- that could kill those sea grasses if persistent turbidity occurs there, or imposed starvation.

Also in the sea grass the Corps along with the Port, some of the best work I have seen you guys do, I always -- you know, my story is, as a Florida sportsman, is mostly pathos and loss, but the Lake Worth Lagoon is one of the places we have shown we have the power to make things a whole lot better. So I encourage you all not to undermine your earlier partnering and work.

These habitat restoration areas are full of fish and wonderful recreational opportunities. The north Lake Worth Inlet or Palm Beach Inlet, as it's often called, is also supplying irrigation sites for snook in the state. I think it's the third largest spawning site. Whatever goes on there should not go on during snook spawning season. This is a fish vital to the economy and to recreational

21 opportunities and it's a very sensitive

22 species, very carefully managed species, and we

23 don't need to use world class dredging going on

24 in the summer months.

25 I'm very concerned also -- and I was glad

to hear that you're going to do core borings and analyzes -- I'm very concerned about turbidity from dredging impacting sounding resources inside the lagoon, outside the lagoon and sea grasses, but turbidity booms, things like those, should be strongly contemplated if this goes on.

Safety is a word that has come up a lot. I hope you aren't considering the recreational boating community in your safety part of the cost benefit analysis. This is the safest inlet I'd say probably north of Port Canaveral and south of Cape Canaveral, maybe Ft. Pierce. But compared to Jupiter and Boynton, this inlet is a cakewalk.

I was fishing offshore in a 13-foot Whaler, in somebody's, as a kid. I never had a problem coming in and out of the inlet. So please don't try to give up safety for recreational boating in that analysis. That

21 would be somewhat dishonest.

22 I'm going to speak as a surfer. On either

23 side of the inlet right about where the B2 sign

24 is and right about where the B1 sign is are two

25 of the best surf breaks in the east coast. B2

is called Pump House, the other one can be referred to as Reef Road. The last time you drenched the inlet after Francis, a lot of that sediment was put in the Reef Road area and it badly degraded the quality of the surf spot. There are thousands of kids and adult kids like me that enjoy that resource, and it generates millions of local economy. People drive from Jacksonville to score these spots. Whatever you do, I think you have noticed how much trouble the surfing foundation can give you all. It can give you a lot of trouble if anything happens to the surf spots.

I have seen a number of cases now to the down-drift beach impacts. I can cite a number of cases. One, the inlets just up drift, Long Beach, Ft. Pierce Inlet, where you all have deepened the inlets and the, quote, need for refurbishment becomes one, two, three, four times more frequent. I think Ft. Pierce has

been done four or five times since the inlet was deepened. I think that has something to do with the venturi effect, if I understand the book correctly. Very concerned.

Palm Beach is about out of sand. Dredging

has had horrible recreational impacts. They're about out of sand. They might have 20 years left offshore. Please don't make our beaches disappear. Please, please don't do that.

I'm glad you noticed the manatees.

And finally, I uncovered a paper the other day from the Caribbean where a massive dredging project in the Caribbean caused an epidemic of ciguatera. I suggest that you check these sediments not just for what they are in terms of define them geologically, but for contaminants. There's a lot of bad stuff coming in and out on these ships and on other things, and I really don't want to get paralyzed from the snapper I take home.

That's about it.

There are a number of other things, but just on the transparency issue, I have done battle with you guys in a hundred contexts, and this is going to go down transparently because

the media is going to be all over it and throughout the whole process.

With that having been said, I know these resources incredibly well, and if you want help finding things or researching things, diving

things, I'll be more than happy to help.

Thank you.

MS. BURNS: Thank you for your comments.

Just let me tell you the order of things. Miss Purvis will be next, Dr. Lilja would be next, Mr. Djubin and then Mr. Ward. So if you could, as people get finished, if you could just come on up.

SPEAKER: Good evening. My name is Lynn Purvis, P-u-r-v-i-s. I'm a life-long resident of Palm Beach County. I currently live in Lake Worth but now we're battling to restore the Lake Worth Lagoon so it kind of irks me to be here about them wanting to do further dredging projects upstream.

I'm also representing Everglades Earth First, which is a chapter of the National Environmental Protection Group who -- some things that you're taking on involves things going on in the Everglades where the Army Corps

21 as in the rest of the country has made it their

22 job to totally disrupt ecosystems and wetlands

23 and our waters, so I have a little bit of

24 hesitancy when it comes to Army Corps projects.

25 Something that doesn't seem to have been

addressed in the process I have seen is the convincing of the need for this project. I don't know if that happens somewhere else, but before I want to see a lot of money and effort and expertise get put into studying if this is feasible and environmentally acceptable, I would like to find out if it's necessary.

What is the expected cargo increases that we're going to see coming through here? What exactly is that cargo? I don't know if the Port picks out those kind of statistics that we can see, but I would like to see that and be convinced of the need to bring in bigger ships and more cargo. Specifically, is that the most cost effective way of meeting our needs?

You know, he talks about watermelons, cars, et cetera being brought in here. Well, to me it would seem a much more wholesome and environmentally acceptable and cost acceptable way to be growing those things here and using

local industry better. So if we're going to be putting in a lot of money being able to ship in foreign things, I would like to know where the ships are coming to, I would like to see is there a better way to get those needs met

locally?

In terms of the cost, as I said, having bigger ships helps bring down the cost of those goods, A: I say that's not the only method; but B: Is that including the cost of this project in all of its aspects or is the Port just taking that as a federal subsidy to their business? Because the cost sharing thing that was mentioned earlier hasn't been broken down. Maybe it hasn't been created yet.

And I really appreciate all the comments that other people have brought up, especially those that are really focused on some of the technical aspects. And I would like to support everything that's been said of the people that have been opposing the project and supporting the no action alternative, and I would like to bring up some more holistic concerns.

I know for those of you up on the panel it's nobody's job description to look at some

21 of these larger issues, but I think that's been

22 one of the main problems with the way that this

23 agency and some of the supporting agencies do

24 business.

25 So in terms of again going back to what is

this cargo that we're bringing in and where are these ships coming from, to me it sounds like a whole lot of oil use because we're shipping in things from afar, and we all know that the larger implications of so much increased petroleum use is war, pollution, and now we're looking at global warming from carbon emissions. I know these are buzz words and people throw them around, but it's real, and I think that those types of things have to be included when we're doing these cost benefit analyzes and when we're creating alternatives.

As you say, you have to look at several different alternatives to the project. I think that those alternatives need to get a little more creative in terms of what is the ultimate goal that we're trying to meet here and are there other ways? Is (sic) there better places to be putting this money to serve those needs?

Not to go back to my other problems, but

we have watched the Everglades get totally torn apart in the name of development, in the name of economy, and people finally caught on to how much damage it was actually doing to our land and our peoples and our communities, and there

is a lot of outcry against that, and it would be a request to have that restored.

Now, that request has been met with technical agreements to do so; the Everglades Restoration Project. But everyone agrees that project has been languishing out there, never come into play, without ever coming to fruition. So I'm really hesitant to allow yet another project where there's been so little accountability to the residents and the other people who benefit from these vibrant ecosystems.

So I would like to get back to more specific things that you guys might feel more comfortable addressing. Is (sic) there any plans to have the people who are benefiting from this project, those being the business owners at the Port, to participate in any kind of mitigation fund or mitigation project and again, looking into more creative alternatives

21 to meeting our needs? So I appreciate you

22 listening.

23 I do have one very specific comment for

24 Mr. Dies, who gave the presentation about the

25 data collection. I would say maybe -- we're

doing public presentations. You used a lot of technical terms. I know I didn't understand, and I've been trying to follow these things for a long time. So I know you get pressed into a very short time period to get through a lot of material, but I would just maybe try to watch out for trying to explain things in terms that people can understand. But I appreciate it.

Thank you.

MS. BURNS: Dr. Lilja, before you come up, Mr. Sam Osher (phonetic).

SPEAKER: I hope you won't mind. I have got another meeting after this and this is my second meeting today.

UNIDENTIFIED VOICE: What's your name?

SPEAKER: Let me think about that.

Thank you very much. I'm Sam Osher. I'm not an engineer. And I've been listening to some very brilliant people here this afternoon and also people talking about the quality of

life, and I'm all for that. I would think before anything is done, there's going to be a study, everything is going to be taken into account, and if the studies don't work out too well, well, okay, it's not going to work out.

However, I want to throat something else into the pot.

You talked about the quality of life and all of that, but from what I see in my vision Palm Beach County is going to grow like you have never seen it before. Businesswise, I think it's going to be one of the most noticed scientific counties in the entire country. It's coming. It's already started. Can't be stopped.

What we need here also -- and I appreciate people talking about the quality of life, and I'd like to see that going on for at least another 30 years personally, but at any rate, there are people out there who need work. Business is coming here, and I hope that things can be worked out so that everybody is pleased. And I'm sure with the brilliance that we have even sitting here, people who we listened to today because their questions and their

thoughts are very good, it will be worked out.

The ports south of us are loaded. They can't do much more. This is the ideal place.

And as I was talking to somebody else, from the standpoint of security and naval ships

coming in, they're smaller ships, they'll come in. It's extremely important to have this port be used for that. But I want to emphasize, and I'm very much involved in that, I represent a number of clubs, people, and we reach out to perhaps fifty thousand or more voters, and I think that's important. How I got to that point I don't know, but boy, I'll tell you it's important.

So my point is this: I represent a lot of people who still have to work or are looking for work and I would remind the folks here that there are a lot of people here for 40, 50, 60 years, families before, and their work is coming, and whether we like it or not, there's going to be progress upon progress. Sometimes that's not good, but it's gonna happen. It is happening right now. So I want to just throat that into the pot with everything else. We're gonna have to rely on you folks to come up with

the answers. I will be here, as you will, and hope for the needs of all of our people.

And by the way, I do want to commend the people that work here at the Port. Lori has been the best thing that's happened to this

Port in about the 10 or 12 years that I've been here.

And I want to thank you for the five dollars you just gave me to say that.

But the point I want to make out is there are two sides: The quality of life, which is extremely important; and then the brilliance of engineers, who can equate everything. May not be able to please everybody, but hopefully you can please most people. It's gonna take a long time, a lot of money, but whether we like it or not, it's going to happen, and you better know it's going to happen. But it could happen in a good way; a way that works out for, hopefully, for everybody. And I expect to be around another 30 years to make sure it happens.

Thank you very much. I've got to get out of here.

MS. BURNS: Thank you folks for letting Mr. Osher go since he had to leave.

Dr. Lilja.

SPEAKER: My name is L-i-l-j-a. I live in Palm Beach. I shall not try to improve on the eloquence of previous speakers that are against this particular project. I will just state the

facts the way I see it.

There are two reasons presented for the change: One reason is that present 300-foot vessels are having difficulties running aground, which is a valid reason. The other reason is to open the Port for up to 900 feet mastodons, which will affect the commercial status of this area and at the same time, of course, will hurt the life that we like here today.

I am all for improving the channel for the present size of vessels, and it can be done in different ways. One is to dredge it a little bit deeper than the 32 feet, as we have done before. Just watch out for your pipe that goes from the sand transfer plant.

And the other one is in addition to that, dredge it a little more frequently. Don't wait until it shoals. It's not that difficult. It's elementary.

I will finish with two technical observations. It was said here in the very beginning in the presentation that the Gulfstream is affecting the approach of vessels into the Port. They're being pushed northward

by the Gulfstream. I beg to differ. As a boater, we all should know that the Gulfstream is out there, but closer to Port we have a southward bound stream, and I would suggest that the Army Corps look into that one and take that into consideration in their philosophy.

The last thing I have is that we have seen many, many investigations of the sand or the silt that we have here that we're dredging. They differ very much, and always in the benign direction. I would urge you to make sure that you really have a true evaluation of the grain size that we're talking about.

Thank you.

MS. BURNS: Thank you for your comments.

Mr. Djubin.

SPEAKER: My name is William Djubin. It's D-j-u-b-i-n. I'm a most recent founder of an environmental organization local here out of Jupiter. Our specifics right now is a coral

reef initiative, and we will begin water
quality monitoring independently later this
month. That will be in collaboration with Reef
Rescue of Palm Beach, and most likely the water
quality monitoring reports will be translated

by Southeast Florida Coral Reef Initiative. That's what we're looking to have here.

I'm not really too sure why I'm here, but I did begin to become confused first in the presentation and then also the speakers' questions.

The presentation seemed as though this was to improve existing navigation in the Port, whereas several people had indicated that we're looking to actually reach out to larger ships and more ships. So I'd like to have that cleared up; as to whether this is for current navigation or whether it is to actually enlarge.

And to add on to previous questions, who is it that -- they're coming here, or is it that we're actually looking to export more?

Living in Florida for 30 plus years I have watched our state go from number one in tourism to now close to number one possibly in energy

and agricultural, and our main source of income for the state now is energy and agriculture, and what it appears to be is tourism is number three. I appreciated tourism. I disappreciated (sic) tourism as much as I did

appreciate tourism. But I believe that the pollution and the effects of agriculture and energy are taking a stronghold on our state, and in our legislature this must be addressed.

If the expansion of this port is to export agriculture and energy abroad, we need to know that. We need to know those facts. If this is truly just because the ships that need to go from the Port of Palm Beach to the Bahamas and existing islands, that those boats are getting larger and it's becoming unnavigable for them to come in and out of port, we need to know that as well. I'm just a little bit confused as far as whether this is fixing an existing problem or if this is actually trying to enlarge the port to take on more work and more transportation. And those are my questions.

Thank you.

MS. BURNS: Thank you for your comments.

Mr. Ward, and then Mr. Williamson will

wind us up.

SPEAKER: I'm Gerald Ward. 31 West 20th St. here in Riviera Beach.

This is a NEPA scoping meeting so we're really not into formalizing for or against

positions, but I have to compliment you, Miss Burns, because the last scoping meeting I went to up in Martin and St. Lucie County for a marine minerals management service offshore meeting was a disaster, and it's pleasant to see that you have the reporting accommodated versus what happened up there.

I would request a copy of any summaries, transcripts or documents as a result of this meeting. Plus, pursuant to 40CFR1502.19 subC I'd like to get hard copies of the draft Environmental Impact Statements and the final. I understand you're limiting the written comments to the 20th. If that's not correct -- that's only 11 days away.

The draft schedule says you are proposing to drag this out until the first quarter of 2010. That's two years hence. My experience in economic and NEPA actions is that that's way too long to do it, and pursuant to

21 40CFR1502.8(c) I request you advance it to no

22 later than the first quarter of 2009. It cuts

23 costs. It will probably not -- if you take an

24 extra year, you probably won't know that much

25 more about this area. And I think it's

important. So you have to, I believe, by that regulation have to look at my request.

How many pages are you proposing for this EIS? I hope it's 150 or less. When you get too big, you overwhelm the public in responding, and we need to have the greatest response on this.

The sixth area, which is my last major topic, is scoping alternatives. The alternatives are the heart of an economic statement, an Environmental Impact Statement. It is really an evaluation process of which many questions were thrown out today that people really want an evaluation. You list in the public notice of the scoping meeting only eight areas, all waterside and all increases in the project. Then you list a combination of those eight projects, again all increases, plus the no action. You have indicated numerous physical models, ship models, studies, economic

21 studies, and you have complained about the

22 maintenance of the existing channel because its

23 depth is now six or so feet. Underneath the

24 project, the depth's at 29 feet, apparently.

25 Therefore, you need another alternative to the

study; what I think is known as a similar action alternative.

Number One, reduce the project navigation depth. Look at not serving bulk cargo. That seems to be the predominant safety issue that you've gotten into. What would it also do? It would free up existing lip faces. And I think that's in accord with what's happened at the Port. Your economist has got to look at how the cargo traffic has gone up in the Port. And they're not big vessels.

You are between two major deports or ports; Port Canaveral, which has significant military assistance for maintenance, Port Everglades with much less wave climate that does not have a significant maintenance problem. Both have little tributary runoff with no currents except the tidal currents in and out from the straits of Florida or the Atlantic Ocean to the inland waters. They deal

in deep channels for different types of vessels. The container shipping that has developed in this port could use more wharfage and cargo container area. That type of transportation and similar island trade, which

is small bulk, plus small ferry or cruise vessels have great future at the Port of Palm Beach.

The Port advertises itself as a niche port, and I think you need to go into how they have promoted themselves. It is a small port. Go to the Port of Shanghai and compare it.

The project, eight projects -- and by the way, interestingly, last night we completed the steering committee for a surety of the CRA, Community Redevelopment Agency of the City of Riviera Beach. That project, report, will be out on the 30th of this month and I hope you at least incorporate it by reference.

But one of the things is that the State Comprehensive Plan, Chapter 186 Florida Statutes, requires the 14 deport of ports to start to accommodate the locals in changing their types of uses. So we expect to see the port -- and several suggestions are already

21 being bantered about of how even this building

22 can become more of a common facility for the

23 public of this area.

24 The project -- I like the man inquiring

25 about A1 and A2, Mr. Gibson. I am not quite

sure that's a viable project.

Project I doesn't make any sense except to spend money. It has a bogus name. North Turning Basin Widener. Look at the Corps manuals, Mr. McMillan. That doesn't compute.

Project G probably has the most economic potential. Moving the Port's waterfront faces south along the existing Florida Power & Light Company wharfage or bulkheads could quickly convert more usable area. Ecology impacts are really minimal, and you have to recite in your investigations that less than a century ago it is only because of the Port of Palm Beach and the Florida Legislature that created two ports. Both have port powerage (sic), or they did have when they were created, that has reduced the marine resources within the Lake Worth system of the magnitude that they are today.

Lastly, I guess of a technical nature, water levels, tides, storms and the resulting

21 surge, the modeling does need to focus on that.

22 I personally have looked at the tides for the

23 federal government prior and after the mid '60s

24 deepening of the inlet. We basically almost

25 doubled the inlet tide range with that project.

NEPA mandates a host of upland-based considerations. I haven't heard a lot of discussion about that, but it includes economics. This should be an economic driven study, not ecology. We need -- didn't see that man here today, or woman, but they are the driving forces to evaluate what's good for Riviera Beach or the Port or Palm Beach County.

MS. BURNS: Thank you for your comments.

Last but not least, Mr. Williamson.

SPEAKER: I'll bet everybody is happy to see me. I'm last.

My name is George Williamson and I work for Rinker Materials, but now we're called Cemex. We were purchased by Cemex back in July. And what that really means is that we have gone from a company of 13,000 employees that did about 5 billion in business per year to a company that does about 25 billion in sales a year and has about 50,000 employees.

We're a construction materials company. The products that we bring in from literally around the world are used in construction; building roads, schools, houses, bridges. We have two facilities here at Palm Beach. One of

them is a cement facility, the other one is aggregate. I'm here to speak on the aggregate side of things.

And in fairness, we are any port's worst nightmare. We are high volume, low dollar material. Everything we do comes in in volume. Big volumes.

We've had our facility here for a while and frankly we have struggled to make it financially viable because of the 28, 29-foot water depth. It is difficult for us to handle business that way economically and we have found ourselves searching for materials as far away as Guiana to bring in in small barges in order to bring the material into the port. Clearly, the deeper it is for us, the better it is. That reduces our costs by bringing it in volume and thereby reduces the cost to our customer, the ultimate user who is building the roads and schools and bridges in the community.

21 I would just like to say that we

22 wholeheartedly support the Port's effort to

23 deepen this facility. Clearly, 35 feet is just

24 a start for us. We'd love to see it go to 40.

25 Our other big terminals throughout the country

are at least 38, 39, 40 feet. We do have some that are a bit shallow because when that happens, when this Port is deepened, we can substantially increase our through port, which means more dollars for the Port and the community, increase our jobs and, most importantly I think, supply a constant -- have a constant supply of quality materials for our customers and the end users.

We also applaud the Corps's efforts to get this far in the survey. Thank you very much.

MS. BURNS: Thank you for your comments.

Okay. Some of you may have some thoughts after this meeting. Again, the comments period for scoping -- and remember, please remember this is not the last time you will have an opportunity to comment -- but for purposes of scoping, which is how we will focus some of our efforts on what we're going to look at, that comment period closes the 20th. So we'll

appreciate getting those comments.

First of all, I wanted to thank all of you for staying and helping us try and frame how we will be looking at this project. Again, the next part of the process is we will be taking

all of your comments again. We've had a very diligent writer. I have heard her scratching over there. But your comments are important and we wanted to make sure that you can see that your comments were captured.

UNIDENTIFIED VOICE: Can I say something?

MS. BURNS: Sure. Please.

UNIDENTIFIED VOICE: I did my best to get your comments. Please look at them. I know I missed a couple things because speakers were going fast. If you see mistakes, I'll be over there. Let me know and I'll correct it.

Thanks.

MS. BURNS: So please, it's some of the neatest writing I have ever seen, at least from here, so please take a look at it. If you have anything we need to add, this will be the first thing that we probably will take a look at and try and post on the site.

Again, you have those sites to look at.

The next step for us will be taking the information that you have given us today, framing again the study that we'll be doing to try and do the studies and the different things that we need to do to answer some of the

questions you have raised and some of the questions all of us have about the project. Again, we're trying to make this as transparent as possible, so if you have any suggestions, please let us know.

Did you have any comment you wanted to make in finishing?

All right. Thank you very much for coming. Grab an apple on the way out. Thanks.

(Thereupon at 5:31 p.m., the meeting was concluded.)

21

22

23

24

25

C E R T I F I C A T E

THE STATE OF FLORIDA
COUNTY OF PALM BEACH.

I, Elaine V. Williams, Registered Professional Reporter, do hereby certify that I transcribed the notes of Lake Worth Inlet Feasibility Study public meeting to the best of my ability.

Dated this 6th day of February 2008.

_____
Elaine V. Williams, RPR

21

22

23

24

25

GENERAL THE MURPHY CONSTRUCTION CO. CONTRACTORS

OFFICE ADDRESS:
1615 CLARE AVENUE
WEST PALM BEACH
FLORIDA 33401

TELEPHONE (561) 655-3634
FACSIMILE (561) 655-3674

MAILING ADDRESS:
P.O. BOX 3768
WEST PALM BEACH
FLORIDA 33402

DEPARTMENT OF THE ARMY
Jacksonville District Corp of Engineers
P.O. Box 4970
Jacksonville, FL 32232

January 9, 2008

Attn: Marie G. Burns, Acting Chief, Planning Division

Re: Lake Worth Inlet/Palm Beach Harbor Feasibility Study NEPA Documents

Dear Sir:

I am writing you as directed from 6th of December 2007 notice. As an adjacent property owner, located North of The Port of Palm Beach, I object to your Plan (Figure 1, [specifically Area E] – Expansion Alternatives Proposed for Lake Worth Inlet (Palm Beach Harbor) as presented. I am concerned that our upland interests and waterfront improvements which date back to the early 1940's are being proposed for impairment by this process.

In conclusion, I ask that 'Area E' be removed from the Environmental Impact Statement for the Expansion of Lake Worth Inlet (Palm Beach Harbor), FL Draft Environmental Impact Statement (EIS). Further, I wish to be copied on any government or private party correspondence or documents related to the above during this entire EIS process

Sincerely,
THE MURPHY CONSTRUCTION CO..

By: _____
Martin E. Murphy
Vice President

cc: ● Rick MacMillian, Jacksonville District, Project Manager
Lori Baer, Executive Director, Port of Palm Beach

Florida Fish and Wildlife Conservation Commission

Commissioners
Rodney Barreto
Chair
Miami

Brian S. Yablonski
Vice-Chair
Tallahassee

Kathy Barco
Jacksonville

Ronald M. Bergeron
Fort Lauderdale

Richard A. Corbett
Tampa

Dwight Stephenson
Delray Beach

Kenneth W. Wright
Winter Park

Executive Staff
Kenneth D. Haddad
Executive Director

Victor J. Heller
Assistant Executive Director

Karen Ventimiglia
Deputy Chief of Staff

Office of Policy and Stakeholder Coordination
Mary Ann Poole
Director

(850) 410-5272
(850) 922-5679 FAX

Managing fish and wildlife resources for their long-term well-being and the benefit of people.

620 South Meridian Street
Tallahassee, Florida
32399-1600
Voice: (850) 488-4676

Hearing/speech impaired:
(800) 955-8771 (T)
(800) 955-8770 (V)

MyFWC.com

January 10, 2008

Ms. Lauren Milligan
Florida Department of Environmental Protection
Florida State Clearinghouse
3900 Commonwealth Boulevard, MS-47
Tallahassee, FL 32399-3000

Re: Palm Beach County, SAI #FL200712103896C, Notice of Intent to prepare a Draft Environmental Impact Statement for expansion of Lake Worth Inlet (Palm Beach Harbor) including widening and deepening of the existing channels and turning basin

Dear Ms. Milligan:

The Florida Fish and Wildlife Conservation Commission's (FWC) Aquatic Habitat Conservation and Restoration Section has coordinated a preliminary agency review of the potential wildlife and wildlife habitat issues associated with the expansion of Lake Worth Inlet (Palm Beach Harbor), Florida. This letter outlines the anticipated concerns and comments related to the feasibility study and proposed Draft Environmental Impact Statement.

Background

The U.S. Army Corps of Engineers (USACE) is performing a feasibility study for the expansion of Lake Worth Inlet (Palm Beach Harbor). The expansion alternatives being reviewed include no action, creation of channel flares, channel deepening and widening, and turning basin expansion. Options for the disposal of dredged material include Peanut Island, disposal in the Palm Beach Harbor Ocean Dredged Material Disposal Site, beach placement, disposal of suitable rock at existing artificial reef sites, and any other viable disposal options that may become available. The USACE intends to prepare a Draft Environmental Impact Statement for this project. The Port of Palm Beach District is the cooperating agency and non-federal sponsor for this project and will provide information and assistance on the resource assessment and mitigation measures and alternatives.

Wildlife

Marine Turtles: The coastal beaches both north and south of Lake Worth Inlet provide nesting habitat for the loggerhead (*Caretta caretta* - threatened), leatherback (*Dermochelys coriacea* - endangered), and the green sea turtle (*Chelonia mydas* - endangered). Construction activities associated with sand placement on these beaches during the marine turtle nesting season (March 1 through October 31) could adversely affect nesting turtles, incubating nests, and emergent hatchlings. The compatibility of sand placed on the nesting beach may also adversely affect the ability of nesting females to construct viable nests and the incubation environment necessary for successful development and escape of marine turtle hatchlings.

Nearshore hardbottom communities and artificial reefs provide foraging, resting and juvenile developmental habitat that could be adversely affected by the expansion of channels associated with this project. Blasting to remove limestone during deepening or widening of channels could be lethal to marine turtles and manatees if it occurs relatively close to individual animals.

Manatees: The Florida Power & Light Riviera Beach power plant located immediately south of the port provides an important winter warm-water refuge for the Florida manatee (*Trichechus manatus latirostris* - endangered). During winter cold fronts, over 400 manatees have been documented using this warm-water refuge. The desired turning basin expansion would encompass the area adjoining this warm-water habitat. Construction activities may directly affect manatees using this site if work is conducted during the cold season (November 15 through March 31), or indirectly by creating a deterrence to the use of this important habitat.

Secondary adverse affects could include altering the nature of the warm-water refuge. Substantially deepening the bathymetry adjacent to the warm-water refuge could result in reduction of warm-water habitat due to an increase of the mixing between the cooler water from the expanded turning basin with the thermal outfall of the power plant. Expansion of the turning basin is also expected to affect seagrass resources that provide forage for manatees. Increased shipping traffic may also increase the risk to manatees due to its proximity to the warm-water refuge and to the travel corridors used to access foraging areas located north of the port.

Habitat

Corals and Hardbottom: Hard corals may be found within the inlet channel and the area marked as "south channel flare" and "north channel flare" on the map provided by the USACE labeled "Study Areas for Potential Improvements (Widening and Deepening)." In addition, the nearshore areas that may be affected by this project fall within the range of staghorn coral (*Acropora cervicornis*), which was recently listed federally as a threatened species. Other hardbottom resources occur on the walls of the existing channel and potentially in the nearshore channel expansion areas. The primary benthic resources expected to be found within the prospective expansion areas include live bottom (soft corals and sponges), solution holes, limestone ledges, and their associated communities.

Potential adverse effects to these benthic resources could result due to dredging, blasting, and sediment disposal. Expansion of the offshore disposal area may also affect hardbottom resources, which will need to be considered if this option is explored.

Seagrass: Six species of seagrass have been documented in Lake Worth Lagoon and all could be affected by the dredging necessary to expand the inlet channel and turning basin. Seagrass species found in Lake Worth Lagoon include turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), star grass (*Halophila engelmannii*), paddle grass (*Halophila decipiens*) and the threatened species Johnson's seagrass (*Halophila johnsonii*). Seagrasses provide important ecological functions to estuarine and marine coastal systems. A wide range

of organisms are directly or indirectly dependent upon seagrasses for food and habitat (Zieman and Zieman1989), including several federally and state-listed endangered species such as green sea turtle and Florida manatee.

Seagrasses, coral, and hardbottom also provide essential fisheries habitat by creating a physically stable refuge and nursery ground for numerous commercially and recreationally viable fish and invertebrates (Zieman 1982, Phillips and Meñez 1988, Fonseca et al. 1988).

Artificial Reefs

Any dredged material that would be considered for disposal at an artificial reef site will need to meet appropriate criteria for artificial reef construction depending upon the proposed deployment location and material types. No silt, sand, clay (of any type), or rock boulders less than 150 pounds each will be allowed to be deployed in the artificial reef site. Ideally, the minimum acceptable weight of each individual piece of rock proposed for artificial reef deployment should weigh at least 500 pounds. Close coordination with the FWC Artificial Reef Program (Attn: Jon Dodrill, FWC-Division of Marine Fisheries Management) and Palm Beach County Artificial Reef Coordinator (Dr. Janet Phipps) will be required if artificial reefing is considered as a disposal option.

Peanut Island

Peanut Island contains a large habitat enhancement project that includes a 7.1-acre maritime hammock, 3 acres of mangroves, 1.5 acres of tidal channels and ponds, 3 acres of shallow-water lagoons and 1.3 acres of shallow-water reef. All of these habitat features provide habitat for a variety of wildlife including shorebirds, fish, crustaceans, and mollusks. Placing spoil on the island and widening the channel in segments C, D and E could adversely affect these habitats.

Resource Surveys

We recommend that multiple resource surveys be conducted as well as a review of historical data in order to evaluate the potential affects of this project on the wildlife and marine habitats that are present within the scope of the project. The draft Environmental Impact Statement should include the results of seagrass surveys within the project boundary areas of Lake Worth Lagoon and the inlet, as well as the results of surveys of hardbottom and coral surveys within the inlet channel and the inlet flares, with special attention paid to the finding of any staghorn coral. We offer our expertise and assistance in developing the protocols for the resource surveys due to their importance in the determination process of the feasibility of the options suggested in this scoping effort.

Summary

Expansion of the Lake Worth inlet channel and turning basin has the potential to adversely affect numerous wildlife and habitat resources of the state of Florida. Many difficult environmental hurdles would need to be overcome for the full extent of this project to come to fruition. We recommend that the USACE and the Port of Palm Beach give great consideration to the natural resources that would be affected

during a project of this nature when assessing the information and determining the feasibility of the expansion options.

We appreciate the opportunity to provide input during the scoping process for the Navigation Feasibility Study for the expansion of the existing channels and turning basin of Lake Worth Inlet (Palm Beach Harbor). Please continue to notify Ron Mezich of all future meetings, information exchanges, and requests for comments regarding this potential project. Should you require additional assistance regarding our comments, please contact him at (850) 922-4330 or at ron.mezich@myfwc.com.

Sincerely,

Mary Ann Poole

Mary Ann Poole, Director
Office of Policy and Stakeholder Coordination

map/rrm
Lake Worth Inlet 1182
ENV 1-3-2
cc: K. Cairns, USFWS, Vero Beach
J. Valade, USFWS, Jacksonville
J. Karasia, NMFS, Miami
P. Davis, PBC-DERM, West Palm Beach

Literature Cited

Fonseca, M.S., W.J. Kenworthy, and G.W. Thayer. 1998. Guidelines for the conservation and restoration of seagrasses in the United States and adjacent waters. National Oceanic and Atmospheric Administration, Coastal Ocean Program Decision Analysis Series No. 12, NOAA Coastal Ocean Office, Silver Spring, MD. pp. 1-222.

Phillips, R.C., and E.G. Menez. 1988. Seagrassses. Smithsonian Institution Press. Smithsonian Contributions to the Marine Sciences. Number 34, pp. 1-104.

Zieman, J.C. 1982. The ecology of the seagrasses of south Florida: A Community Profile. U.S.Fish and Wildlife Service., Office of Biological Services, Washington, D.C. FWS/OBS-82/25, 158pp. (Human Impacts p.84-90).

Zieman, J.C., and R.T. Zieman. 1989. The ecology of the seagrass meadows of the west coast of Florida: a community profile. U.S. Fish and Wildlife Service, Biological Report 85 (7.25). Washington, D.C.

Florida
Department of Environmental Protection

"More Protection, Less Process"

Project Information	
Project:	FL200712103896C
Comments Due:	01/11/2008
Letter Due:	01/21/2008
Description:	DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT CORPS OF ENGINEERS - SCOPING NOTICE - DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR EXPANSION OF LAKE WORTH INLET (PALM BEACH HARBOR) - PALM BEACH COUNTY, FLORIDA.
Keywords:	ACOE - SCOPING - EXPAND LAKE WORTH INLET/PALM BEACH HARBOR - PALM BEACH CO.
CFDA #:	12.107

Agency Comments:

TREASURE COAST RPC - TREASURE COAST REGIONAL PLANNING COUNCIL

The proposed study is not in conflict or inconsistent with the Strategic Regional Policy Plan. It furthers Regional Goal 7.1 that calls for a balanced and integrated transportation system.

PALM BEACH -

COMMUNITY AFFAIRS - FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS

FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

The FWC has provided a number of comments regarding the potential direct and secondary impacts of: 1) beach sand placement activities during the marine turtle nesting season (March 1 through October 31) on sea turtle nesting, nests and emergent hatchlings; 2) turning basin expansion and subsequent alteration of the warm-water refuge utilized by manatees at the Florida Power & Light Riviera Beach power plant south of the port; 3) dredging, blasting and sediment disposal activities within the turning basin, inlet channel and channel flares on seagrass, corals and hardbottom resources; and 4) Peanut Island dredged material placement on wildlife habitat. FWC staff advises that dredged material considered for disposal at artificial reef sites must meet appropriate criteria for artificial reef construction. Staff also recommends that project managers conduct multiple resource surveys and review historical data to evaluate the potential effects of the project on wildlife and marine habitats. Please refer to the enclosed FWC letter for additional detailed comments and recommendations.

STATE - FLORIDA DEPARTMENT OF STATE

No Comments Received

ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

The DEP Bureau of Beaches and Coastal Systems notes that a Joint Coastal Permit (JCP) will be required for the proposed project and offers comments on the potential effects of the project on: the existing sand transfer plant at the inlet, Peanut Island and other proposed upland disposal sites, seagrass beds around Peanut Island, the FP&L plant warm-water manatee refuge and current inlet hydraulics. Continued coordination with the DEP Bureau of Beaches and Coastal Systems and FWC to facilitate resolution of project design, sediment management, protected species monitoring and resource impact minimization and mitigation issues is strongly advised. Please contact Ms. Roxane Dow at (850) 922-7852 for further information and assistance.

SOUTH FLORIDA WMD - SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Released Without Comment

For more information or to submit comments, please contact the Clearinghouse Office at:

3900 COMMONWEALTH BOULEVARD, M.S. 47
TALLAHASSEE, FLORIDA 32399-3000
TELEPHONE: (850) 245-2161

1-12-08

Ms C.L. Brooks
Planning Division
Dept of the Army
P.O Box 4970
Jacksonville, Fl. 32232-0019

Re: Port Channel, Palm Beach County Widening

I am sending our comments regarding the above subject.

Our option is to take no action on the widening!

This widening if implemented, will be the demise of the Manatee. Grass Beds will be impacted along with the reefs. Peanut Island has just been restored, and certainly will be impacted.

We don't need larger vessels here, just because a cargo client is losing business!

Sincerely,

Stella Rossi
Coalition for Wilderness Islands
Founded 1982

625 Whispering Pines Rd
Boynton Bch Fl. 33435

PURPOSE: SCOPING MEETING - Environmental Impact Statement for Palm Beach Harbor, Feasibility Study of Navigation Improvements
DATE: 9 January 2008
LOCATION: Riviera Beach, FLORIDA (Port of Palm Beach)

RECEIVED
JAN 22 2008

REID HANSEN
NAME AND TITLE (PLEASE PRINT)

Myself
BUSINESS OR ORGANIZATION YOU REPRESENT

131 DATE PALM DR
MAILING ADDRESS

LAKE PARK, FL 33403
CITY, STATE, ZIP CODE

captainhansen@yahoo.com
EMAIL ADDRESS

Mail Your Comments to:

U.S. Army Corps of Engineers
Attention: PD-EC
P.O. Box 4970
Jacksonville, Florida 32202-4412

YOUR COMMENTS OR NOTES BELOW:

see typed sheet attached

BY JAN 20

PRIVACY ACT STATEMENT

AUTHORITY: 42 USC 4321, 4331-4335
PRINCIPAL PURPOSES: Information on this card is used for organization and conduct of this meeting. It may be added to the mailing list for notification of future meetings on the topic and for addressing correspondence subsequent to the meeting.
ROUTINE USES: This information is a public record and may be disclosed to other Federal or local agencies for governmental purposes as well as to private individuals and organizations under the Freedom of Information Act.
MANDATORY OR VOLUNTARY DISCLOSURE: Completion of this card is voluntary. However, failure to supply the information requested may result in your (or your agency's) omission from further notification regarding participation in the process.

January 18, 2008

When determining whether or not the Port of Palm Beach should be revitalized with widening, deepening, and any expansion in general, there are many considerations that must be taken into account. However, the affect on the greater good, or, the big picture, is most important. It is Lake Worth Inlet itself that has provided the surrounding areas and people with economy, employment, and recreation. People in protest seem to forget this. Ports are highly valued economic hubs for shipping and trade and therefore extremely important to not only local economies, but the state and national economy as well. The opinions of the protesting multi-millionaires on Palm Beach, who are worried about their view and width of their private beaches, have no merit. The greater good for the economy, while taking safety and/or any fragile environmental issues into consideration is of the utmost importance in this matter.

RH

Reid Hansen
Palm Beach Pilots

Florida Department of Environmental Protection

Coral Reef Conservation Program
1277 NE 79th Street Causeway
Miami, Florida 33138

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

RECEIVED
JAN 22 2008

January 18, 2008

Ms. Catherine L. Brooks
U.S. Army Corps of Engineers
Jacksonville District, Planning Division
Environmental Section, P.O. Box 4970
Jacksonville, FL 32207

RE: Notice of Intent to Prepare a Draft Environmental Impact Statement for Expansion of Lake Worth Inlet (Palm Beach Harbor), FL

Dear Ms. Brooks:

The Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program (CRCP) has reviewed the above-referenced Notice of Intent and the information presented by the U.S. Army Corps of Engineers (USACE) and its contractors at the public and agency scoping meeting held at the Port of Palm Beach on 9 January 2008. The FDEP-CRCP recognizes the importance addressing navigational safety issues and maintaining infrastructure necessary to support the economy of the State of Florida, when conducted in accordance with management practices that are appropriate for the exceptional natural resources in the proposed project area. Our environmental concerns, comments and recommendations are provided below to support the development of a comprehensive Feasibility Study and Draft Environmental Impact Statement by USACE for the proposed Lake Worth Inlet project.

Project Need/Justification

The FDEP-CRCP understands the navigational safety issues associated with shoaling which has reduced the authorized depth of the Lake Worth Inlet channel from 33' to 29', and that a project to conduct channel depth maintenance may be necessary. However, the need for the proposed Lake Worth Inlet expansion project, including widening and deepening of existing channels and turning basins, has not been demonstrated. Adjacent ports, at Port Everglades and the Port of Miami, are currently planning or preparing (respectively) to undergo major expansion projects, and therefore, an additional expansion project for the Port of Palm Beach may not be necessary or appropriate. The need for these three, or even two of these, ports within the 83-mile distance from the Port of Miami to the Port of Palm Beach to accommodate larger, deeper-draft vessels must be evaluated as a fundamental component of the economic analysis prepared for the feasibility study for this proposed project.

The economic analysis must also address the exceptional natural resources in the proposed project area, including their economic value and the economic losses associated with impacts to these natural resources. For, example, a study by Johns et al. (2001) concluded that the reef resources in Palm Beach County generate $699 million dollars in annual sales and income, and support 6300 jobs in the County. The economic value of reef resources in Miami-Dade and Broward counties is even greater. Due to the presence and economic importance of the extensive nearshore and offshore sensitive coral reef communities, endangered species, seagrasses, and other sensitive marine habitats and animals which lie within the footprint and surrounding area of the proposed project, the FDEP-CRCP strongly encourages consideration of alternative port expansion project locations in the feasibility study, where the potential impacts to valuable natural resources and the multi-decadal timescales required for resource recovery are fewer than in southeast Florida. FDEP-CRCP also notes that the intrinsic value of these natural resources to the citizens and businesses of Palm Beach County is exceptionally high, as demonstrated by local community members who voiced opposition to the proposed project during the public comment period of the recent scoping meeting.

Offshore Hardbottom and Coral Reefs

The proposed Lake Worth Inlet channel and flare expansion would directly impact hardbottom and coral reef communities. As cited above, in addition to supporting a diverse assortment of marine life, hardbottom communities and coral reefs drive an important economic engine in southeast Florida. These reefs support a thriving and economically indispensable tourism industry, as well as recreational and commercial fisheries, and provide shoreline protection. Dredging activities pose significant risks and may cause irreversible harm to hardbottom communities from potential increased turbidity and direct impacts from dredging equipment. Mitigation using artificial reefs can never fully replace a natural reef community. Further, the cost and challenges of providing mitigation at scales which attempt to compensate for the loss of ecological services following project construction may be greater than the economic benefits derived from project construction.

Nearshore Hardbottom and Seagrass Communities

The ecological relationship between seagrasses and coral reefs is inseparable and irreplaceable. Impacts to either community carry severe repercussions to both, including loss of critical habitat, fisheries stock, and primary productivity. Hardbottom and seagrass communities provide important habitat to numerous adult and juvenile fishes and foraging and resting grounds for sea turtles. Of particular note, the Lake Worth Inlet is known to be one of the largest of the few remaining snook spawning sites on the Atlantic Coast. Burial or dredging of nearshore hardbottom and seagrass communities will result in loss of habitat, biodiversity, foraging grounds, and natural shoreline stabilization and protection. Mitigation for hardbottom and seagrass communities cannot avoid or replace the associated organismal and biodiversity losses.

The proposed channel and turning basin expansion and anticipated increase in subsequent beach nourishment (due to increased post-project construction erosion) will directly and permanently impact these important nearshore habitats through direct habitat destruction (i.e. removal by dredging), and burial of the hardbottom by smothering the associated algal, sponge, coral and worm reef communities from sand placement and offshore sand migration after placement.

Nearshore and Offshore Softbottom/ Sandy Habitat

It is also important to note that sandy and softbottom seafloors, bays and lagoons provide an important, unique, but often overlooked habitat for numerous meiofauna –organisms that live and move among the grains of sand – as well as other marine fauna which bury themselves (e.g. flat fishes, stingrays), live in burrows in the sand (e.g. burrowing anemones, molluscs), or forage for food in softbottoms (numerous fishes, invertebrates and marine mammals). Blasting and dredging activities and offshore migration of sand placed on the beach can displace and/or destroy many of these fauna, and should be avoided or minimized. Destruction of this habitat may cause significant ecological repercussions.

Study Design

At the scoping meeting, USACE representatives stated that funding has been received, and the firm PBS&J has been contracted, by USACE to comprehensively survey the aquatic resources which will be impacted by the proposed project. However, the sampling design presented by Don Deis of PBS&J is inadequate to address the (1) extent and nature of potential project impacts, (2) options for minimization of impacts, and (3) the amount and appropriate mitigation required to compensate for resources destroyed by the construction of the proposed project, should it be approved. Of particular concern, we note that the surveys of the potential project impact areas A1 and A2, as well as the channel floor (project area B), and channel walls (project areas B1 & B2) are limited to towed video sampling. This methodology by itself is insufficient to address questions which must be answered by the survey. Diver surveys, both inside and adjacent to the proposed impact areas, incorporating an appropriate suite of sampling methodologies and replication must be performed to provide the ecological data necessary to fully evaluate the proposed environmental impacts associated with this project. FDEP-CRCP would be pleased to work with USACE and PBS&J to develop a comprehensive survey protocol, and would appreciate the opportunity to review and recommend specific modifications to the survey protocol in advance of the actual survey period.

For example, FDEP-CRCP encourages USACE and PBS&J to incorporate an active and directed *Acropora* spp. (Elkhorn and Staghorn coral) search into its survey protocol. We define an active search as surveying an area while specifically seeking to locate and enumerate target species. In light of the recent designation of these two coral species as Threatened under the U.S. Endangered Species Act, and the documented evidence that reefs throughout southeast Florida historically and currently provide suitable habitat for these threatened species, it would be a

gross oversight to exclude an active search for these species in the study design and report. Other factors, such as the classification of stony coral, octocorals and barrel sponge size classes also need to be considered.

The total potential area of impact is not clear. The total areas should include identification and percent cover of marine resources (in hectares and acres) defined as "live cover" (i.e. scleractinians, hydrocorals, octocorals, sponges, turf algae and macroalgae) including the natural areas of sand and uncolonized hardbottom which normally occur on reefs in southeast Florida. These areas need to be surveyed and mapped in detail to determine the extent of marine resources they include, and the total area of potential impact should include and evaluation of these areas. The study should also provide information on the impact to the nearshore and offshore softbottom or sandy habitat. Finally, the total anticipated area of both direct impacts and indirect impacts from the expansion of the Port of Palm Beach must be clearly defined.

Beach Erosion

FDEP-CRCP has concerns regarding the beach erosion and associated consequences that may result from construction of this project, including but not limited to:

- Impacts to nearshore and hardbottom resources.
- Sediment and turbidity associated with project construction methods (e.g. an inadequate buffer zone of 150ft has been proposed for this project).
- No accounting for potential impacts beyond the buffer zone.
- Subsequent need to re-nourish affected beaches which will exacerbate impacts to nearshore and hardbottom resources.
- Lack of suitable beach nourishment sand sources compatible in both grain size and composition.

In addition to the concerns addressed above, recreational activities including swimming, snorkeling, diving, and fishing may also be adversely affected by the proposed Lake Worth Inlet expansion project, and anticipated subsequent increased frequency of beach nourishment projects, due to increased turbidity and loss of habitat and biodiversity. Increased environmental pollution, road traffic, development, and infrastructure necessary to support increased maritime activity and port commerce must be considered and will impact the surrounding residential communities, as well as the greater south Florida area. Construction of this project may result in substantial, irreplaceable, and potentially unnecessary losses to the State of Florida.

The FDEP Coral Reef Conservation Program recommends that alternative ports in the State of Florida be thoroughly investigated for their potential to accommodate deeper draft vessels and increased maritime activity, in lieu of the ports in southeast Florida (e.g. Port of Palm Beach and Port Everglades). The extent of potential marine resource and associated environmental impacts from newly proposed channel deepening and widening (if needed) at alternative Ports should be compared to the proposed resource impacts anticipated to result from port expansion projects in

southeast Florida. The FDEP-CRCP requests full consideration of all potential methods and alternatives which address the stated No Action alternative for this project. As further information about this project is made available by USACE, we anticipate providing additional comments and recommendations.

Please copy me on any further activities and communications regarding this proposed project at Chantal.Collier@dep.state.fl.us.

Sincerely,

Chantal Collier

Chantal Collier
Coral Reef Program Manager
Office of Coastal and Aquatic Managed Areas
Florida Department of Environmental Protection

cc via e-mail:
Stephanie Bailenson, FDEP-CAMA
Dan Bates, Palm Beach County ERM
Marie Burns, USACE
Paul Davis, Palm Beach County ERM
Lisa Gregg, FWC
Jocelyn Karazsia, NOAA-NMFS
Vladimir Kosmynin, FDEP-BBCS
Audra Livergood, NOAA-NMFS
Stephen MacLeod, FDEP-BBCS
Ellen McCarron, FDEP-CAMA
Erin McDevitt, FWC
Janet Phipps, Palm Beach County ERM
Joanna Walczak, FDEP-CRCP

Literature Cited:
Johns GM, Leeworthy VR, Bell FW, Bonn MA (2001) Socioeconomic Study of Reefs in Southeast Florida. Final Report. Hazen and Sawyer Environmental Engineers & Scientists

Powell

Department of Environmental Resources Management
2300 North Jog Road, 4th Floor
West Palm Beach, FL 33411-2743
(561) 233-2400
FAX: (561) 233-2414
www.co.palm-beach.fl.us/erm

Palm Beach County Board of County Commissioners

Addie L. Greene, Chairperson

Jeff Koons, Vice Chair

Karen T. Marcus

Robert J. Kanjian

Mary McCarty

Burt Aaronson

Jess R. Santamaria

County Administrator

Robert Weisman

"An Equal Opportunity Affirmative Action Employer"

printed on recycled paper

January 22, 2008

Ms. Marie Burns, Acting Chief
Planning Division (PD-EC)
US Army Corps of Engineers
PO Box 4970
Jacksonville, Florida 32202-4412

SUBJECT: PALM BEACH HARBOR EIS/FEASIBILITY STUDY

Dear Ms. Burns:

The Department of Environmental Resources Management (ERM) has conducted a preliminary review of the issues associated with the proposed expansion of Palm Beach Harbor and Lake Worth Inlet. While the Port has been working closely with Palm Beach County to improve the management of the inlet and Peanut Island, the proposed project will have major environmental impacts that need to be addressed in the Feasibility Study and Environmental Impact Statement. Palm Beach County has agreed to support this study to get a better understanding of project alternatives and their impacts.

PROPOSED WORK

The study will evaluate options for widening and deepening the Lake Worth Inlet and expanding Palm Beach Harbor to improve navigation safety, improve port efficiency and to accommodate larger ships. Potential expansion alternatives include no action, channel deepening, channel widening, addition of channel flares offshore, and expansion of the turning basin to the north and south as outlined on the enclosed map.

HABITAT ISSUES

- One of the primary concerns is that dredging will destroy valuable seagrass, hardbottom and softbottom resources. Depending on the extent of dredging proposed, the potential exists for negative impacts to offshore reefs and the artificial reefs within the channel flare footprint (Study Areas A1 and A2), hardbottom communities on the inlet channel walls (Study Area B), hardbottom and seagrass communities east of Peanut Island (Study Area C), and seagrass communities (Study Areas D, F and G). Additionally, substantial amounts of shallow, productive softbottom supporting a diverse invertebrate community may be eliminated in all study areas.
- Surveys of these habitats that have been performed by ERM are not sufficient to address potential impacts from the proposed work. Detailed resource surveys will need to be conducted to adequately characterize each study area.
- While some of the resources that will be affected have been created by man (artificial reefs, channel walls, hardbottom rubble), these communities have been established for decades. They have been colonized by hard corals, soft corals, and sponges, support recreationally and commercially species (including lobsters), and provide important environmental functions that need to be recognized in the study.
- The seagrass beds within the project limits are some of the most diverse in the county with at least 5 species documented to occur. These beds have additional

significance given the proximity to the manatee aggregation site at the Florida Power and Light (FPL) warm-water discharge.

- Mitigation for seagrass impacts at the scale being considered will have a poor chance of success in Lake Worth Lagoon. The most likely method to mitigate for any seagrass impacts would be to fill large portions of the Lake Worth Lagoon to raise the bottom to the photic zone. The only location near the inlet where mitigation at this scale could be constructed is located about 1 ½ miles south of the inlet. It is unlikely a sufficiently large mitigation project could be constructed here since it is expected to have additional significant impacts to nearby seagrasses, benthic invertebrates, navigation, and flushing of the lagoon. Further, based upon their limited distribution in the lagoon and their light and nutrient requirements, it is highly unlikely that manatee grass (*Syringodium filiforme*) or turtle grass (*Thalassia testudinum*) would grow at this location. For these reasons, every effort should be made to significantly reduce or eliminate seagrass impacts.
- The proposed dredging is in direct conflict with the Lake Worth Lagoon Management Plan which lists seagrass preservation as one of its priority objectives, and the Coastal Management Element (CME) of the Palm Beach County Comprehensive Land Use Plan, which has a goal of preserving and protecting coastal resources.
- Impacts to water quality and the potential for increased flushing in the Lake Worth Lagoon need to be evaluated. While it is likely that increased oceanic water in the lagoon will provide benefits from improved clarity, there will be changes in lagoon salinity that may affect a number of other species that need to be evaluated. It is recommended that predicted changes in salinity in the lagoon be evaluated using an existing model (Zarillo, 2003). Additionally, the potential for increased flushing of nutrient rich lagoon waters onto offshore reefs needs to be considered.

LISTED SPECIES ISSUES

- Manatees are the listed species most affected by this project which is located where the majority of manatees are found in the county. The FPL discharge provides an important warm-water refuge for hundreds of manatees in the winter. Alterations to the basin near the discharge are likely to affect manatees and will be one of the most challenging impacts to offset.
- Sea turtles utilize a number of habitats in the project area including the beaches, reefs, seagrass beds, and inlet jetties. Recent studies conducted by ERM have documented juvenile green turtles utilizing seagrass beds 1 ½ miles north of Palm Beach Inlet and they may be using the beds south of the inlet. Juvenile green and hawksbill turtles utilize nearshore reefs near the inlet. Juvenile green turtles have also been killed during maintenance dredging of the inlet indicating that they may be foraging on algae found on the rocks (similar to those observed in the Trident submarine basin in Port Canaveral and Brazos Santiago Pass in Texas). Four species of sea turtles (loggerhead, green, leatherback, and hawksbill) utilize the nesting beaches adjacent to the inlet and five species (loggerhead, green, leatherback, hawksbill, and Kemp's ridley) occur in the ocean near the inlet.
- Lighting at the Port is currently impacting sea turtles. High mast lighting that has been added during recent Port renovations that increased illumination in the coastal area, has been implicated in sea turtle hatchling disorientation incidents on Palm

Beach Shores, and probably contributes to many other disorientations in the area. Increased cargo traffic will likely mean increased coastal lighting impacts in the cargo handling area. Port lighting should be evaluated during the EIS process to determine methods for achieving sufficient illumination for port operations while minimizing the amount of light trespass off the property.

- Johnson's seagrass (*Halophila johnsonii*) is one of the most commonly occurring seagrasses in Lake Worth Lagoon. Impacts from dredging and sedimentation, as well as alterations to salinity and water clarity will impact this threatened species.
- Whales, including humpback and right whale, have infrequently been observed in the inlet and in adjacent waters.
- The Lake Worth Inlet is one of the most important areas for several species of the Atlantic population of snook (*Centropomus* spp), a species of special concern. Thousands of snook utilize the inlet and nearby structure during summer spawning aggregations and return to this location every year.
- Construction will have to be timed to minimize impacts in the winter to manatees and during the summer to nesting sea turtles and spawning snook. Another consideration in determining timing of construction is that offshore currents tend to be stronger in summer which would increase flushing, dilution and transportation of a turbidity plume.
- The public notice stated that blasting may not be necessary for this project. However, based upon our understanding of the geology, previous dredging at this inlet, and recent dredging in the Port of Miami, we expect that there will strong economic incentive to use blasting. Any consideration for blasting must take into account the impacts to listed species and fishes.

INLET AND BEACH MANAGEMENT ISSUES

- The Lake Worth Inlet is already the primary cause of erosion of downdrift beaches. Any widening and deepening of the inlet and the nearshore will alter the wave climate and littoral sand transport which could increase the loss of sand to the downdrift beaches. Any impacts will require an increase in the amount of sand bypassing and beach nourishment (which can have negative impacts) to compensate. The costs to mitigate for downdrift beach impacts must be clearly and fully defined.
- All beach compatible sand must be placed on the beach. There may be options for disposing of non-beach compatible material in existing dredge holes in Lake Worth Lagoon. Use of the offshore spoil disposal area should be only as a last resort since there are important deep reef habitats downstream from the disposal area. Geotechnical work should be performed as part of this study to adequately characterize the sediments and determine the quantities that will be available for disposal at the different sites.

PORT OPERATIONS

- Expansion of the inlet and turning basin to accommodate larger ships will have secondary impacts that should be addressed in the EIS.
- Concerns have been raised recently about potential damage associated with the existing anchorage area and a study has been initiated to evaluate options for

revising the anchorage area. This issue should be addressed in the EIS since the ships that would be using the anchorage are usually associated with the Port.

- ERM currently uses the lot west of Study Area G as the artificial reef construction staging area. In the event the Port acquires this site for expansion. ERM would like to receive assurances that there will be provisions for such a staging area in future Port plans.

RECREATION ISSUES

- NEPA requires that impacts to recreation be evaluated. The inlet vicinity is heavily used by boaters, fisherman, snorkelers, divers, surfers, and the general public.
- Safety issues will need to be evaluated since larger ships operating close to a popular park (Peanut Island), amidst large numbers of recreational and commercial small craft, and near popular dive sites is likely to increase the chance of accidents.
- Dredging of the channel flare (Study Area A) will affect wave generation that may alter local surf conditions. Given the quality and popularity of the Reef Road and Pump House surf breaks, it is recommended that potential changes to the surf be evaluated.
- Erosion of the southeast corner of Peanut Island has necessitated increasing amounts of armoring to protect recreational amenities. Dredging the channel deeper and closer to the island will allow for increased wave and current energy to alter the shoreline and threaten additional amenities. Those impacts and costs should be evaluated.

BENEFIT/COST

- A key determinant of feasibility is the benefit/cost ratio of each alternative. It is requested that, in addition to construction costs, the true costs to all the resources be included in the analysis. This would include costs for mitigation, monitoring, increased beach and inlet management, and loss of recreation resources.

In summary, a thorough study is necessary to adequately evaluate alternatives. Given the extent of potential impacts, it does not appear that it is possible to construct all components of the project without significant environmental effect. The challenge will be to develop a plan that meets some of the Port's goals while minimizing impacts.

Thank you for the opportunity to provide comments. Please call me at 561-233-2400 or Mr. Paul Davis at 561-233-2509 if you have any questions.

Sincerely,

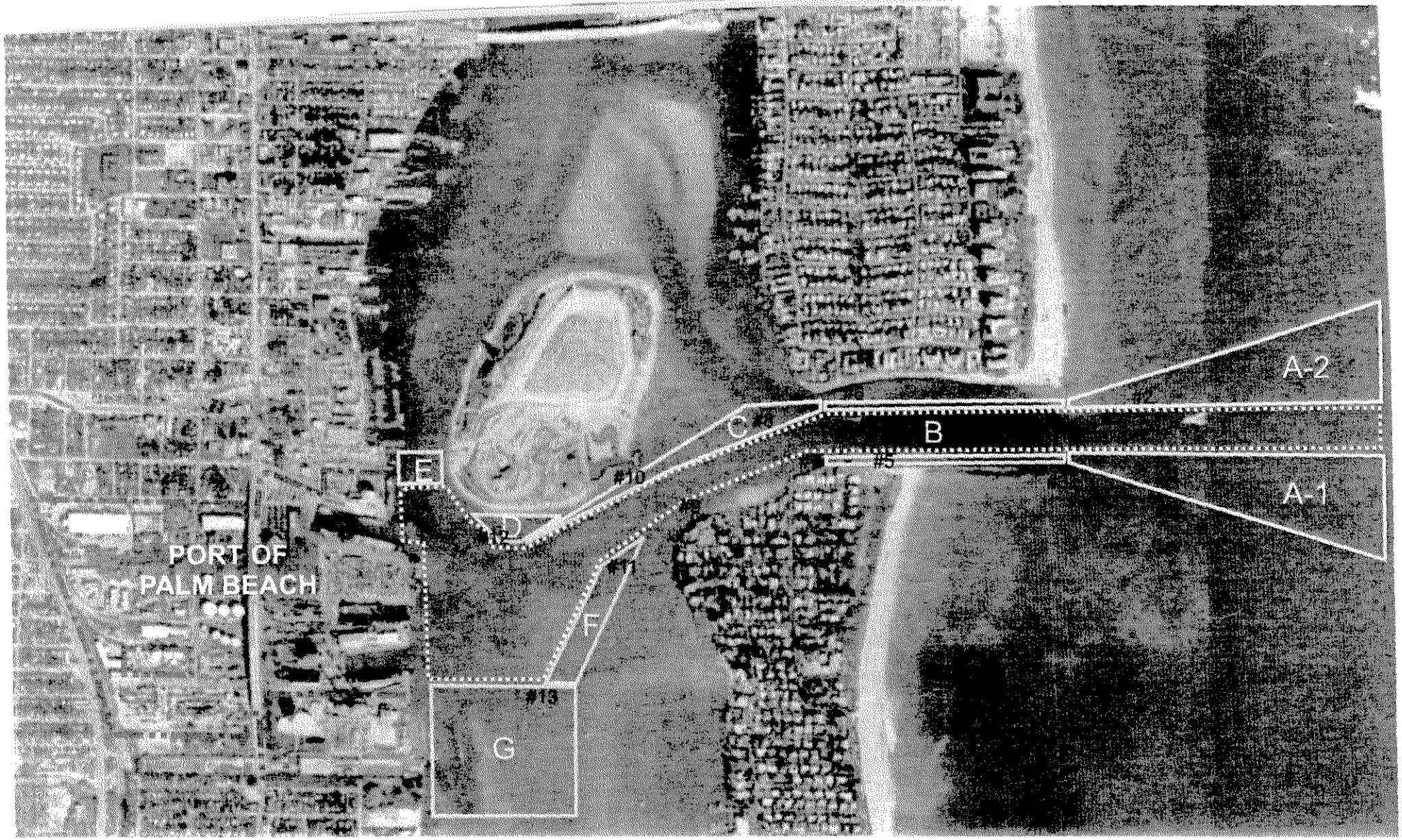
Richard E. Walesky

Richard E. Walesky, Director
Environmental Resources Management

REW:PD:dab

Enclosure

c: (w/ enclosure):
Robert Weisman, County Administrator
Members of the PBC Artificial Reef and Environmental Enhancement Committee
Lori Baer, Director, Port of Palm Beach
Peter Elwell, Town Manager, Town of Palm Beach
Cynthia Lindscoog, Town Administrator, Town of Palm Beach Shores
William Wilkins, City Manager, Riviera Beach
Edward Mitchell, City Administrator, West Palm Beach
Dennis Eshleman, Director, PBC Parks and Recreation
David Roach, Executive Director, FIND



LEGEND

--- Federal Harbor Project Potential Improvement Areas

Note: Improvement areas are general study areas only; extensive analysis is required prior to refinement and selection of any expansion alternative.

A-1 - South Channel Flare
A-2 - North Channel Flare
B - Widener inside jetties
C - Widener
D - Peanut Island Widener
E - North Basin Widener
F - Turning Basin Eastern Widener
G - Turning Basin Southern Expansion
1- Channel Marker Number

Palm Beach Harbor/Lake Worth Inlet
Navigation Feasibility Study
Study Areas for Potential Improvements
Port of Palm Beach District

Source: Google Earth; The Four Gates Company, 2007

Florida Department of Environmental Protection

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

January 23, 2008

Ms. Catherine L. Brooks
Jacksonville District, Planning Division
U. S. Army Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232-0019

RE: Department of the Army, Jacksonville District Corps of Engineers - Scoping Notice Draft Environmental Impact Statement for Expansion of Lake Worth Inlet (Palm Beach Harbor) - Palm Beach County, Florida.
SAI # FL200712103896C

Dear Ms. Brooks:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 95-359, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated a review of the above public notice.

The Florida Department of Environmental Protection's (DEP) Bureau of Beaches and Coastal Systems notes that a Joint Coastal Permit (JCP) will be required for the proposed project and offers the following comments:

1) Please be advised that there is an existing sand transfer plant at the inlet. In 1996, the pipe was drilled approximately 15 feet under the existing channel. The costs of redrilling the pipe should be included in the total project costs if the proposed entrance channel depth approaches this pipeline depth.

2) The DEP will consider the effects of dredged material disposal and management on Peanut Island and other upland sites. Any potential discharges from the disposal site (i.e., return water) must be reviewed, along with any construction to increase the capacity of the containment dikes. (If no dike construction is necessary, an engineer's certification of containment dike integrity will still be required.) Impacts of disposal operations on water-dependent bird species must be considered, especially if conducted during nesting season.

3) Continuous seagrass beds border the south turning basin, and seagrasses have also been observed around the south end of Peanut Island. Any expansion within the areas labeled C, D, F and G on Figure 1 of the scoping notice will likely require seagrass mitigation.

4) A Florida Power & Light (FP&L) power plant exists south of the port. Expansion to the south would bring larger ships closer to this warm-water manatee refuge, increasing the risk of primary and secondary impacts.

5) Neither the Lake Worth Inlet Management Plan study by Applied Technology and Management, Inc. (April 1995) nor prior studies by the Jacksonville District Corps of Engineers have obtained any recent inlet hydraulics data, so DEP does not have a complete understanding of this inlet's hydraulics. Changes to the federal navigation project through this inlet propose channel deepening and widening that would affect the inlet's hydraulics. Water quality effects, tidal prismatic modification, and changes to interior waters circulation are among the physical environmental reasons to develop an understanding of the inlet's hydraulics. Physical changes to the inlet's hydraulics may also have biological effects.

   The effect of channel deepening and widening on the sand transfer plant's discharge line and pumping performance should also be evaluated. Although the inlet trap northeast of the inlet should entrap most of the sediment, it is too early to ascertain its success or calculate the amount of sediment that will still be entrapped by the inlet channel. At most other inlets in Florida, channel deepening would have a significant impact on natural sand bypassing.

   DEP staff requests the collection of current inlet hydraulics data to utilize in the evaluation of any proposed modifications.

Continued coordination with the DEP Bureau of Beaches and Coastal Systems and Florida Fish and Wildlife Conservation Commission to facilitate resolution of project design, sediment management, protected species monitoring and resource impact minimization and mitigation issues is strongly advised. Please contact Ms. Roxane Dow at (850) 922-7852 for further information and assistance.

The Florida Fish and Wildlife Conservation Commission (FWC) has provided a number of comments regarding the potential direct and secondary impacts of:

1) Beach sand placement activities during the marine turtle nesting season (March 1 through October 31) on sea turtle nesting, nests and emergent hatchlings;
2) Turning basin expansion and subsequent alteration of the warm-water refuge utilized by manatees at the FP&L Riviera Beach power plant south of the port;

3) Dredging, blasting and sediment disposal activities within the turning basin, inlet channel and channel flares on seagrasses, corals and hardbottom resources; and
4) Peanut Island dredged material placement on wildlife habitat.

FWC staff advises that dredged material considered for disposal at artificial reef sites must meet appropriate criteria for artificial reef construction. Staff also recommends that project managers conduct multiple resource surveys and review historical data to evaluate the potential effects of the project on wildlife and marine habitats. Please refer to the enclosed FWC letter for additional detailed comments and recommendations.

Based on the information contained in the scoping notice and the enclosed state agency comments, the state has determined that, at this stage, the proposed activities are consistent with the Florida Coastal Management Program (FCMP). The concerns identified by our reviewing agencies must be addressed, however, prior to project implementation. The state's continued concurrence with the project will be based, in part, on the adequate resolution of issues identified during this and subsequent reviews. The state's final review of the project's consistency with the FCMP will be conducted during the environmental permitting stage.

Thank you for the opportunity to review the proposed project. Should you have any questions regarding this letter, please contact Ms. Lauren P. Milligan at (850) 245-2170.

Yours sincerely,

Sally B. Mann

Sally B. Mann, Director
Office of Intergovernmental Programs

SBM/lm
Enclosures

cc: Roxane Dow, DEP, BBCS
Mary Ann Poole, FWC

Project Information	
Project:	FL200712103896C
Comments Due:	01/11/2008
Letter Due:	01/21/2008
Description:	DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT CORPS OF ENGINEERS - SCOPING NOTICE - DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR EXPANSION OF LAKE WORTH INLET (PALM BEACH HARBOR) - PALM BEACH COUNTY, FLORIDA.
Keywords:	ACOE - SCOPING - EXPAND LAKE WORTH INLET/PALM BEACH HARBOR - PALM BEACH CO.
CFDA #:	12.107

Agency Comments:

TREASURE COAST RPC - TREASURE COAST REGIONAL PLANNING COUNCIL

The proposed study is not in conflict or inconsistent with the Strategic Regional Policy Plan. It furthers Regional Goal 7.1 that calls for a balanced and integrated transportation system.

PALM BEACH -

COMMUNITY AFFAIRS - FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS

FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

The FWC has provided a number of comments regarding the potential direct and secondary impacts of: 1) beach sand placement activities during the marine turtle nesting season (March 1 through October 31) on sea turtle nesting, nests and emergent hatchlings; 2) turning basin expansion and subsequent alteration of the warm-water refuge utilized by manatees at the Florida Power & Light Riviera Beach power plant south of the port; 3) dredging, blasting and sediment disposal activities within the turning basin, inlet channel and channel flares on seagrass, corals and hardbottom resources; and 4) Peanut Island dredged material placement on wildlife habitat. FWC staff advises that dredged material considered for disposal at artificial reef sites must meet appropriate criteria for artificial reef construction. Staff also recommends that project managers conduct multiple resource surveys and review historical data to evaluate the potential effects of the project on wildlife and marine habitats. Please refer to the enclosed FWC letter for additional detailed comments and recommendations.

STATE - FLORIDA DEPARTMENT OF STATE

No Comments Received

ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

The DEP Bureau of Beaches and Coastal Systems notes that a Joint Coastal Permit (JCP) will be required for the proposed project and offers comments on the potential effects of the project on: the existing sand transfer plant at the inlet, Peanut Island and other proposed upland disposal sites, seagrass beds around Peanut Island, the FP&L plant warm-water manatee refuge and current inlet hydraulics. Continued coordination with the DEP Bureau of Beaches and Coastal Systems and FWC to facilitate resolution of project design, sediment management, protected species monitoring and resource impact minimization and mitigation issues is strongly advised. Please contact Ms. Roxane Dow at (850) 922-7852 for further information and assistance.

SOUTH FLORIDA WMD - SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Released Without Comment

For more information or to submit comments, please contact the Clearinghouse Office at:

3900 COMMONWEALTH BOULEVARD, M.S. 47
TALLAHASSEE, FLORIDA 32399-3000
TELEPHONE: (850) 245-2161

Florida Fish and Wildlife Conservation Commission

Commissioners
Rodney Barreto
Chair
Miami
Brian S. Yablonski
Vice-Chair
Tallahassee
Kathy Barco
Jacksonville
Ronald M. Bergeron
Fort Lauderdale
Richard A. Corbett
Tampa
Dwight Stephenson
Delray Beach
Kenneth W. Wright
Winter Park

Executive Staff
Kenneth D. Haddad
Executive Director
Victor J. Heller
Assistant Executive Director
Karen Ventimiglia
Deputy Chief of Staff

Office of Policy and Stakeholder Coordination
Mary Ann Poole
Director
(850) 410-5272
(850) 922-5679 FAX

Managing fish and wildlife resources for their long-term well-being and the benefit of people.

620 South Meridian Street
Tallahassee, Florida
32399-1600
Voice: (850) 488-4676
Hearing/speech impaired:
(800) 955-8771 (T)
(800) 955-8770 (V)
MyFWC.com

January 10, 2008

RECEIVED
JAN 14 2008
OIP / CLGA

Ms. Lauren Milligan
Florida Department of Environmental Protection
Florida State Clearinghouse
3900 Commonwealth Boulevard, MS-47
Tallahassee, FL 32399-3000

Re: Palm Beach County, SAI #FL200712103896C, Notice of Intent to prepare a Draft Environmental Impact Statement for expansion of Lake Worth Inlet (Palm Beach Harbor) including widening and deepening of the existing channels and turning basin

Dear Ms. Milligan:

The Florida Fish and Wildlife Conservation Commission's (FWC) Aquatic Habitat Conservation and Restoration Section has coordinated a preliminary agency review of the potential wildlife and wildlife habitat issues associated with the expansion of Lake Worth Inlet (Palm Beach Harbor), Florida. This letter outlines the anticipated concerns and comments related to the feasibility study and proposed Draft Environmental Impact Statement.

Background

The U.S. Army Corps of Engineers (USACE) is performing a feasibility study for the expansion of Lake Worth Inlet (Palm Beach Harbor). The expansion alternatives being reviewed include no action, creation of channel flares, channel deepening and widening, and turning basin expansion. Options for the disposal of dredged material include Peanut Island, disposal in the Palm Beach Harbor Ocean Dredged Material Disposal Site, beach placement, disposal of suitable rock at existing artificial reef sites, and any other viable disposal options that may become available. The USACE intends to prepare a Draft Environmental Impact Statement for this project. The Port of Palm Beach District is the cooperating agency and non-federal sponsor for this project and will provide information and assistance on the resource assessment and mitigation measures and alternatives.

Wildlife

Marine Turtles: The coastal beaches both north and south of Lake Worth Inlet provide nesting habitat for the loggerhead (*Caretta caretta* - threatened), leatherback (*Dermochelys coriacea* - endangered), and the green sea turtle (*Chelonia mydas* - endangered). Construction activities associated with sand placement on these beaches during the marine turtle nesting season (March 1 through October 31) could adversely affect nesting turtles, incubating nests, and emergent hatchlings. The compatibility of sand placed on the nesting beach may also adversely affect the ability of nesting females to construct viable nests and the incubation environment necessary for successful development and escape of marine turtle hatchlings.

Nearshore hardbottom communities and artificial reefs provide foraging, resting and juvenile developmental habitat that could be adversely affected by the expansion of channels associated with this project. Blasting to remove limestone during deepening or widening of channels could be lethal to marine turtles and manatees if it occurs relatively close to individual animals.

Manatees: The Florida Power & Light Riviera Beach power plant located immediately south of the port provides an important winter warm-water refuge for the Florida manatee (*Trichechus manatus latirostris* - endangered). During winter cold fronts, over 400 manatees have been documented using this warm-water refuge. The desired turning basin expansion would encompass the area adjoining this warm-water habitat. Construction activities may directly affect manatees using this site if work is conducted during the cold season (November 15 through March 31), or indirectly by creating a deterrence to the use of this important habitat.

Secondary adverse affects could include altering the nature of the warm-water refuge. Substantially deepening the bathymetry adjacent to the warm-water refuge could result in reduction of warm-water habitat due to an increase of the mixing between the cooler water from the expanded turning basin with the thermal outfall of the power plant. Expansion of the turning basin is also expected to affect seagrass resources that provide forage for manatees. Increased shipping traffic may also increase the risk to manatees due to its proximity to the warm-water refuge and to the travel corridors used to access foraging areas located north of the port.

Habitat

Corals and Hardbottom: Hard corals may be found within the inlet channel and the area marked as "south channel flare" and "north channel flare" on the map provided by the USACE labeled "Study Areas for Potential Improvements (Widening and Deepening)." In addition, the nearshore areas that may be affected by this project fall within the range of staghorn coral (*Acropora cervicornis*), which was recently listed federally as a threatened species. Other hardbottom resources occur on the walls of the existing channel and potentially in the nearshore channel expansion areas. The primary benthic resources expected to be found within the prospective expansion areas include live bottom (soft corals and sponges), solution holes, limestone ledges, and their associated communities.

Potential adverse effects to these benthic resources could result due to dredging, blasting, and sediment disposal. Expansion of the offshore disposal area may also affect hardbottom resources, which will need to be considered if this option is explored.

Seagrass: Six species of seagrass have been documented in Lake Worth Lagoon and all could be affected by the dredging necessary to expand the inlet channel and turning basin. Seagrass species found in Lake Worth Lagoon include turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), star grass (*Halophila engelmannii*), paddle grass (*Halophila decipiens*) and the threatened species Johnson's seagrass (*Halophila johnsonii*). Seagrasses provide important ecological functions to estuarine and marine coastal systems. A wide range

of organisms are directly or indirectly dependent upon seagrasses for food and habitat (Zieman and Zieman1989), including several federally and state-listed endangered species such as green sea turtle and Florida manatee.

Seagrasses, coral, and hardbottom also provide essential fisheries habitat by creating a physically stable refuge and nursery ground for numerous commercially and recreationally viable fish and invertebrates (Zieman 1982, Phillips and Meñez 1988, Fonseca et al. 1988).

Artificial Reefs

Any dredged material that would be considered for disposal at an artificial reef site will need to meet appropriate criteria for artificial reef construction depending upon the proposed deployment location and material types. No silt, sand, clay (of any type), or rock boulders less than 150 pounds each will be allowed to be deployed in the artificial reef site. Ideally, the minimum acceptable weight of each individual piece of rock proposed for artificial reef deployment should weigh at least 500 pounds. Close coordination with the FWC Artificial Reef Program (Attn: Jon Dodrill, FWC-Division of Marine Fisheries Management) and Palm Beach County Artificial Reef Coordinator (Dr. Janet Phipps) will be required if artificial reefing is considered as a disposal option.

Peanut Island

Peanut Island contains a large habitat enhancement project that includes a 7.1-acre maritime hammock, 3 acres of mangroves, 1.5 acres of tidal channels and ponds, 3 acres of shallow-water lagoons and 1.3 acres of shallow-water reef. All of these habitat features provide habitat for a variety of wildlife including shorebirds, fish, crustaceans, and mollusks. Placing spoil on the island and widening the channel in segments C, D and E could adversely affect these habitats.

Resource Surveys

We recommend that multiple resource surveys be conducted as well as a review of historical data in order to evaluate the potential affects of this project on the wildlife and marine habitats that are present within the scope of the project. The draft Environmental Impact Statement should include the results of seagrass surveys within the project boundary areas of Lake Worth Lagoon and the inlet, as well as the results of surveys of hardbottom and coral surveys within the inlet channel and the inlet flares, with special attention paid to the finding of any staghorn coral. We offer our expertise and assistance in developing the protocols for the resource surveys due to their importance in the determination process of the feasibility of the options suggested in this scoping effort.

Summary

Expansion of the Lake Worth inlet channel and turning basin has the potential to adversely affect numerous wildlife and habitat resources of the state of Florida. Many difficult environmental hurdles would need to be overcome for the full extent of this project to come to fruition. We recommend that the USACE and the Port of Palm Beach give great consideration to the natural resources that would be affected

December 6, 2007

Planning Division
Environmental Branch

To Whom It May Concern:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is gathering information to define issues and concerns that may be associated with expansion of Lake Worth Inlet (Palm Beach Harbor), Florida

A Feasibility Study is being undertaken to determine if the authorized project should be modified. During the feasibility study, environmental considerations will be addressed in an Environmental Impact Statement. Alternatives that are being considered include no action, widening and deepening of existing channels and turning basin modifications, or a combination of alternatives (see enclosed Figure).

Significant issues that are anticipated include concern for nearshore and offshore hard bottom communities, fisheries, threatened and endangered species, sea grasses, marine mammals, migratory birds, and water quality. For additional information, see the enclosed Notice of Intent to prepare a Draft Environmental Impact Statement.

Preliminary geotechnical reports indicate that blasting may not be necessary to achieve the proposed inlet expansion. Disposal options being considered include Peanut Island (with possible off-load to another use or location), ocean disposal in the Palm Beach Harbor Ocean Dredged Material Disposal Site (which may require expansion or modification), beach placement (if sufficient beach compatible material), artificial reef (if sufficient suitable rock), and any other disposal or beneficial use options that may become available.

Letters of comment or inquiry should be submitted within 45 days from the date of this letter to the letterhead address, attention of Ms. C. L. Brooks, Planning Division. Your concerns or comments may also be communicated in one of several public and agency scoping meetings that will be conducted on this project. The first public and agency scoping meeting will be held January 9, 2008, at 3:00 p.m., Port of Palm Beach, One East 11th Street, Riviera Beach, Florida, 33404,. Additional information and project updates can be obtained from website: http://www.portofpalmbeach.com/feasibility_study.htm

Sincerely,

Marie G. Burns
Acting Chief, Planning Division

Enclosures

Figure 2. Port of Palm Beach Proposed Expansion Alternatives

BILLING CODE: 3710-AJ

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent to Prepare a Draft Environmental Impact Statement for Expansion of Lake Worth Inlet (Palm Beach Harbor), FL

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DOD.

COOPERATING AGENCY: Port of Palm Beach District, Riviera Beach, Florida

ACTION: Notice of intent.

SUMMARY: The Jacksonville District, U.S. Army Corps (Corps) of Engineers intends to prepare a Draft Environmental Impact Statement (EIS) for expansion, including widening and deepening of existing channels and turning basins in Lake Worth Inlet (Palm Beach Harbor). The project is a cooperative effort between the U.S. Army Corps of Engineers (lead Federal agency) and Port of Palm Beach District (non-Federal sponsor and cooperating agency).

ADDRESSES: Ms. Catherine L. Brooks, U.S. Army Corps of Engineers, Jacksonville District, Planning Division, Environmental Section, P.O. Box 4970, Jacksonville, FL 32207.

FOR FURTHER INFORMATION CONTACT: Catherine L. Brooks at (904) 232-2130.

SUPPLEMENTARY INFORMATION: Authority for the proposed study was received under the House Resolution of June 25, 1998. An expedited Reconnaissance Report completed in 2001 by the Corps, concluded based on preliminary findings, there was a

federal interest in pursuing harbor improvements.

Alternatives: The project's expansion alternatives include no action, creation of channel flares, wideners, deepening, turning basin, or a combination of the considered alternatives. Alternatives being considered for disposal of dredged material include Peanut Island (with possible off-load to another use or location), ocean disposal in the Palm Harbor Ocean Dredged Material Disposal Site (which may require expansion or modification), beach placement (if there is sufficient beach compatible material), artificial reef (if there is sufficient suitable rock) and any other disposal or beneficial use options that may become available.

Issues: The EIS will consider impacts on coral reefs and other hardbottom communities, sea grasses, protected species, shore impacts, health and safety, water quality, aesthetics and recreation, fish and wildlife resources, cultural resources, energy conservation, socio-economic resources, navigation, and other impacts identified through scoping, public involvement and interagency coordination.

Scoping: The scoping process will involve Federal, State, County and municipal agencies and other interested persons and organizations. A public and agency scoping meeting will be held on January 9, 2008, at 3:00 p.m. at the Port of Palm Beach, One East 11th Street, Riviera Beach, FL, 33404.

Public Involvement: We invite the participation of affected Federal, State and local agencies, affected Native-American Tribes, and other interested private organizations and individuals. In addition to the agency and public scoping meeting on January 9, 2008, and receipt of written comments at various stages of the Feasibility Study, there will be a public meeting on the Draft Environmental Impact Statement following its preparation. The date,

time, and location will be announced.

Coordination: The proposed action is being coordinated with the U.S. Fish and Wildlife Service (FWS) and NOAA-National Marine Fisheries Service (under Section 7 of the Endangered Species Act) and the Wildlife Coordination Act (FWS only). The proposed action is also being coordinated with the Florida State Historic Preservation Officer, the U.S. Coast Guard, and the U.S. Environmental Protection Agency.

Other Environmental Review and Consultation: The proposed action would involve evaluation for compliance with guidelines pursuant to Section 404(b)(1) of the Clean Water Act, water quality certification (application to the State of Florida) pursuant to Section 401 of the Clean Water Act, certification of state lands, easements, and rights-of-way, determination of Coastal Zone Management Act Consistency, and the use of the Ocean Dredged Material Disposal Site for Palm Beach
Harbor pursuant to the Marine Protection, Research, and Sanctuaries Act (Ocean Dumping Act).

Agency Role: As the cooperating agency, non-Federal sponsor and leading local expert, the Port of Palm Beach will provide information and assistance on the resources to be impacted, mitigation measures and alternatives. Other agencies having either regulatory authority or special expertise may also be invited to become a cooperating agency in preparation of the EIS.

Draft EIS Preparation: It is estimated that the Draft EIS will be available to the public by November 2008. As the study and EIS develop, additional information will be posted under Palm Beach County on the Jacksonville District's Environmental Documents web page at: *http://planning.saj.usace.army.mil/envdocs/envdocsb.htm*. The status of any

Florida Department of Environmental Protection application submitted for permit of this action will be posted on the internet at:

http://www.dep.state.fl.us/beaches/permitting/permits.htm.

December 6, 2007

DATE

MARIE G. BURNS
ACTING CHIEF, PLANNING DIVISION

USDA

United States Department of Agriculture

Animal and Plant Health Inspection Service

Plant Protection and Quarantine

One East 11th St., Suite 332, Box 3
Riviera Beach, FL 33404

Phone: (561) 841-4873
Fax: (561) 841-4871

Federal Relay Service
(Voice/TTY/ASCII/Spanish)
1-800-877-8339

December 12, 2007

Ms. Catherine L. Brooks
U.S. Army Corps of Engineers
Jacksonville District
Planning Division, Environmental Section
P.O. Box 4970
Jacksonville, FL 32207

Dear Ms. Brooks:

We recently received a package from Marie Burns, Acting Chief, Planning Division, regarding the expansion of Lake Worth Inlet (Palm Beach Harbor), Florida (page 1 enclosed).

Our address on the envelope and Port of Palm Beach Mailing List (November 2007) is incorrect. Please make the following change to our address which appeared on page 12 of the mailing list (copy enclosed):

OLD ADDRESS: US DEPT OF AGRICULTURE
THE MARITIME OFFICE BLDG
4 EAST PROT ROAD SUITE 112
RIVIERA BBEACH FL 33404

NEW ADDRESS: **US DEPT OF AGRICULTURE**
MARITIME OFFICE BLDG
1 EAST 11TH ST., STE 332, BOX 3
RIVIERA BEACH FL 33404

If you have any questions concerning this matter, call me at 561-841-4873. Thank you.

Sincerely,

John Gilmore

John Gilmore
Supervisory PPQ Officer
USDA, APHIS, PPQ

Enclosures:
1. Ltr from Corp dtd 12/06/07
2. Pg 12 of Address List w/correction

Sondra Mack
958 North Lake Way
Palm Beach, FL 33480

December 11, 2007

Ms. C. L. Brooks
Planning Division
Department of the Army
Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville, FL 32232-0019

Dear Ms. Brooks:

I am in receipt of the letter from Acting Chief Marie Burns regarding the expansion of Lake Work Inlet. I think it's a great idea. Whatever we can do to help the inlet and beaches will benefit everyone.

Yours truly,

Sondra Mack

Sondra Mack

SM:jl

Surfrider Foundation
CONSERVATION • ACTIVISM • RESEARCH • EDUCATION
P.O. BOX 6010
SAN CLEMENTE, CA 92674-6010

WEST PALM BEACH
FL 334
05 JAN 2008 PM 1 L

USA 41

General Grosskruger
US Army Corps of Engineers, Jacksonville District
701 San Marco Boulevard
Jacksonville, FL
32207-0019

Printed on Recycled Paper

32207+8175

RECEIVED
2 Jan 08

Marie Burns
Planning Division
Dept of the Army

December 23, 2007

Re: Expansion of Lake Worth Inlet

Dear Ms. Burns:

I have received your letter dated Dec 6, 2007 about the possible expansion of Lake Worth Inlet.

Our property is located in the 'C' section or Northwest part of Palm Beach Island. Over the years of the inlet dredging we have lost as much as 50 feet of our property and beach. We do not want anymore dredging to go on because we have lost too much property already. Please do NOT dredge in the 'C' area.

We would appreciate it if you would put back the beaches that were on the Northwest portion of Palm Beach Island. They have been taken away by prior dredgings and hurricane conditions.

If you have any questions or comments please let me know.

Sincerely,

Jeffrey P. Prudden

Jeffrey P. Prudden

PURPOSE: SCOPING MEETING - Environmental Impact Statement for Palm Beach Harbor, Feasibility Study of Navigation Improvements
DATE: 9 January 2008
LOCATION: Riviera Beach, FLORIDA (Port of Palm Beach)

Kelly Novic, Staff Biologist
NAME AND TITLE (PLEASE PRINT)

Save the Manatee Club
BUSINESS OR ORGANIZATION YOU REPRESENT

500 N Maitland Ave
MAILING ADDRESS

Maitland, FL 32751
CITY, STATE, ZIP CODE

knovic@savethemanatee.org
EMAIL ADDRESS

Mail Your Comments to:

U.S. Army Corps of Engineers
Attention: PD-EC
P.O. Box 4970
Jacksonville, Florida 32202-4412

YOUR COMMENTS OR NOTES BELOW:

SMC would like to express our concerns over the impacts this project will have on manatees and their food source. Historical, current, and projected manatee use needs to be examined and considered. Please review FWRI manatee sighting and telemetry data. Holly Edwards at FWRI may be able to assist with this data aquisition (727-896-8626).

Please also coordinate with the FWS regarding Mike Runge's findings for the east coast in 2003 and 2007. Runge's study is available through USFWS (Jim Valade is contact: 904-232-2580).

Runge's model predicts a stable to slightly increasing current manatee population that is projected to decline on the East Coast in the next 10 to 15 years. Warm water refuges like FPL Riviera Beach are critical.

SMC will be monitoring the development of this plan and would like to see negative impacts to manatees, their habitats and their food sources avoided.

PRIVACY ACT STATEMENT

AUTHORITY: 42 USC 4321, 4331-4335
PRINCIPAL PURPOSES: Information on this card is used for organization and conduct of this meeting. It may be added to the mailing list for notification of future meetings on the topic and for addressing correspondence subsequent to the meeting.
ROUTINE USES: This information is a public record and may be disclosed to other Federal or local agencies for governmental purposes as well as to private individuals and organizations under the Freedom of Information Act.
MANDATORY OR VOLUNTARY DISCLOSURE: Completion of this card is voluntary. However, failure to supply the information requested may result in your (or your agency's) omission from further notification regarding participation in the process.

DEPARTMENT OF DEFENSE

Department of the Army

Army Science Board Plenary Meeting

AGENCY: Department of the Army, DoD.

ACTION: Notice of open meeting.

SUMMARY: Pursuant to the Federal Advisory Committee Act of 1972 (5 U.S.C., Appendix, as amended), the Sunshine in the Government Act of 1976 (U.S.C. 552b, as amended) and 41 Code of the Federal Regulations (CFR 102–3. 140 through 160, the Department of the Army announces the following committee meeting:

Name of Committee: Army Science Board (ASB).

Date(s) of Meeting: January 15 & 16, 2008.

Time(s) of Meeting: 0800–1700, January 15, 2008.

0800–1600, January 16, 2008.

Place of Meeting: University of Maryland University College (UMUC) Inn and Conference Center, Adelphi, MD. 3501 University Boulevard E, Adelphi, MD.

FOR FURTHER INFORMATION CONTACT: For information please contact Ms. Sharon Harvey at *sharon.harvey1@us.army.mil* or (703) 604–7466 or Mr. Wayne Joyner at *wayne.joyner@saalt.army.mil* or (703) 604–7490.

SUPPLEMENTARY INFORMATION: *Proposed Agenda:* The Army Science Board will meet on January 15 & 16, 2008 at the University of Maryland University College (UMUC) Inn and Conference Center. Purpose of the meeting on both days is to allow each study; Generation Force Functional Census, Institutionalized Lifecycle Management of Innovation Organizations, Information Operations, and Persistent CSR to collect data and hold discussions as it relates to each individual study.

Brenda S. Bowen,

Army Federal Register Liaison Officer.

[FR Doc. E7–24151 Filed 12–12–07; 8:45 am]

BILLING CODE 3710–08–P

DEPARTMENT OF DEFENSE

Department of the Army

Conservation Measures for Transfer of Federal Land at Parks Reserve Forces Training Area, Dublin, CA

AGENCY: Department of the Army, DoD.

ACTION: Notice of requirement.

SUMMARY: Pursuant to the proposed conservation measures found within the U.S. Fish and Wildlife Service Biological Opinion #1106F1752 dated December 18, 2006, acceptance of any portion of the 170.5-acre land exchange property located at Parks Reserve Forces Training Area (PFRTA), Dublin, CA is conditioned on the developer engaging the U.S. Fish and Wildlife Service in Section 7 or Section 10 Endangered Species Act consultation prior to the development of the aforementioned land. This consultation requirement is because of the potential loss of habitat and potential for take of the endangered San Joaquin Kit Fox (*Vulpes macrotis mutica*), the threatened California red-legged frog (*Rana aurora draytonii*), and the threatened California tiger salamander (*Ambystoma californiense*).

ADDRESSES: Public Affairs Office, U.S. Army CTSC, Camp Parks, 790 5th Street, Dublin, CA 94568–5201.

FOR FURTHER INFORMATION CONTACT: Amy Phillips, (925) 875–4298, *amy.phillips@usar.army.mil.*

SUPPLEMENTARY INFORMATION: A Request for Proposal (RFP) regarding the 170.5-acre land exchange property will be available upon request.

Kevin R. Riedler,

Colonel, U.S. Army, Commanding.

[FR Doc. E7–24193 Filed 12–12–07; 8:45 am]

BILLING CODE 3710–08–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent to Prepare a Draft Environmental Impact Statement for Expansion of Lake Worth Inlet (Palm Beach Harbor), FL

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

COOPERATING AGENCY: Port of Palm Beach District, Riviera Beach, Florida.

ACTION: Notice of intent.

SUMMARY: The Jacksonville District, U.S. Army Corps (Corps) of Engineers intends to prepare a Draft Environmental Impact Statement (EIS) for expansion, including widening and deepening of existing channels and turning basins in Lake Worth Inlet (Palm Beach Harbor). The project is a cooperative effort between the U.S. Army Corps of Engineers (lead Federal agency) and Port of Palm Beach District (non-Federal sponsor and cooperating agency).

ADDRESSES: Ms. Catherine L. Brooks, U.S. Army Corps of Engineers, Jacksonville District, Planning Division, Environmental Section, P.O. Box 4970, Jacksonville, FL 32207.

FOR FURTHER INFORMATION CONTACT: Catherine L. Brooks at (904) 232–2130.

SUPPLEMENTARY INFORMATION: Authority for the proposed study was received under the House Resolution of June 25, 1998. An expedited Reconnaissance Report completed in 2001 by the Corps, concluded based on preliminary findings, there was a federal interest in pursuing harbor improvements.

Alternatives: The project's expansion alternatives include no action, creation of channel flares, wideners, deepening, turning basin, or a combination of the considered alternatives. Alternatives being considered for disposal of dredged material include Peanut Island (with possible off-load to another use or location), ocean disposal in the Palm Harbor Ocean Dredged Material Disposal Site (which may require expansion or modification), beach placement (if there is sufficient beach compatible material), artificial reef (if there is sufficient suitable rock) and any other disposal or beneficial use options that may become available.

Issues: The EIS will consider impacts on coral reefs and other hardbottom communities, sea grasses, protected species, shore impacts, health and safety, water quality, aesthetics and recreation, fish and wildlife resources, cultural resources, energy conservation, socio-economic resources, navigation, and other impacts identified through scoping, public involvement and interagency coordination.

Scoping: The scoping process will involve Federal, State, County and municipal agencies and other interested persons and organizations. A public and agency scoping meeting will be held on January 9, 2008, at 3 p.m. at the Port of Palm Beach, One East 11th Street, Riviera Beach, FL 33404.

Public Involvement: We invite the participation of affected Federal, State and local agencies, affected Native-American Tribes, and other interested private organizations and individuals. In addition to the agency and public scoping meeting on January 9, 2008, and receipt of written comments at various stages of the Feasibility Study, there will be a public meeting on the Draft Environmental Impact Statement following its preparation. The date, time, and location will be announced.

Coordination: The proposed action is being coordinated with the U.S. Fish and Wildlife Service (FWS) and NOAA-National Marine Fisheries Service (under Section 7 of the Endangered Species Act) and the Wildlife Coordination Act (FWS only). The proposed action is also being coordinated with the Florida State

Historic Preservation Officer, the U.S. Coast Guard, and the U.S. Environmental Protection Agency.

Other Environmental Review and Consultation: The proposed action would involve evaluation for compliance with guidelines pursuant to Section 404(b)(1) of the Clean Water Act, water quality certification (application to the State of Florida) pursuant to Section 401 of the Clean Water Act, certification of state lands, easements, and rights-of-way, determination of Coastal Zone Management Act Consistency, and the use of the Ocean Dredged Material Disposal Site for Palm Beach Harbor pursuant to the Marine Protection, Research, and Sanctuaries Act (Ocean Dumping Act).

Agency Role: As the cooperating agency, non-Federal sponsor and leading local expert, the Port of Palm Beach will provide information and assistance on the resources to be impacted, mitigation measures and alternatives. Other agencies having either regulatory authority or special expertise may also be invited to become a cooperating agency in preparation of the EIS.

Draft EIS Preparation: It is estimated that the Draft EIS will be available to the public by November 2008. As the study and EIS develop, additional information will be posted under Palm Beach County on the Jacksonville District's Environmental Documents web page at: *http://planning.saj.usace.army.mil/envdocs/envdocsb.htm*. The status of any Florida Department of Environmental Protection application submitted for permit of this action will be posted on the internet at: *http://www.dep.state.fl.us/beaches/permitting/permits.htm*.

Dated: December 6, 2007.

Marie G. Burns,

Acting Chief, Planning Division.

[FR Doc. E7–24150 Filed 12–12–07; 8:45 am]

BILLING CODE 3710–AJ–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

U.S. Army Corps of Engineers (Corps) Regulatory Guidance Letter (RGL) 07–02: Exemptions for Construction or Maintenance of Irrigation Ditches and Maintenance of Drainage Ditches under Section 404 of the Clean Water Act (CWA)

AGENCY: U.S. Army Corps of Engineers, Department of Defense.

ACTION: Notice of availability.

SUMMARY: The Corps issued RGL 07–02 to further explain the regulatory exemptions for construction or maintenance of irrigation ditches and maintenance of drainage ditches consistent with Section 404(f) of the CWA (33 U.S.C. 1251 et seq.) and implementing regulations. Specifically, the RGL clarifies when Section 404(f) exempts from permitting requirements discharges of dredged or fill material into waters of the United States associated with the construction and maintenance of irrigation ditches and maintenance of drainage ditches. The RGL also clarifies how certain terms in the regulations at 33 CFR 323.4 are applied in the context of the Sections 404(f) exemptions, including irrigation ditch, drainage ditch, construction, and maintenance. In addition, the guidance provides a framework for determining the applicability of the exemptions and the recapture provision, consistent with the CWA and implementing regulations. This RGL was effective July 4, 2007.

DATES: Comments must be received on or before February 11, 2008.

ADDRESSES: Submit your comments, identified by docket number COE–2007–0038, by one of the following methods:

- *http://www.regulations.gov:* Follow the on-line instructions for submitting comments.
- *E-mail: Kimberly.S.McLaughlin@usace.army.mil.* Include the docket number, COE–2007–0038 in the subject line of the message.
- *Mail:* 441 G Street, NW., Washington, DC 20314.
- *Hand Delivery:* 441 G Street, NW., Washington, DC 20314. Such deliveries are only accepted during normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to docket number COE–2007–0038. The Corps's policy is that all comments received will be included in the public docket without change and may be made available online at *www.regulations.gov*, including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through *www.regulations.gov* or e-mail. The *www.regulations.gov* Web site is an ''anonymous access'' system, which means the Corps will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to the Corps without going through *www.regulations.gov* your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, the Corps recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If the Corps cannot read your comment due to technical difficulties and cannot contact you for clarification, the Corps may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses.

Docket: All documents in the docket are listed in the *www.regulations.gov* index. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *www.regulations.gov* or in hard copy at 441 G Street, NW., Washington, DC 20314. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays.

FOR FURTHER INFORMATION CONTACT: Kim McLaughlin, Regulatory Community of Practice (CECW–CO), U.S. Army Corps of Engineers, Headquarters, 441 G Street, NW., Washington, DC 20314; telephone number: (202) 761–7763; fax number: (202) 761–5096; e-mail address: *Kimberly.S.McLaughlin@usace.army.mil.*

SUPPLEMENTARY INFORMATION:

I. General Information

The Corps is requesting public comment on RGL 07–02, which is available at: *http://www.usace.army.mil/cw/cecwo/reg/rgls/rgl07–02.pdf.*

At the same time, the Corps appreciates that the public has considerable interest in the issues addressed in this guidance. The Corps is particularly interested in hearing from the public regarding their actual experience with implementing the guidance. The Corps is providing a 60-day public comment period, and encourages the public to provide comments informed by actual experience. To assure the public of our commitment to carefully consider their comments, and to address issues that

Mr. Gerald Ward
30 West 20th Street
Riviera Beach, FL 33404

Mr. John Marshall
525 S. Flagler Drive, Apt 10C
West Palm Beach, FL 33401

Mr. K. Dan Shalloway
1201 Belvedere Road
West Palm Beach, FL 33405

Executive Director
Advisory Council on Historic Preservation
The Old Post Office Bldg. Ste 809
1100 Pennsylvania Ave NW
Washington, DC 20004

Chairman
American Littoral Society
PO Box 491228
Miami, FL 33149

Mr. Eric Draper
Audubon of Florida
444 Brickell Avenue, Ste 850
Miami, FL 33131

Ann B. Hodgson, Ph.D.
Audubon Society
410 Ware Blvd.
Tampa, FL 33619

Superintendent
Biscayne National Park
9700 SW 328th Street
Homestead, FL 33033

Ms. Angela M. Berry
Brown & Caldwell
1475 Centrepark Blvd., Suite 210
West Palm Beach, FL 33401

Caribbean Conservation Corp.
PO Box 2866
Gainesville, FL 32602

Penny Cutt
Coastal Systems International
2047 Vista Parkway #101
West Palm Beach, FL 33411

Cry of the Water
PO Box 8143
Coral Springs, FL 33075

Pat Saunders
Ducks Unlimited
4343 Tideview Drive
Jacksonville Beach, FL 32250

Mr. Richard Sanchez
Egmont Key Alliance
PO Box 66238
St. Petersburg, FL 33736

Dr. Ken Lindeman
Environmental Defense Fund
14630 SW 144th Terrace
Miami, FL 33186

The Honorable Lori Berman
FL House of Representatives, Dist 90
2300 High Ridge Road, Suite 161
Boynton Beach, FL 33426-8747

Save the Manatee Club
500 North Maitland Avenue
Maitland, FL 32751

DOT Inspector General
FED Highway Administration
1200 New Jersey Ave SE
West Bldg, 7th Floor
Washington DC 20590

Mr. Douglas Murphy, Regional Administrator
Federal Aviation Administration
PO Box 20636
Atlanta GA 30320

Ms. Virginia Lane
Federal Aviation Administration
5950 Hazeltine National Drive
Citadel International Bldg, Ste 400
Orlando, FL 32822

Federal Highway Administration
Florida Division
545 John Knox Rd., Suite 200
Tallahassee, FL 32303

Regional Director
FEMA Insurance & Mitigation Division
3003 Chamblee Tucker Road
Atlanta, GA 30341

The Honorable Kevin Rader
FL House of Representatives, Dist 81
9045 La Fontana Blvd, Suite 117
Boca Raton, FL 33434-5641

Florida Audubon Society
1101 Audubon Way
Maitland, FL 32751

Florida Coastal Islands Sanctuaries
Audubon of Florida
410 Ware Blvd, Suite 702
Tampa, FL 33619

Mr. Tom Lundeen
Deputy Port Director
Port of Palm Beach
One East 11th Street, Suite 600
Riviera Beach, FL 33404

The Honorable Patrick Rooney, Jr.
FL House of Representatives, Dist 85
3970 RCA Blvd, Suite 7001
Palm Beach Gardens, FL 33410-4231

The Honorable Irving Slosberg
FL House of Representatives, Dist 91
7499 West Atlantic Ave, Suite 200
Delray Beach, FL 33446-1394

The Honorable Mark Pafford
FL House of Representatives, Dist 86
2240 Palm Beach Lakes Blvd, Suite 102
West Palm Beach, FL 33409-3403

Mr. Bob King
Palm Beach Post
2751 South Dixie Highway
West Palm Beach, FL 33405

Ms. Florette Braun
Florida Power and Light
PO Box 14000
North Palm Beach, FL 33408

USDA – NRCS
Royal Palm Beach Service Center
420 S State Road 7
Royal Palm Beach, FL 33414-4306

Florida Wildlife Federation
PO Box 6870
Tallahassee, FL 32314

Chairperson
Gulf of Mexico Fishery Mgmt. Council
2203 North Lois Avenue, Ste 1100
Tampa, FL 33607

K. Lynn Enterprises
PO Box 61492
Ft. Myers, FL 33906

Ms. Michelle Diffenderfer
Lewis Longman & Walker
515 North Flagler Drive, Suite 1500
West Palm Beach, FL 33401

Mr. Robert Diffenderfer
Lewis Longman & Walker
515 North Flagler Drive, Suite 1500
West Palm Beach, FL 33401

Mr. Tom MacVicar
MacVicar Federico & Lamb
4524 Gun Club Road
West Palm Beach, FL 33415

Mr. Jeff Rosenfeld
MacVicar Federico & Lamb
4524 Gun Club Road
West Palm Beach, FL 33415

Marine Operations Center, Atlantic
439 West York Street
Norfolk, VA 23510

Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota, FL 34236

Mr. David Vela, Regional Director
National Park Service
100 Alabama Street SW
1924 Building
Atlanta, GA 30303

John Hammond
National Wildlife Federation
730 Peachtree Street NE, Suite 1000
Atlanta, GA 30308

Director, Deland Service Center
US Dept. of Agriculture, NRCS
101 Heavens Gate Road, Suite F
Deland, FL 32720

Mr. William Baxley
NAVSEA South Florida Testing Facility
91 North Beach Road
Dania Beach, FL 33004

Office of Constituent Services
NMFS Recreational Fisheries Branch
1315 East West Highway
Silver Spring, MD 20910

Mr. Mark Sramek
NMFS – SERO – HCD
263 13th Avenue South
St. Petersburg, FL 33701

NMFS – SERO – Protected Resources Div
263 13th Avenune South
St. Petersburg, FL 33701

Mr. Mark Thompson
NMFS – HCD
3500 Delwood Beach Drive
Panama City, FL 32408

Mr. Pace Wilbur
NMFS – HCD
219 Fort Johnson Road
Charleston, SC 29412

Ms. Jocelyn Karazsia
NMFS – HCD Miami Area Office
400 N Congress Ave., Suite 120
West Palm Beach, FL 33401

DEP Southeast District Office
400 N. Congress Avenue, Suite 200
West Palm Beach, FL 33401

Mr. Ken Hollingshead
NMFS Marine Mammal Conservation Div
1315 East West Highway PR2
Silver Spring, MD 20910

Mr. David Bernhart
NOAA – NMFS – PSB
263 13th Avenue South
St. Petersburg, FL 33701

Mr. Miles Croom
NOAA – NMFS – SERO – HCD
263 13th Avenue South
St. Petersburg, FL 33701

Director, Office of Env Policy & Compliance
U.S. Department of the Interior
1849 C Street, NW (MS2462)
Washington, DC 20240

Regional Environmental Clearance Officer
US Dept of Housing & Urban Development
75 Spring Street SW, Room 600-C
Atlanta, GA 30303

The Honorable Bill Nelson
US Senate
413 Clematis Street, Suite 210
West Palm Beach, FL 33401

The Honorable Marco Rubio
US Senate
4580 PGA Blvd., Suite 201
Palm Beach Gardens, FL 33418

The Ocean Conservancy
South Atlantic Regional Office
449 Central Avenue, Suite 200
St. Petersburg, FL 33701

Mr. Paul Gagliano
US EPA Region 4
Environmental Policy Section
61 Forsyth Street SW
Atlanta, GA 30303-8960

The Honorable Lois Frankel
US House of Representatives, Dist 22
2500 N. Military Trail, Suite 490
Boca Raton, FL 33431

The Honorable Debbie Schultz
US House of Representatives, Dist 23
10100 Pines Blvd.
Pembroke Pines, FL 33026

Commanding Officer
US Coast Guard, Ft. Lauderdale Station
7000 North Ocean Drive
Dania Beach, FL 33004

Commanding Officer
US Coast Guard, Marine Safety Office
100 MacArthur Cswy
Miami Beach, FL 33139

Commander
US Coast Guard, Seventh District
Brickell Plaza Federal Building
909 SE 1st Avenue
Miami, FL 33131

Director, Region 4
US Fish and Wildlife Service
1875 Century Blvd, Suite 400
Atlanta, GA 30345-3319

The Honorable Bobby Powell
FL House of Representatives, Dist 88
2715 North Australian Ave, Suite 105
West Palm Beach, FL 33407-4500

Southern Regional Forester
USDA Forest Service
1720 Peachtree Road NW
Atlanta, GA 30309

Mr. Scott Benyon
Rinker Materials Corporation
PO Box 24635
West Palm Beach, FL 33416

USDA – NRCS
Royal Palm Beach Service Center
420 S State Road 7
Royal Palm Beach, FL 33414-4306

Dr. Bill Venezia
South Florida Testing Facility
8010 North Ocean Drive
Dania Beach, FL 33004

The Honorable Bill Hager
FL House of Representatives, Dist 89
301 Yamato Road, Suite 1240
Boca Raton, Fl 33431-4931

Mr. Peter Elwell
Town of Palm Beach
PO Box 2029
Palm Beach, FL 33480

State Conservationist
USDA – NRCS
PO Box 141510
Gainesville, FL 32605

Ms. Melissa Meeker
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33416

Ms. Cindy Lindskoog
Town of Palm Beach Shores
247 Edwards Lane
Palm Beach Shores, FL 33404

Leo Vecellio
White Rock Quarries
PO Box 15065
West Palm Beach, FL 33416

Director, Environmental Resources Mgmt.
Palm Beach County Dept. of Env. Resources
2300 North Job Road
West Palm Beach, FL 33411

The Honorable MaryLynn Magar
FL House of Representatives, Dist 82
11704 Southeast Dixie Highway
Hobe Sound, FL 33475-5457

The Honorable Marco Rubio
US Senate
4580 PGA Blvd., Suite 201
Palm Beach Gardens, FL 33418

Director, Region 4
US Fish and Wildlife Service
1875 Century Blvd, Suite 400
Atlanta, GA 30345-3319

Mr. Larry Williams
South Florida Ecological Services Office
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

The Honorable Dave Kerner
FL House of Representatives, Dist 87
226 Cypress Lane, Suite 250
Palm Springs, FL 33461-1604

DEP, Bureau of Beaches & Coastal Systems
JCP Compliance Officer
3900 Commonwealth Blvd., MS 300
Tallahassee, FL 32399-3000

US Department of Agriculture
Maritime Office Building
1 East 11th Street, Suite 332 Box 3
Riviera Beach, FL 33404

The Honorable Theodore Deutch
US House of Representatives, Dist 21
8177 Glades Road, Suite 211
Boca Raton, FL 33434

Distribution List | Insert | Format Text

Save & Close | Send | Delete | Members | Notes | Select Members | Add New | Remove | Update Now | E-mail | Meeting | Categorize | Follow Up | Private | Spelling

Actions | Show | Members | Communicate | Options | Proofing

Name: LWI Feasibility Mail List

Name	E-mail
Commissioner Hal Valeche (PBC Dist 1)	HValeche@pbcgov.org
Commissioner Jess Santamaria (PBC Dist 6)	jsantama@pbcgov.org
Commissioner Mary Lou Berger (PBC Dist 5)	MBerger@pbcgov.org
Commissioner Paulette Burdick (PBC Dist 2)	pburdick@pbcgov.org
Commissioner Priscilla Taylor (PBC Dist 7)	ptaylor@pbcgov.org
Commissioner Shelley Vana (PBC Dist 3)	svana@pbcgov.org
EPA, Richard Harvey	harvey.richard@epa.gov
FIND, David Roach (Executive Director)	droach@aicw.org
FL Senator Jeff Clemens	clemens.jeff.web@flsenate.gov
FL Senator Joe Negron	negron.joe.web@flsenate.gov
FL Senator Joseph Abruzzo	abruzzo.joseph.web@flsenate.gov
FL Senator Maria Lorts Sachs	sachs.maria.web@flsenate.gov
Mayor Steven Abrams (PBC Dist 4)	SAbrams@pbcgov.org
Melissa McKinlay, Legislative Delegation Aide	mmckinlay@pbcgov.org
Rachael Merlan, Executive Director	rmerlan@pbcgov.org
Reagan Walker, Director, Board, & Executive Services	rwalker@sfwmd.gov
SFWMD GB Daniel O'Keefe	dokeefe@sfwmd.gov
SFWMD GB Glen Waldman	gwaldman@sfwmd.gov
SFWMD GB James Moran	jmoran@sfwmd.gov
SFWMD GB Joe Collins	jcollins@sfwmd.gov
SFWMD GB Juan Portuondo	jportuon@sfwmd.gov
SFWMD GB Kevin Powers	kpowers@sfwmd.gov
SFWMD GB Sandy Batchelor	sbatchel@sfwmd.gov
SFWMD GB Timothy Sargent	tsargent@sfwmd.gov
Sierra Club Florida Regional Office	frank.jackalone@sierraclub.org
Sierra Club South Florida Regional Office	jonathan.ullman@sierraclub.org
The Nature Conservancy, Florida Chapter	florida@tnc.org
Tropical Audubon Society	director@tropicalaudubon.org

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

JUL 20 2012

Robert Bendus, SHPO
Division of Historical Resources
State Historic Preservation Officer
500 South Bronough Street
Tallahassee, Florida 32399-0250

Dear Mr. Bendus:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is evaluating the environmental effects from our proposed project to deepend and widen the entrance channel and the large turning basin at Lake Worth Inlet at Palm Beach Harbor in Palm Beach County, Florida. Enclosures 1 and 2 show the location and footprint of the proposed project. Palm Beach Harbor is a deep-draft harbor and extends from the Atlantic Ocean to the Port of Palm Beach, a distance of 1.7 miles.

Initial consultation with your office (DHR Project file No. 2000-03471), when we were preparing the Environmental Assessment for the Operations and Maintenance of Palm Beach Harbor, indicated the potential for cultural resources to be present in the project area. An underwater cultural resource survey including diver identification was conducted for the Intracoastal Waterway and Palm Beach Harbor in 2001 by Wes Hall. These surveys included the Palm Beach Harbor Inlet. No cultural resources were identified within the Palm Beach Harbor project area as a result of this survey. Your office concurred with the Corps determination of no historic properties (DHR Project file No. 2000-5816). The proposed settling basin expansion area was surveyed for cultural resources in 2003 by Tuttle. No cultural resources were located by this survey. Your office again concurred with the Corps' determination of no historic properties (DHR Project File No. 2004-1138). Enclosure 3 shows our proposed project footprint superimposed on the DHR survey file.

We once again ask for your concurrence with our determination of no historic properties affected by this proposed project. Please provide your comments within 30 day. Your comments and correspondence will be included in the Lake Worth Inlet Integrated Feasibility Study and Environmental Impact Statement. If you have questions or require additional information, contact archeologist David McCullough at 904-232-3685 or by email at david.l.mccullough@usace.army.mil

Sincerely,

Eric P. Summa
Chief, Environmental Branch

Enclosures

FLORIDA DEPARTMENT of STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Palm Beach Regulatory Office
Jacksonville USACE
4400 PGA Boulevard, Suite 500
Palm Beach Gardens, Florida 33410

September 13, 2012

Re: Projects Reviewed by the Florida State Historic Preservation Office
No Historic Properties Likely Affected - **See Attached List**
Date Received –August 14- August 31, 2012

To Whom It May Concern:

This office received and reviewed the above referenced project applications in accordance with Section 106 of the National Historic Preservation Act of 1966 (Public Law 89-665), as amended in 1992; 36 C.F.R., Part 800: Protection of Historic Properties for assessment of possible adverse impact to cultural resources (any prehistoric or historic district, site, building, structure, or object) listed, or eligible for listing, in the National Register of Historic Places.

Our review of the Florida Master Site File indicates that no historic properties are recorded within the project areas. Furthermore, because of the location and/or nature of the project it is unlikely that historic properties will be affected.

If you have any questions concerning our comments, please contact Michael Hart, Historic Sites Specialist, by phone at 850.245.6333, or by electronic mail at Michael.Hart@dos.myflorida.com. Your continued interest in protecting Florida's historic properties is appreciated.

Sincerely,

Robert F. Bendus, Director
Division of Historical Resources
and State Historic Preservation Officer

DHR NO.	***App. No.***	***Project Name***	***County***
2012-03897	SAJ-2000-02301 (IP-MJW)	Palm Beach County/ South Lake Worth Inlet Maintenance Dredging	Palm Beach
2012-04092	SAJ-2012-02152 (LP-JMC)	Holly S. Powell/ Proposed Seawall and Boat Basin	Palm Beach
2012-04093	SAJ-2004-05180 (LP-GGL)	Robert W. Block III/ Dolphin Piles	Palm Beach

McCullough, David L SAJ

From: Hart, Michael R. [Michael.Hart@DOS.MyFlorida.com]
Sent: Friday, November 30, 2012 4:43 PM
To: McCullough, David L SAJ
Subject: RE: Lake Worth Inlet (UNCLASSIFIED)
Attachments: Nofxlist, 09-13-2012, PB.doc

David,

Attached is the list-letter that included the Lake Worth Project.

Michael Hart
Historic Sites Specialist | Bureau of Historic Preservation | Division of Historical Resources | Florida Department of State | 500 South Bronough Street | Tallahassee, Florida 32399 | 850.245.6300| 1.800.847.7278 | www.flheritage.com

-----Original Message-----
From: McCullough, David L SAJ [mailto:David.L.McCullough@usace.army.mil]

Sent: Friday, November 30, 2012 4:37 PM
To: Hart, Michael R.
Subject: RE: Lake Worth Inlet (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Hart, Michael R. [mailto:Michael.Hart@DOS.MyFlorida.com]
Sent: Wednesday, September 12, 2012 11:58 AM
To: McCullough, David L SAJ
Subject: RE: Lake Worth Inlet (UNCLASSIFIED)

David,

I received your voicemail. Yes, I have the project (SAJ-2000-02301). It's in my pile and I should have it done in the next couple of days.

If you need it sooner, let me know.

Thank you,

Michael Hart
Historic Sites Specialist | Bureau of Historic Preservation | Division of Historical Resources | Florida Department of State | 500 South Bronough Street | Tallahassee, Florida 32399 | 850.245.6300| 1.800.847.7278 | www.flheritage.com

Florida is headed in the right direction! View Florida's Jobs Growth Chart: http://www.flgov.com/photoview/jobcreationchart.jpg
The Department of State is leading the commemoration of Florida's 500th anniversary in 2013. For more information, please go to www.fla500.com.
The Department of State is committed to excellence. Please take our Customer Satisfaction Survey:
http://survey.dos.state.fl.us/index.aspx?email=Michael.Hart@DOS.MyFlorida.com

-----Original Message-----
From: McCullough, David L SAJ [mailto:David.L.McCullough@usace.army.mil]

Sent: Tuesday, September 11, 2012 1:57 PM
To: Hart, Michael R.
Subject: Lake Worth Inlet (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Good afternoon Michael. I just left you a voice mail about this. I am not sure if you are my reviewer for this project, but Scott and I thought we would start with you. I am attaching a copy of a letter that I sent in July. I hope you or someone there can hunt it up and have a look at it.

Thanks,

David McCullough
Archeologist
USACE, Jacksonville District
9i04-232-3685

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Pilot Approval Letter and Associated Correspondence

Gregory G. Turner
William G. Roden, Jr.

William D. Messer
Matthew L. Rigby
Reid Hansen

Palm Beach Harbor Pilots' Association

200 E. 13th Street, Suite B
Riviera Beach, Florida 33404-6946
Office (561) 845-2628 FAX (561) 845-2644
Email: PBPilots@aol.com

April 22nd, 2012

The Palm Beach Harbor Pilots have reviewed and approve Revised Plan 2 of the Army Corps of Engineer's Channel Improvement Plan. We feel the new plan will maximize ship size: length and beam, that can safely enter to the Port of Palm Beach. We also feel Revised Plan 2 will require the least amount of dredging and minimize the ecological impact to the Lake Worth Inlet and turning basin while providing maximum economic benefit.

Sincerely,

Captain Gregory G. Turner, President
Palm Beach Harbor Pilots' Association

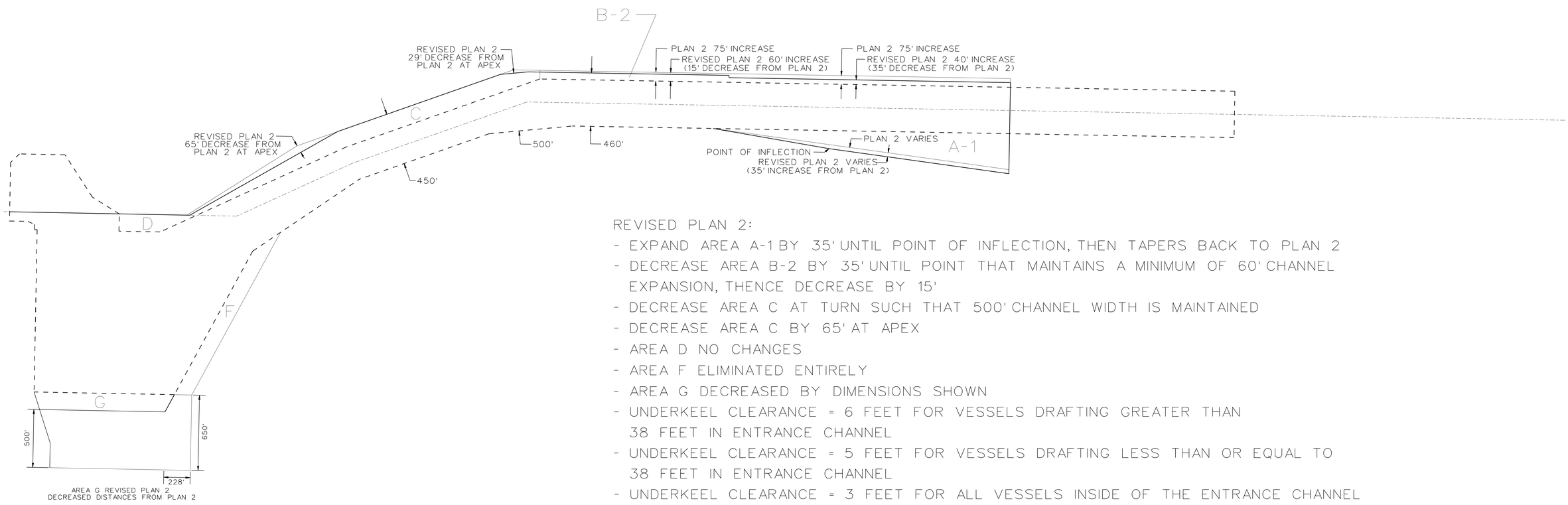
REVISED PLAN 2

LEGEND:

EXISTING PROJECT

PLAN 2 PROJECT EXPANSION

REVISED PLAN 2 PROJECT EXPANSION



REVISED PLAN 2:

- EXPAND AREA A-1 BY 35' UNTIL POINT OF INFLECTION, THEN TAPERS BACK TO PLAN 2
- DECREASE AREA B-2 BY 35' UNTIL POINT THAT MAINTAINS A MINIMUM OF 60' CHANNEL EXPANSION, THENCE DECREASE BY 15'
- DECREASE AREA C AT TURN SUCH THAT 500' CHANNEL WIDTH IS MAINTAINED
- DECREASE AREA C BY 65' AT APEX
- AREA D NO CHANGES
- AREA F ELIMINATED ENTIRELY
- AREA G DECREASED BY DIMENSIONS SHOWN
- UNDERKEEL CLEARANCE = 6 FEET FOR VESSELS DRAFTING GREATER THAN 38 FEET IN ENTRANCE CHANNEL
- UNDERKEEL CLEARANCE = 5 FEET FOR VESSELS DRAFTING LESS THAN OR EQUAL TO 38 FEET IN ENTRANCE CHANNEL
- UNDERKEEL CLEARANCE = 3 FEET FOR ALL VESSELS INSIDE OF THE ENTRANCE CHANNEL
- RANGE MARKERS WILL REMAIN IN PLACE AND BUOYS WILL BE RELOCATED AS NECESSARY BY THE USCG

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

FEB 13 2008

REPLY TO
ATTENTION OF

Planning Division
Plan Formulation Branch

Mr. Martin E. Murphy
The Murphy Construction Company
1615 Clarke Avenue
West Palm Beach, Florida 33401

Dear Mr. Murphy:

Thank you for your response to the December 6, 2007 Notice of Intent to prepare a Draft Environmental Impact Statement for Expansion of Lake Worth Inlet (Palm Beach Harbor), Florida. The Port is no longer considering expansion of their cruise terminal to the north.

Element E of the study was being considered for navigational reasons. The harbor pilots had identified conditions, particularly when a strong east wind occurred with Tropical vessels berthed along the marginal wharf approach that the northern extent of the basin during turning maneuvers was limiting. The alternative does not include expansion of the Port of Palm Beach to the north.

This study area has a low priority with both the pilots and the Port of Palm Beach and based upon further consideration is being removed from the study as an alternative.
I would like to thank you for taking the time to attend the scoping meeting and providing input into this process. If you have any questions, please contact Samantha Brucker at (904) 232-1066.

Sincerely,

Marie G. Burns
Acting Chief, Planning Division

Copy Furnished:

Ms. Kathy Andress, Deputy Port Director, One East 11th Street, Ste. 400, Riviera Beach, Florida 33404

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-PM (10-1-7a)

29 MAR 2001

MEMORANDUM FOR COMMANDER, SOUTH ATLANTIC DIVISION
ATTN: CESAD-CM-P

SUBJECT: Lake Worth Inlet (Palm Beach Harbor), Florida - Section 905(b) Analysis

1. Reference: E-mail Message from Mr.William H. Osborne, CESAD-CM-C, dated 16 March 2001, which forwarded the subject analysis to HQUSACE.

2. The subject analysis and letter of intent, which were provided as an attachment to the referenced message, are approved for proceeding into the feasibility phase of planning. The district should plan to convene an in-progress review meeting early in the feasibility study to ensure that the study is focused and tailored to meet specific objectives. Based on the results of the in-progress review meeting, the project study plan may need to be revised to better define depth of analysis required and/or refine study constraints.

3. Submission of the model feasibility cost sharing agreement is not required, provided no deviations are required.

FOR THE COMMANDER:

James F. Johnson

JAMES F. JOHNSON
Chief, Planning and Policy Division
Directorate of Civil Works

Gregory G. Turner
William G. Roden, Jr.

William D. Messer
Matthew L. Rigby

Palm Beach Harbor Pilots' Association

200 E. 13th Street, Suite B
Riviera Beach, Florida 33404-6946
Office (561) 845-2628 FAX (561) 845-2644
Email: PBPilots@aol.com

June 28, 2005

To: Vessel Operators, Ship's Agents and Port Officials

This letter is to help clarify our parameters as to what size, beam, and draft that vessels may transit the Port of Palm Beach. A synopsis of our guidelines is listed below; however, it is impossible to regulate each scenario. When a vessel is calling on the Port for the first time, the Pilots must be contacted before scheduling vessels that are either 550' LOA or greater, 85' or over in beam, or over 30' in draft. The Pilots should be contacted at least 72 hours prior to arrival for all other vessels calling on the Port for the first time to discuss any tug or docking requirements that may delay the vessel.

The maximum salt-water draft is 33'-00" for the Port of Palm Beach when the channel and turning basin are free from shoaling. During periods when shoaling is present, further restrictions beyond what is stated below might be applied to the draft, length, or beam.

Vessels 600' and over LOA will enter only during daylight hours.
Vessels 600' and over LOA or a beam of 90' or greater may have an additional draft restriction.
Vessels within 3 feet of maximum allowable draft are restricted to high water slack.
Single screw vessels 500' LOA or greater may be restricted to maneuvering during daylight slack water depending upon the draft of the vessel and the current weather conditions.
Single screw vessels must have at least 50' of clearance to adjacent vessels in the slip in order for the tugs to operate safely. All vessels may expect delays whenever this situation occurs.
Deep draft vessels over 600' should be advised that the west end of the South Slip (Slip #3) has a depth of 25' at MLW.

Vessels less than 550' LOA and 85' beam with 50 feet of clearance in the slip can be safely handled using the two local tugs under most weather conditions. When vessels exceed this size or when the weather deteriorates, we have found that it is necessary to order an outside tug and/or restrict the draft to improve the maneuvering of these vessels. Briefly, the reasons for this are; the low horsepower of the local tugs, the strength of the Gulf Stream at the mouth of the inlet, the width of the turn in the inner channel, and wind velocities that exceed 20 knots.

Single screw vessels will require a third tug if they exceed the following parameters:

550' LOA or greater when there are adverse weather conditions
600' LOA or greater with drafts at 30' or greater
Inbound vessels with a LOA of 550' or greater and a draft over 32' or beam over 85' and a draft over 30'
A combination of LOA over 600' and a beam over 85' at any draft with 30' being the maximum

Vessels 500' LOA or greater may need a third tug when backing into a slip in a loaded condition. Twin-screw ships, and single screw vessels fitted with thrusters, may not have all of the restrictions that are listed above depending upon the handling characteristics of the vessel. The Pilots should be contacted regarding such vessels.

Additional recommendations for Oil Tankers and Barges:

It is recommended that vessels carrying oil transit during slack water for safety reasons. Flood tides should be avoided at all times. Certain vessels such as steam tankers may require 3 tugs. The maximum draft for oil is 32'-00" unless limited by the above parameters or shoaling.

It has been and will continue to be the Port's decision on what vessels will have priority and to which berths they will be assigned. We will continue to work with the staff at the Port of Palm Beach in order to fully utilize the Port. Please contact the Port and the Pilots for further information before considering vessels for charter within the parameters specified above. Guidelines for vessels entering the North Slip (located at the new Cruise Terminal) will be determined after all bottom surveys and simulator studies are complete.

Gregory G. Turner
President / Palm Beach Harbor Pilots

APPENDIX F

LAKE WORTH INLET

Palm Beach Harbor

APPENDIX F

DRAFT

LAKE WORTH INLET
PALM BEACH COUNTY, FLORIDA
NAVIGATION STUDY
FEASIBILITY REPORT

REAL ESTATE PLAN

LAKE WORTH INLET
PALM BEACH COUNTY, FLORIDA
NAVIGATION STUDY
FEASIBILITY REPORT

REAL ESTATE PLAN

APPENDIX F - TABLE OF CONTENTS

Section **Page No.**

1. STATEMENT OF PURPOSE. 4

2. PROJECT AUTHORIZATION. 4

3. PROJECT LOCATION AND DESCRIPTION. 4

4. REAL ESTATE REQUIREMENTS. 6

5. FEDERALLY-OWNED LAND. 7

6. NON-FEDERALLY-OWNED LAND. 7

7. NON-FEDERAL OPERATION/MAINTENANCE RESPONSIBILITIES. 7

8. NON-FEDERAL AUTHORITY TO PARTICIPATE IN PROJECT. 7

9. NAVIGATION SERVITUDE. 7

10. ATTITUDE OF OWNERS. 8

11. MINERALS. 8

12. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW). 8

13. INDUCED FLOODING. 8

14. ZONING ORDINANCES 8

15. RELOCATIONS ASSISTANCE (PUBLIC LAW 91-646). 8

16. RELOCATIONS, ALTERATIONS, VACATIONS, AND ABANDONMENTS. 8

17. STANDING TIMBER AND VEGETATIVE COVER. 8

18. RECREATION RESOURCES. 9

19. CULTURAL RESOURCES. 9

20. OUTSTANDING RIGHTS. 9

21. MITIGATION. 9

22. ACQUISITION/ADMINISTRATIVE COSTS. 9

23. SUMMARY OF PROJECT REAL ESTATE COSTS. 9

24. REAL ESTATE ACQUISITION SCHEDULE. 10

25. ESTATES TO BE ACQUIRED. 10

26. MAPS. 10

27. CHART OF ACCOUNTS FOR PROJECT. 10

EXHIBIT F-1: PROJECT AUTHORIZATION HISTORY
EXHIBIT F-2: FDEP COASTAL MONUMENT REFERENCE MAP
EXHIBIT F-3: PALM BEACH HARBOR – FEDERAL PARCEL REAL ESTATE MAP
EXHIBIT F-3: REAL ESTATE CAPABILITY ASSESSMENT (DRAFT INCLUDED)

12/2012 lhz
Rev 3/2013 lhz

REAL ESTATE PLAN
LAKE WORTH INLET
PALM BEACH COUNTY, FLORIDA
NAVIGATION STUDY
FEASIBILITY REPORT

1. Statement of Purpose.

a. The purpose of this report is to determine the feasibility of improving the existing Federal navigation project at Lake Worth Inlet, Florida.

b. This real estate plan is tentative in nature for planning purposes only and both the final real property acquisition lines and estimates of value are subject to change even after approval of this report.

2. Project Authorization.

The non-Federal sponsor, the Port of Palm Beach, requested a feasibility study to focus on evaluating deepening and widening of the entrance channel and the large turning basin. A 905(b) Analysis was approved for proceeding into the feasibility phase of planning on March 29, 2001. The memorandum can be found in Appendix F. The Port of Palm Beach applied for a state grant to assist in the 50% non-Federal share, the FCSA was then signed in August 2005. Since signing of the FCSA in 2005, the schedule has been linked to the appropriations received.

House Resolution dated June 25, 1998, authorized the Lake Worth Inlet study. The full text of the resolution is as follows:

"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Palm Beach Harbor, Florida, published as House Document 283, 86th Congress, 1st Session, and other pertinent reports, with a view of determining if the authorized project should be modified in any way at this time, with particular reference to widening the existing interior channel through Lake Worth Inlet."

See Exhibit F-1 of this appendix for additional project authorizations.

3. Project Location and Description.

Lake Worth Inlet (LWI), also known as the Palm Beach Inlet, is located in Palm Beach County, Florida, and is approximately 80 miles north of Miami and 135 miles south from Port Canaveral. The LWI provides access to deep draft vessel traffic using terminal facilities located at the Port of Palm Beach. The inlet is the 4th busiest Port in Florida. (See Figure ES-2in the Executive Summary of the main report for existing conditions and location map.)

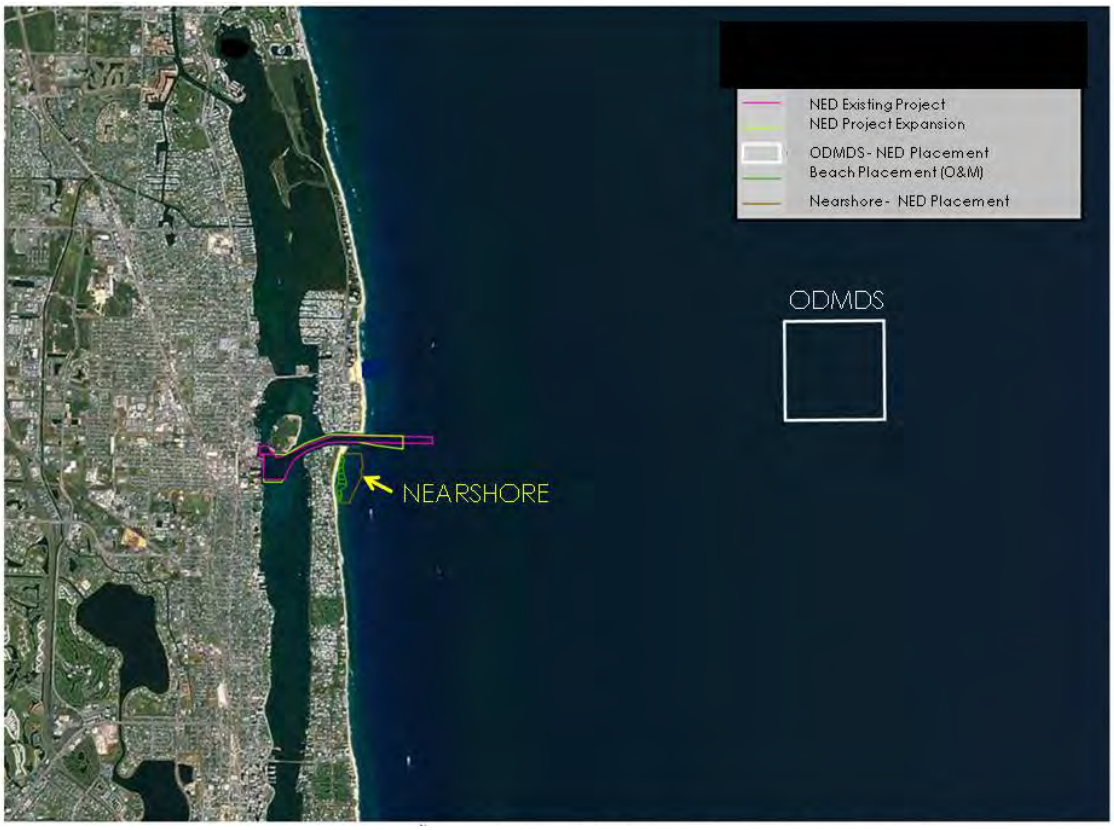
The present authorized channel for the Palm Beach Harbor Navigation Project includes the following: an entrance channel 35 feet deep, 400 feet wide, and 0.8 miles long, merging with an inner channel 33 feet deep, 300 feet wide and 0.3 miles long, then flaring into a turning basin, 1,400 feet north-south along the side next to the berthing area by a minimum of 1,210 feet east-west; maintenance of a local turning basin to the north of the project turning basin of 24 feet; removal of south point; and jetties and shore revetments at the inlet. The entire length of the project is approximately 1.6 miles. Maintenance of the northern turning basin including the area of slip 1 is authorized to 24 feet; however much of this area is constructed to 33 feet by the non-Federal sponsor.

The recommended (NED) plan for the project includes a new channel flare on the south side of the Entrance Channel, a widening of the Entrance Channel by either 40' or 60' to the north, widening of the Inner Harbor Cuts 1 and 2 to provide for a minimum channel width of 450', a 150' expansion of the Southern (Main) Turning Basin to the south, and an expansion of the Southern (Main) Turning Basin on the north side to remove a notch currently encroaching into the basin. (See page 6, Figure F-1, of this appendix for map of NED plan). The channel would be deepened to a project depth of 39 feet Mean Lower Low Water (MLLW) for the Inner Harbor and 41 feet MLLW for the Entrance Channel. These features are necessary to facilitate the safe and efficient navigation of the design vessel. Additional project features include North Jetty stabilization, reconfiguration of the Advance Maintenance Zones, reconfiguration of the Settling Basin, Seagrass Mitigation Area construction, and Hardbottom Mitigation Area construction. **See Engineering Appendix A for additional details.**

The material anticipated to be excavated from the widening and deepening of the project will be placed within the least cost disposal options. These options include the ODMDS, the proposed seagrass mitigation locations, and beach nearshore areas. These areas are located at or adjacent to Lake Worth Inlet, within Sections 34 and 35 Township 42 South, Range 43 East. The nearshore disposal template begins 500 linear feet south of the south jetty, between FDEP coastal reference monuments R-76.5 and R-79 (See Exhibit F-2 of this appendix for FDEP Coastal Monument Reference Map).

Further opportunities for additional beneficial use of dredged material exist in the project vicinity such as the filling of anoxic deepwater holes in the Lake Worth Inlet Lagoon, creation of hardbottom habitat, creation of habitat for submerged aquatic vegetation such as seagrasses, and/or placement of beach quality material in the uplands south of the Inlet or below MHW at Mid-Town Beach (reference Figure 4-2 of the main report for locations). These areas are located as discussed above but also includes upland placement from FDEP Monument R-76.5 extending to R-81. Mid-Town beach fill template is located between R-90.4 and R-101.4.

The current proposed mitigation plan involves placing quarry rock at a potential artificial reef offshore and placing project material for sea grass rehabilitation in a dredged hole site. Other opportunities for mitigation are identified and can be found in the Mitigation Plan, Section 3 of Appendix D.



Recommended Plan (NED Plan) – Figure F-1

4. Real Estate Requirements.

The deepening and widening activities as well as proposed mitigation features are within the navigable waters of the United States and are available to the Federal Government by navigation servitude. The disposal areas identified for the project are near shore and an existing ODMDS. These sites are also within the navigable waters of the United States.

The local sponsor, as well as the State of Florida, has communicated the preference for beach compatible dredged material to be placed on the beach, both landward and seaward of the mean high water line (MHWL). Beach placement in this area is not considered a least cost disposal option and is not a part of the recommended plan.

At the time of this report, the Town of Palm Beach, Florida, approximately 23 temporary construction easements have been acquired as part of the existing Palm Beach Harbor Maintenance Dredging Beach Placement Project. The easements are to expire May of 2015. The easements extend from approximately R-76.5, 2,500 feet to R-79. These parcels have been certified for the Palm Beach Harbor Navigation Project. The easement allows the USACE to nourish, renourish, protect, operate and to perform any other work necessary and incident to the maintenance between MHW and vegetation. The existing easements, as well as the an additional 20 parcels, (R-76 through R-81), are in the process of being extended or acquired for continued disposal placement. All lands seaward of the MHWL is owned by the State of Florida and should be included within the Joint Coastal Permit (JCP). During PED phase if the template within the area described above is filled to capacity then an additional placement area at Mid-Town Beach between R-90.4 through R-101.4 may be used. The material will be placed below the

MHWL and no easements will be required. All construction easements from private owners would be acquired and funded solely by the local sponsor or other local interests. This includes all administrative costs. They will be certified by the local sponsor prior to project construction if necessary.

Staging and work areas will be within the lands below the designated MHWL line or on sponsor provided construction easements.

Federal fee and easement properties located at the south jetty may be used temporarily for construction purposes. No land acquisition is necessary. (See Exhibit F-3).

5. Federally-Owned Land.

USACE controls numerous fee and easement tracts within the project area. (See Exhibit F-3 of this appendix). A pipeline to deposit sand on the beach may require access to (and over) the south jetty and within areas controlled by the USACE.

6. Non-Federally-Owned Land.

The Port of Palm Beach and the Town of Palm Beach have lands within the project area. They own approximately 154 acres.

7. Non-Federal Operation/Maintenance Responsibilities.

a. The Local Sponsor shall provide and maintain, at its own expense, all project features other than those for general navigation, including dredged depths commensurate with those in related general navigation features in berthing areas and local access channels serving the general navigation features.

b. The Local Sponsor shall provide to the Government all lands, easements, and rights-of-way, including dredged material disposal areas, and perform, or assure performance of, all alterations or relocations of facilities and utilities (except relocations or alterations of highway bridges and railroad bridges and approaches thereto), determined by the Government to be necessary for maintenance of the Project.

8. Non-Federal Authority to Participate in the Project.

The local sponsor, Port of Palm Beach, Florida, is a sub-division of the State Division and was established under provisions of Laws of Florida Acts of 1915, Chapter 7081, as amended and supplemented. The Port of Palm Beach entered into a tri-party interlocal agreement in August 2006 with the Town of Palm Beach and Palm Beach County to share local costs of the navigability of the Lake Worth Inlet. This agreement expires September 30, 2016.

9. Navigation Servitude

Lands required for deepening and widening of the project, as well as the mitigation features, are available to the Federal Government via navigation servitude. Coordination with the State of Florida will occur to provide the necessary permission for the submerged lands.

10. Attitude of Owners.

All public landowners impacted by the proposed project have been involved in the planning process and have indicated strong support for the project. Upland beach owners are aware of the project and have previously provided temporary construction easements to the Town of Palm Beach, Florida, for the Palm Beach Harbor Navigation Project.

11. Minerals.

There are no known minerals of value in the project area.

12. Hazardous, Toxic and Radioactive Wastes (HTRW).

A phase I environmental assessment was completed for the proposed dredging and disposal activity areas and did not identify HTRW within the areas. Prior to disposal of the dredged material additional testing will occur and contaminated materials will be coordinated with the appropriate environmental agencies and disposed of in accordance with Federal, State and Local laws.

13. Induced Flooding.

There will be no induced flooding directly associated with this project.

14. Zoning Ordinances

Zoning ordinances are not of issue with this project. Application or enactment of zoning ordinances will not to be used in lieu of acquisition.

15. Relocations Assistance (Public Law 91-646).

There are no persons or businesses that will need to be relocated due to project implementation.

16. Relocations, Alterations, Vacations and Abandonments (Utilities, Structures and Facilities, Cemeteries, and Towns).

There is a pipeline within the harbor right of way. The pipeline provides the Sand Transfer Plant, located north of the north jetty, to move accumulated sand south of the south jetty. This pipeline is located well beneath the bottom lands and will not be affected by this deepening project.

17. Standing Timber and Vegetative Cover.

There is no timber or unusual vegetative cover in the project area. Final mitigation compensation will range between 8.25 to 11.25 acres for seagrass impacts, and a range of 4.9 -9.8 acres is proposed for hardbottom impacts. Final mitigation will be determined during the public review of the document by the USACE and Federal and state agencies.

18. Recreation Resources.

There are no separable recreational lands identified for the project.

19. Cultural Resources.

There are no known cultural resources that have been identified as being affected by the project. Further investigations will be performed prior to any construction activities.

20. Outstanding Rights.

There are no known outstanding rights in the project area.

21. Mitigation.

The widening of the existing turning basin and the entrance channel will result in impacts to seagrass and hardbottom habitat. Final mitigation compensation will range between 8.25 to 11.25 acres for seagrass impacts, and a range of 4.9 -9.8 acres is proposed for hardbottom impacts. Final mitigation will be determined during the public review of the document by the USACE and Federal and state agencies.

A variety of mitigation options and locations have been considered. Specific details of these options can be found in the Mitigation Plan, in Attachment 3 of Appendix D .

All lands considered for mitigation are submerged and are within the navigable waters of the United States and under control of the State of Florida. Coordination with the appropriate resource agencies is ongoing.

22. Acquisition/Administrative Costs.

The estimate of the Federal real estate acquisition/ administrative cost is $15,000. This figure includes project real estate planning, review and monitoring cost. The non-Federal sponsor will receive credit towards its share of real estate administrative project cost incurred for certification. Non-Federal administrative costs are estimated to be $10,000.

23. Summary of Project Real Estate Costs.

The following cost figures are subject to change prior to construction:

a. Lands and Damages		$0
b. Acquisition – Administrative costs		$25,000
Federal*	$15,000	
Non-Federal	$10,000	
c. Public Law 91-646		$0

d. Condemnations		$0
e. Total Estimated Real Estate Cost		$25,000
f.	Contingency (30%)	$ 8,000
g.	Total Real Estate Cost with Contingency	$33,000

* Includes Corps Real Estate planning and monitoring costs

24. Real Estate Acquisition Schedule.

With no formal acquisition processes required for the tentatively selected plan, no schedule is currently proposed.

25. Estates to be Acquired.

There are no estates required for the project.

26. Maps.

See Figures F-1 (page 6) of this appendix for map showing the tentatively selected plan. Exhibit F-2 shows Federal ownership or interests in the area of the project.

27. REAL ESTATE CHART OF ACCOUNTS

01	Lands & Damages	$ 0
01AA	Project Planning	$ 10,000
01B--	Acquisition/Admin	
01B20	By Local Sponsor (LS)	$ 10,000
01B40	Review of Local Sponsor	$ 5,000
01C--	Condemnations	
01C20	By Local Sponsor	$ 0
01C40	Review of Local Sponsor	$ 0
01E--	Appraisals	
01E30	By Local Sponsor	$0
01E50	Review of Local Sponsor	$0
01F--	PL 91-646 Assistance	
01F20	By Local Sponsor	$0
01F40	Review of Local Sponsor	$0
01R--	Real Estate Payments	

01R1	Land Payments		
01R1B	By Local Sponsor	$0	
01R2	PL 91-646 Assistance Payments		
01R2B	By Local Sponsor	$0	
TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY			**$25,000**
	Contingency (30%)		**$ 8,000**
TOTAL REAL ESTATE COST WITH CONTINGENCY			**$33,000**

(Contingency costs were formulated from the cost risk analysis and added to total project costs).

EXHIBIT F-1

Previous authorizations are as follows:

ACT	WORK AUTHORIZED	DOCUMENTS
March 13, 1934 P.W.A. Program	Maintenance of improvements previously constructed by local interests.	H. Doc 185/73/2
December 10, 1935 P.W.A. Program	Deepening channels and turning basin to 20 feet.	Recommended by COE to P.W.A. October 17, 1934
August 30, 1935	Authorized work previously approved by the P.W.A. and restoration of jetties, removal of south point, revetment of banks, widening of channels, and enlargement of turning basin.	H. Doc. 185/73/2 and R&H Comm. Doc. 42/74/1
March 2, 1945	Deepening channels and turning basin to 25 feet.	H. Doc 530/78/2
May 17, 1950	Extending turning basin southward 550 feet.	H. Doc 704/80/2
July 14, 1960	Deepening channels to 35 and 33 and enlarging turning basin.	H. Doc 283/86/1
November 17, 1986	Maintenance of locally expanded turning basin to a depth of 25 feet on north side of existing basin.	Public Law 99-662
July 11, 1992	Authorized Port of Palm Beach to deepen the northern side of existing basin from 25 feet to 33 feet.	Permit Number: 199130682

EXHIBIT F-2

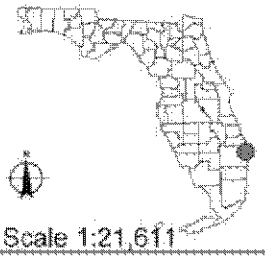
FDEP Coastal Range Monument Reference Map

26°46'39.5815", -80°3'23.6353"

26°46'35.4026", -80°0'58.2643"

26°44'59.5113", -80°3'27.2150"

26°44'55.3335", -80°1'1.8807"



Scale 1:21,611

Aerial Imagery 2010 NAIP

Coastal Range Monuments

Range Monuments

Virtual Monuments

Counties

Aerial Imagery Flight Dates 2010 NAIP

Florida Department of Environmental Protection Disclaimer: This map created in Map Direct on Thu, 21 Mar 2013 22:00:00 UTC is intended for display purposes only. It was created using data from different sources collected at different times, with differ levels of accuracy, and/or covering different periods of time. NAVTEQ road data is provided "AS IS" and without warranties of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, satisfactory quality and non-infringement. YOU SHOULD THEREFORE VERIFY ANY INFORMATION OBTAINED FROM THE SITE BEFORE ACTING ON IT.

EXHIBIT F-3

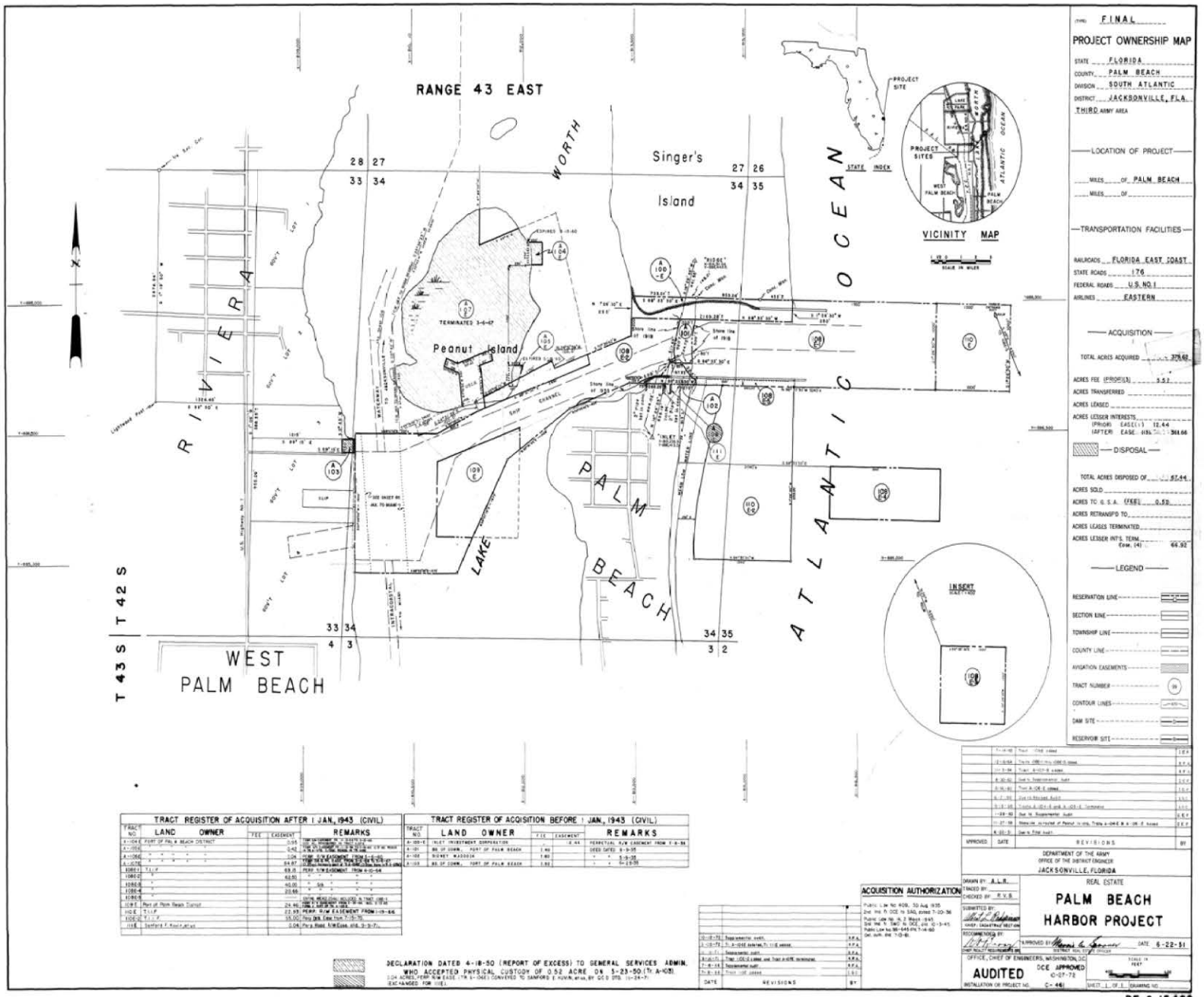

FINAL
PROJECT OWNERSHIP MAP
STATE FLORIDA
COUNTY PALM BEACH
DIVISION SOUTH ATLANTIC
DISTRICT JACKSONVILLE, FLA.
THIRD ARMY AREA
LOCATION OF PROJECT
MILES OF PALM BEACH
MILES OF
TRANSPORTATION FACILITIES
RAILROADS FLORIDA EAST COAST
STATE ROADS 176
FEDERAL ROADS U.S. NO. 1
AIRLINES EASTERN
ACQUISITION
TOTAL ACRES ACQUIRED 376.60
ACRES FEE (PROPER) 3.52
ACRES TRANSFERRED
ACRES LEASED
ACRES LESSER INTERESTS
(PRIOR) EASE. (1) 12.44
(AFTER) EASE. (15) 364.66
DISPOSAL
TOTAL ACRES DISPOSED OF 57.44
ACRES SOLD
ACRES TO G.S.A. (FEE) 0.52
ACRES RETRANSFD TO
ACRES LEASES TERMINATED
ACRES LESSER INT'S. TERM. (Con. (4)) 64.92
LEGEND
RESERVATION LINE
SECTION LINE
TOWNSHIP LINE
COUNTY LINE
AVIGATION EASEMENTS
TRACT NUMBER
CONTOUR LINES
DAM SITE
RESERVOIR SITE
RANGE 43 EAST
T 43 S | T 42 S
RIVIERA
WEST PALM BEACH
NORTH
Singer's Island
Peanut Island
LAKE
PALM BEACH
ATLANTIC OCEAN
PROJECT SITE
STATE INDEX
VICINITY MAP
PROJECT SITES
WEST PALM BEACH
PALM BEACH
ATLANTIC OCEAN
SCALE IN MILES
INSERT
TERMINATED 3-6-47
EXPIRES 1-13-60
SHIP CHANNEL
TRACT REGISTER OF ACQUISITION AFTER 1 JAN., 1943 (CIVIL)
TRACT REGISTER OF ACQISITION BEFORE 1 JAN., 1943 (CIVIL)
DECLARATION DATED 4-18-50 (REPORT OF EXCESS) TO GENERAL SERVICES ADMIN. WHO ACCEPTED PHYSICAL CUSTODY OF 0.52 ACRE ON 5-23-50 (Tr. A-103).
(124 ACRES, PERP. R/W EASE. (Tr. A-106) CONVERED TO SANFORD E. KUHN, et ux, BY QCD (TR. 11-24-7) (EXCHANGED FOR 110E).
ACQUISITION AUTHORIZATION
Public Law No. 408, 70 Aug. 1935
2nd Ind. Pr. OCE to SAD, dated 7-10-36
Public Law No. 14, 2 March 1945
3rd Ind. Pr. SAD to OCE, dtd 10-3-45
Public Law No. 98-645 PR 7-14-60
Det. auth. Ind. 7-12-60
DEPARTMENT OF THE ARMY
OFFICE OF THE DISTRICT ENGINEER
JACKSONVILLE, FLORIDA
REAL ESTATE
PALM BEACH
HARBOR PROJECT
DRAWN BY: A.L.R.
TRACED BY:
CHECKED BY: R.V.B.
SUBMITTED BY:
RECOMMENDED BY:
APPROVED BY
DATE 6-22-51
OFFICE, CHIEF OF ENGINEERS, WASHINGTON, D.C.
DCE APPROVED
6-27-72
AUDITED
INSTALLATION OR PROJECT NO. C-461
SHEET 1 OF 1
DRAWING NO.
RE-C 15,468
REVISIONS
DATE
BY

EXHIBIT F-4

DRAFT

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY FOR LAKE WORTH INLET NAVIGATION PROJECT

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES**
b. Does the sponsor have the power of eminent domain for this project? **YES**
c. Does the sponsor have "quick-take" authority for this project? **YES**
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **NO**
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **NO**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require technical training to become familiar with the real estate requirements of Federal projects including P.L. 91·646, as amended? **NO**
b. If the answer to IIa. is "yes," has a reasonable plan been developed to provide such training? **N/A**
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **YES**
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? **YES**
e. Can the sponsor obtain contractor support, if required in a timely fashion? **YES**
f. Will the sponsor likely request USACE assistance in acquiring real estate? **NO**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **YES**
b. Has the sponsor approved the project/real estate schedule/milestones? **YES**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **YES**
b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. **HIGHLY CAPABLE**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? YES/NO
b. Does the sponsor concur with this assessment? YES/NO

Date:_____

Prepared by:

_____
Lynn H. Zediak
Realty Specialist
REAL ESTATE DIVISION
JACKSONVILLE DISTRICT

Reviewed and approved by:

_____
Audrey C. Ormerod
Chief, Real Estate Division
REAL ESTATE DIVISION
JACKSONVILLE DISTRICT

APPENDIX G

LAKE WORTH INLET

Palm Beach Harbor

Preliminary Assessment Update
Palm Beach Harbor, Florida

National Harbors Program:
Dredged Material Management Plans

January 2013

Preliminary Assessment Update
Palm Beach Harbor, Florida

National Harbors Program:
Dredged Material Management Plans

Table of Contents

1 Project Name and Description 3
2 Authority 4
3 Economic Assessment (2012) 4
4 Maintenance Dredging AND ADVANCE MAINTENANCE 8
5 New conStruction Dredging 12
6 Dredged Material Disposal Site Capacity and Usage 12
7 Environmental Compliance 15
8 Conclusions 15
9 Recommendations 16

1 PROJECT NAME AND DESCRIPTION

The existing Federal navigation project, authorized in 1960, Lake Worth Inlet, is on the Atlantic Coast of Florida 47 miles north of Port Everglades and 71 miles north of Miami Harbor. The entrance channel is through an artificial cut across the barrier beach. An inner channel crosses Lake Worth (a narrow coastal lagoon), and connects the entrance channel to a turning basin at the terminal and transfer facilities of the Port of Palm Beach.

The currently authorized project, provides for:

1. An approach channel 35 feet deep over a bottom width of 400 feet and 0.8 mile long;
2. An inner channel that is 33-foot deep, 300 feet wide, and 0.3 mile long;
3. A main turning basin 33-foot deep over a trapezoidal bottom area with a turning diameter 1400 feet;
4. A secondary turning basin 24 feet deep over an irregular shaped bottom area with a turning diameter of 600 feet;
5. Maintenance of jetties at the channel entrance; and
6. Maintenance of the authorized channel.

Construction of the project included 2 feet of required overdepth in a portion of the entrance channel and turning basin due to rock at project depths. That overdepth was not for advance maintenance but rather to enable more efficient and economical maintenance in the future.

The Sponsor is the Port of Palm Beach District, P.O. Box 9935, Riviera Beach, FL 33419, 407-842-4201. The cooperation agreement in effect is a resolution which the Port of Palm Beach District signed on October 21, 1960.

This update will serve the following purpose:

1. To state that the current base plan can accommodate the O&M dredging events for the next 20 year planning horizon.
1. Include the proposed new work widening and deepening project, Lake Worth Inlet Feasibility Study and Integrated EIS, as well as associated operation and maintenance dredging for a 20 year planning horizon.
2. Include historic shoaling from 1994-2019.
3. Provide updated economic analysis
4. Include the additional advance maintenance and expanded settling basin from the Request for Additional Advance Maintenance Package, approved December 2011, as well as the updated recommendation for advance maintenance as proposed in the Lake Worth Inlet Feasibility Study and Integrated EIS.

2 AUTHORITY

House Resolution dated 25 June 1998 authorized the Lake Worth Inlet study:

"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Palm Beach Harbor, Florida, published as House Document 283, 86th Congress, 1st Session, and other pertinent reports, with a view of determining if the authorized project should be modified in any way at this time, with particular reference to widening the existing interior channel through Lake Worth Inlet."

ACT	WORK AUTHORIZED	DOCUMENTS
March 13, 1934 P.W.A. Program	Maintenance of improvements previously constructed by local interests.	H. Doc 185/73/2
December 10, 1935 P.W.A. Program	Deepening channels and turning basin to 20 feet.	Recommended by COE to P.W.A. October 17, 1934
August 30, 1935	Authorized work previously approved by the P.W.A. and restoration of jetties, removal of south point, revetment of banks, widening of channels, and enlargement of turning basin.	H. Doc. 185/73/2 and R&H Comm. Doc. 42/74/1
March 2, 1945	Deepening channels and turning basin to 25 feet.	H. Doc 530/78/2
May 17, 1950	Extending turning basin southward 550 feet.	H. Doc 704/80/2
July 14, 1960	Deepening channels to 35 and 33 and enlarging turning basin.	H. Doc 283/86/1
November 17, 1986	Maintenance of locally expanded turning basin to a depth of 25 feet on north side of existing basin.	Public Law 99-662
July 11, 1992	Authorized Port of Palm Beach to deepen the northern side of existing basin from 25 feet to 33 feet.	Permit Number: 199130682

3 ECONOMIC ASSESSMENT (2012)

OVERVIEW – COMMODITIES

Lake Worth Inlet connects the Palm Beach Harbor to the Atlantic Ocean. The port is located in Riviera Beach, Palm Beach County, Florida – 80 miles north of Miami and 135 miles (217 km) south of Port Canaveral. The Port of Palm Beach is the fourth busiest container port in Florida and the eighteenth busiest in the continental United States. The port is positioned well for growth due to its access to intermodal capabilities, as well as its acreage available for warehousing. The port has evolved into an export port (one of only 11 in the United States) and is a major nodal point for the shipment of bulk sugar, molasses, cement, utility fuels, water, produce, and breakbulk items. In addition, the Bahamas Celebration cruise ship is based at the port. Located in the heart of south Florida's tourism enclave, the port also serves significant recreational boat traffic.

The Port of Palm Beach, along with its tenants, is an economic engine for the county, state, and nation - contributing $260 million in business revenue and $12 million in state and Federal taxes. Over $7 billion worth of commodities move through the port each year, and approximately 2,400 people are employed directly and indirectly because of the port.

The Port of Palm Beach is a niche port, meaning, a relatively small number of commodities make up a large portion of the total tonnage that transits through the port. For example, cement and concrete,

molasses, sugar, and petroleum products represented roughly 10% of vessel calls in 2007. However, these same four commodity groups accounted for almost 60% of total tonnage that year Figure 3-1. In addition to traditional bulk commodities and general cargo, the Port is also home to an overnight cruise service to the Bahamas, a day-cruise that sails twice daily, and a containership operator that services the Caribbean islands on small container vessels. Throughout the following analysis, 2007 data is used as the baseline as it represents a typical level of historical commodity tonnage and vessel calls prior to the economic recession.

Figure 3-1: Comparison of Tonnage and Vessel Calls by Commodity Type[1]

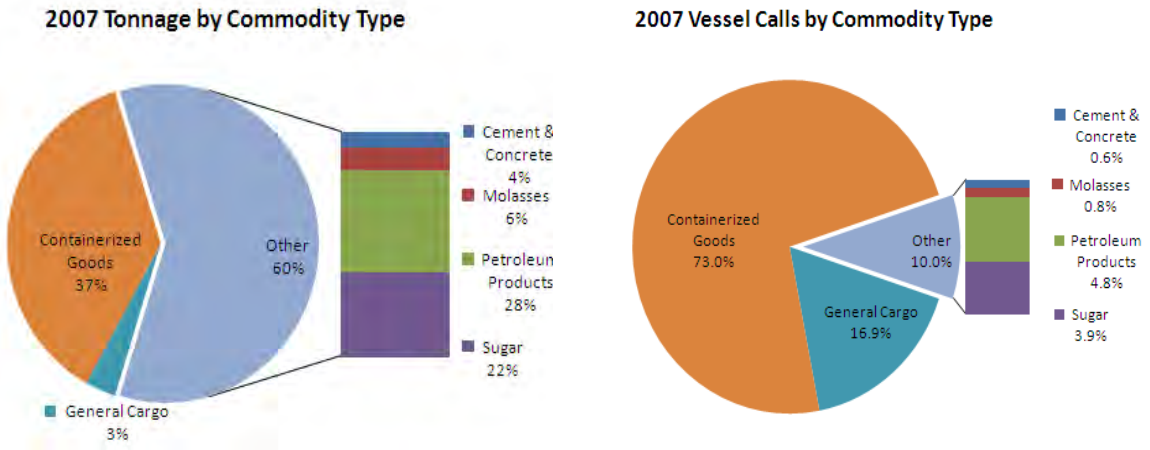


Figure 3-1 depicts the major bulk commodity tonnages for the period 1996 through 2010 that would be associated with the deepest draft vessels calling the port. Total major bulk cargo grew from 1.889 million tons in 1996 to 2.669 million short tons in 2004 for a combined annual growth rate (CAGR) of 4.415 percent. Bulk cargoes declined in 2005-2006 largely related to hurricane and storm disruptions, for example exports of molasses and receipts of fuel oil. Fuel oil has been declining recently due to the closure of the Riviera Beach power generation facility for renovations and modernization. Cement has declined due to the recent housing market price decreases. Not shown on this table is the recent substantial increase in diesel fuel and asphalt tonnage due to a new port tenant who is importing diesel and asphalt.

It is important to note that due to the economic recession, the demand for some commodities has temporarily declined, but that it is reasonable to assume that demand would rebound as the economic conditions of the nation improve.

The future commodity growth for a 50-year planning horizon from the base year of 2017 to 2067 is shown graphically in Figure 3-2.

[1] Source: Waterborne Commerce Statistics Center, GEC, and Port of Palm Beach Pilots' Log.
Notes: Petroleum Products includes: Residual Fuel Oil, Distillate Fuel Oil, Gasoline, Kerosene, and Asphalt.

Figure 3-2: Annual Cargo Tons through the Port of Palm Beach (1996-2009).

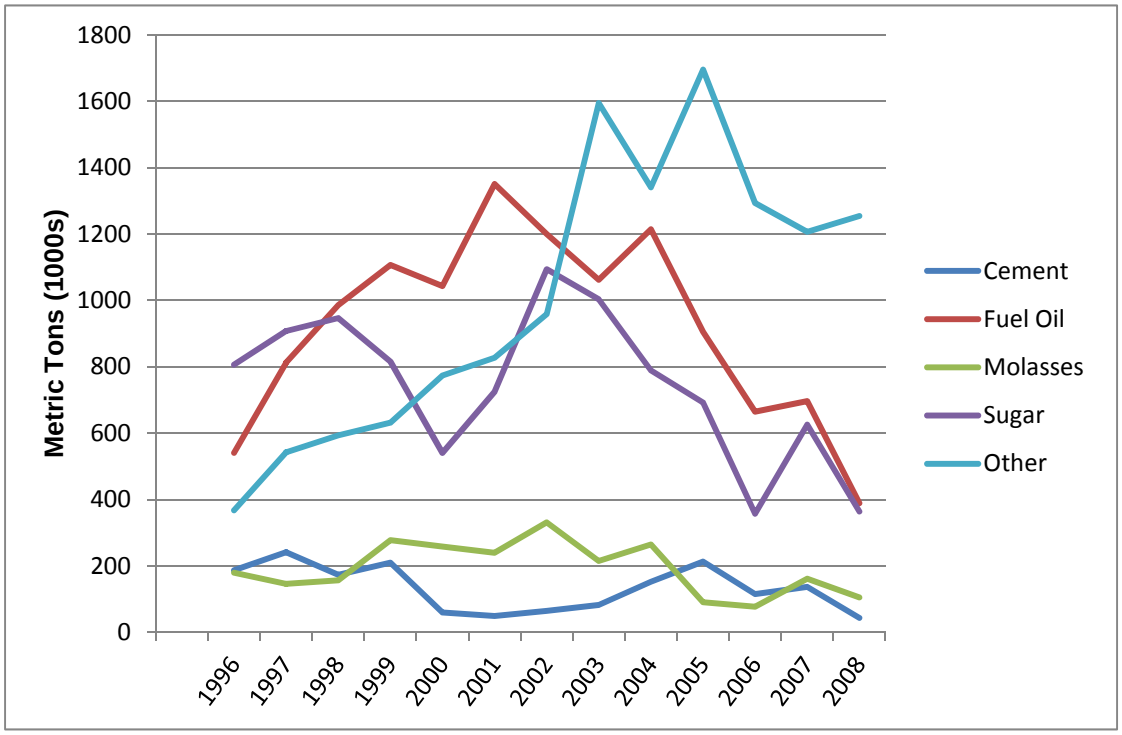
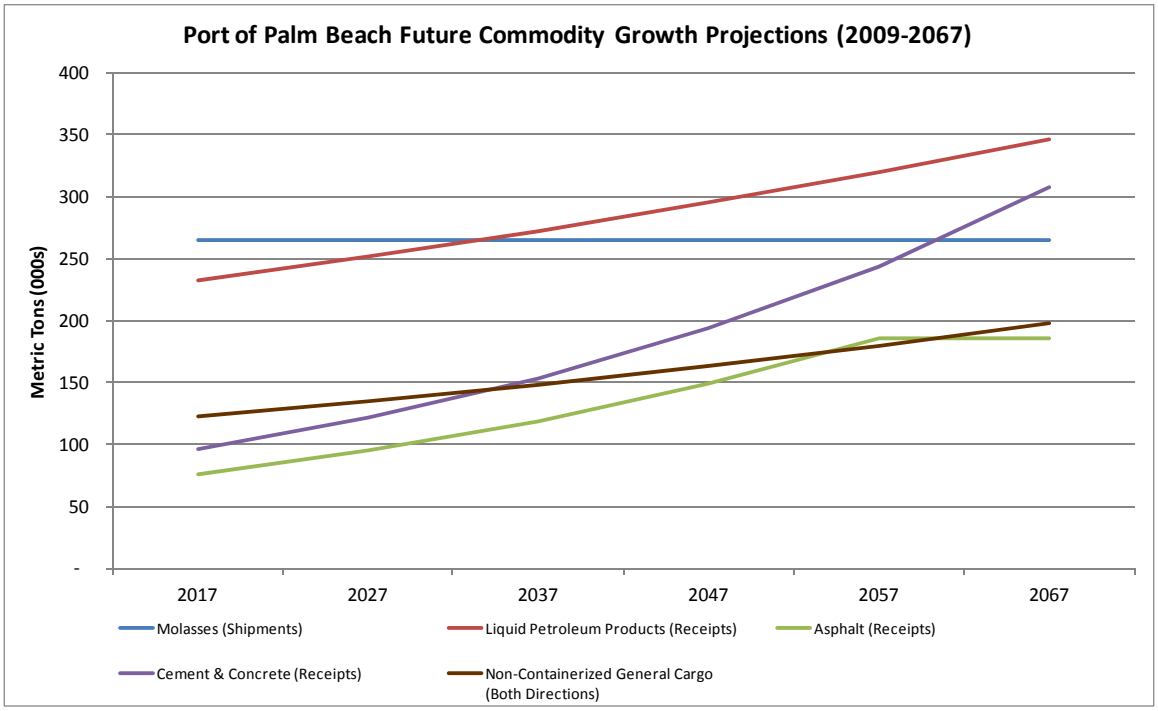


Figure 3-3: Future Commodity Movement Forecasts for Port of Palm Beach.



OVERVIEW - FLEET

Figure shows the total annual inbound and outbound vessel trips at the port between 1996 and 2010. The sharp decline in total vessel trips, which occurred between 1996 and 1999, is primarily due to a reduction in small domestic vessel calls. This is also shown by the increase in annual cargo tons during the same period (Figure 3-2). From 2000 to 2005, annual vessel trips were steady, while cargo tonnage continued to increase from 2000 to 2003, suggesting more cargo was being loaded on the same or larger vessels. Since 2005, both annual cargo tonnage and annual vessel trips have steadily declined. Figure 3-5 shows the number of vessel movements by draft from 2004 to 2010. Note that as the total movements have declined, movements that are 27 feet of draft and above have remained steady from 2006 to 2009 and increased substantially in 2010.

Figure 3-4: Port of Palm Beach Total Annual Vessel Trips

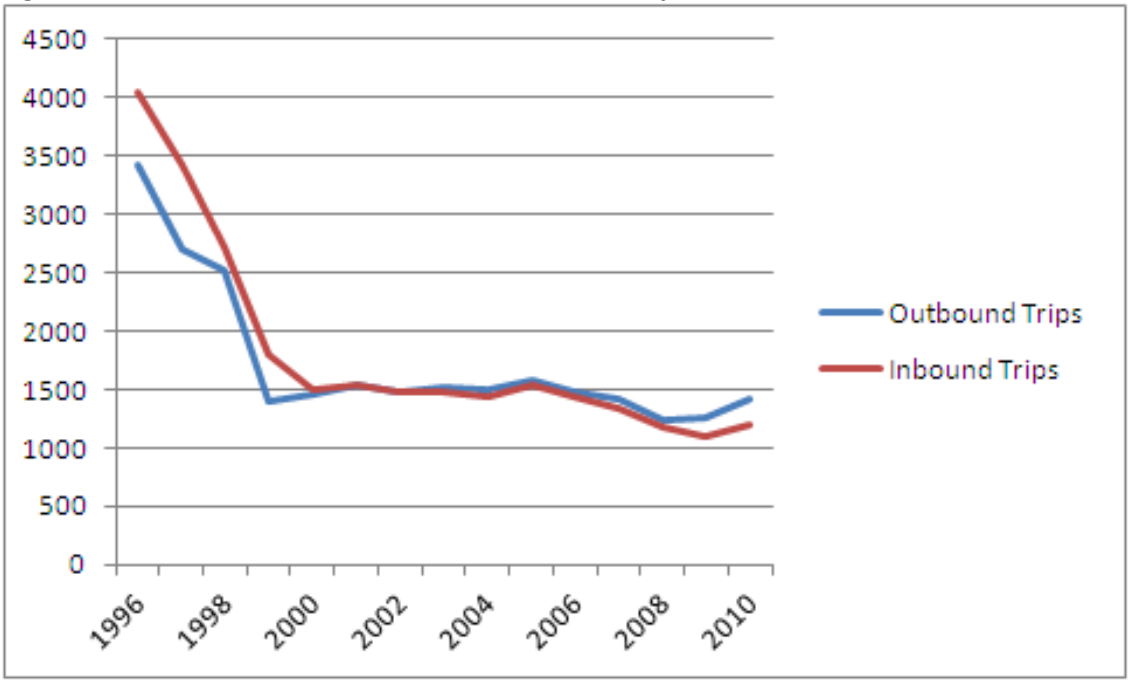
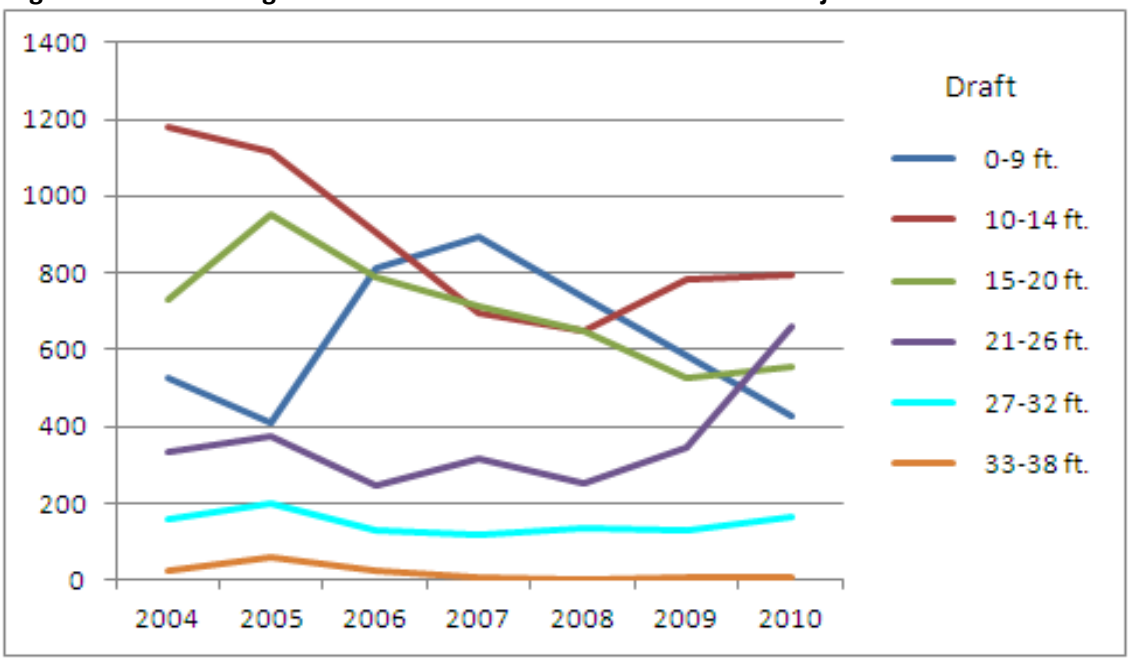


Figure 3-5: Benefiting Vessel Call Forecasts for Future Without-Project



4 MAINTENANCE DREDGING AND ADVANCE MAINTENANCE

Summary of Past PA:
Construction dredging occurred in 1938, 1948, 1951, 1965, and 1987. Initial construction of the navigation project involved the dredging of about 1 million cubic yards of material. Historical records indicate about 3.5 million cubic yards of material have been removed since 1950.

Shoals form in two primary areas of the entrance channel. The outer shoal builds up between mile -0.1 and 0.1 and has encroached to the channel centerline in the past. Surveys in 1993 showed depths of 9 to 10 feet northerly of the channel and due east of the north jetty. The predominantly southerly littoral drift moves material down the beach, around the east end of the north jetty and into the channel. The inner shoal builds up between Mile 0.2 and 0.3 with a depth of 28 to 31 feet usually near the center of the channel. Maintenance has been required 12 times for the 1978-93 period and the quantity of material has increased considerably over the past 10 years.

Maintenance dredging for 1991 through 1995 indicates the removal of 395,000 cubic yards from the project over the past 5 years which averages 79,000 cubic yards for that period. The wide variance in the amount of material dredged from year to year is attributed to the port's close proximity to the Gulfstream, coral rock bottom, and unbuffered susceptibility to storms from the northeast. A survey of the existing Federal project in November 1995 indicated two significant problem areas. Several feet of shoaling located on the south side of the entrance channel at mile 0.0. About 1-foot of shoaling is along the north and eastern sides of the shallower depth turning basin immediately adjacent to Peanut Island.

Update:
Per the "Request for Additional Advance Maintenance Dredging package", December 2011, hereafter in this report known as the **December 2011 report,** the annual shoaling rate during 1994 through 2009 in

144,000 cy. The average annual shoaling rate during 1994 though 2003 is 125,000 cy. The average shoaling rate during 2004 through 2009 is 176,000 cy. The hurricanes in 2004 and 2005 significantly increased the average annual shoaling rate even though the south jetty was sand-tightened in early 2004. Table 4-1 below shows annual shoal quantities for the years 1994 through 2009 (pg. 3, December 11 report)

Table 4-1: Historic Shoaling

No. of Events	Year	Cubic Yards
2	1994	169,700
1	1995	179,330
1	1996	150,110
1	1997	175,500
1	1998	55,100
1	1999	52,100
1	2000	143,600
1	2001	75,300
1	2002	151,900
1	2003	97,900
2	2004	275,500[2]
1	2005	305,500
2	2006	73,000[3]
1	2007	185,000
1	2008	157,800
1	2009	64,000

The December 2011 report gave approval to:

1. Construct an expanded existing settling basin with dimensions 550 feet by 500 feet at a dredging depth of 35’ + 2’ MLLW.
2. Construct and maintain an additional 2 feet (39’+2’ MLLW) of advance maintenance from Sta. 30+00 to Sta. 47+00 in the entrance channel.

Further advance analysis during the Lake Worth Inlet Feasibility Study and Integrated EIS (widening and deepening) determined the following modifications, shown in Figure 4-1 and Table 4-2.

[2] Routine and emergency
[3] Routine and emergency

Figure 4-1: Proposed modifications to Advance Maintenance

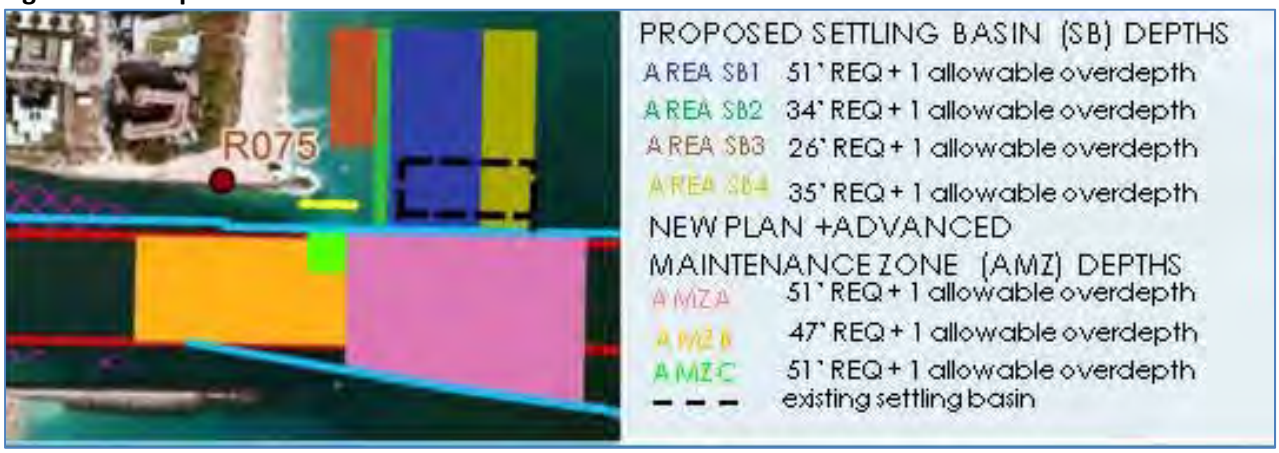


Table 4-2: All proposed modifications to Federal project and Advance Maintenance

Location	**Required Depth + Overdepth (proposed)**	**Required Depth + Overdepth (future O&M)**	**USACE Boundaries (Approximate)**
Feasibility Recommended Plan			
Entrance Channel with widened footprint	41 feet + 2 feet	41 feet + 2 feet	see drawings for widened footprint Rge, Stn (47.0 to 60.0)
Inner Channel with widened footprint	39 feet + 2 feet	39 feet + 2 feet	see drawings for widened footprint Rge, Stn (60.0 to 8.0)
Turning Basin (Main), with 150 foot ext to south	39 feet + 2 feet	39 feet + 2 feet	see drawings for widened footprint Rge, PI Stn (-1.4 to 17.2)
Turning Basin (Northern)	unchanged	25 feet + 2 feet	Rge (-500 to 150), PI Stn (10.1 to 19.6)
Slip 3 Deepening (Port of Palm Beach)	39 feet + 2 feet	39 feet + 2 feet	see drawings for widened footprint Rge and Stn
Advance Maintenance			
Settling Basin			
Settling Basin - SB4	35 feet + 2 feet	35 feet + 2 feet	Rge(-60 to -800), Stn(32.0 to 34.0)
Settling Basin - SB1	51 feet + 1 foot	49 feet + 2 feet	Rge(-60 to -800), Stn(34.0 to
Settling Basin - SB2	34 feet + 1 foot	32 feet + 2 feet	Rge(-60 to -800), Stn(37.5 to
Settling Basin - SB3	22 feet + 1 foot	20 feet + 2 feet	Rge(-350 to -800), Stn(38.0 to

Entrance Channel			
Zone A (rectangle)	51 feet + 1 foot	49 feet + 2 feet	Rge(400 to -40), Stn(30.0 to 40.75)
Zone A (trapezoid)	51 feet + 1 foot	49 feet + 2 feet	see drawings for widened footprint Rge, Stn(30.0 to 38.75)
Zone B	47 feet + 1 foot	45 feet + 2 feet	Rge(400 to -40), Stn(40.75 to 47.0)
Zone C	51 feet + 1 foot	49 feet + 2 feet	See drawings for Rge and Stn

These modifications to the advance maintenance plan would have been the proposed plan for the December 2011 report, had the Coastal Modeling System (CMS) been available at that time to model to this level accuracy 10 years ago. The CMS model makes it possible to more accurately predict the sediment transport.

This improved advance maintenance plan is recommended for the existing project, even if this new construction project is never built. The improved maintenance plan would normally be incorporated into existing maintenance and funded by the O&M program. However, the O&M program is not authorized to initially fund and construct areas which contain rock.[4] Therefore, this improved maintenance plan is submitted for approval with this feasibility study and this project will fund initial construction of this recommended advance maintenance plan, with the intent that future maintenance of those areas, after they no longer contain rock, will be funded out of the O&M program.

Future maintenance from project induced shoaling for the entrance channel, including advance maintenance, is projected at a rate of 33,000 cy/yr, and for the settling basin at a rate of 68,000 cy/yr for a total of 101,000 cy/year. That would be added to the current shoaling rate of 101,000 cy/year. With the improvements, however, a significant portion of the volume will be trapped in the settling basin and in the deeper portions of the entrance channel rather than the navigable potion of the channel. Therefore, the total maintenance volume estimate is 202,000 cy/2 yr. This is based on an average basis, depending upon storm activity, where there may be periods when dredging is required annually and others when dredging is not required until 3 years after the previous maintenance event. Based on experience from other construction deepening projects completed by the USACE, it is anticipated that the first maintenance event for the project will not be needed until the third year following initial construction. This is primarily due to the incorporation of required overdepth in the initial construction dredging.

The existing maintenance includes dredging 240,000 cy every year at a cost of $5,200,000 per year, and smaller hopper event every other year.

[4] ER 1130-2-520, dated 29 November 1996, page 8-1, specifically prohibits the dredging of advance maintenance in rock under the O&M program: "Advance maintenance involving removal of rock Is not authorized under the Operation and Maintenance, General appropriation."

The proposed advance maintenance assumes $7 million for initial construction cost and routine dredging of 250,000 cy every 2 years.

The December 2011 report stated that the frequency of dredging would be reduced from up to twice a year to once a year, and that AAEQ savings of $207,433 would be realized. The new recommended advance maintenance plan would propose to reduce the frequency of dredging to once every two years (24 maintenance dredging events over a 50-yr period of analysis) to produce an additional AAEQ savings of $250,588 when compared to the December 2011 report.

5 NEW CONSTRUCTION DREDGING

The Lake Worth Inlet Feasibility Study and Integrated EIS propose a plan which will dredge an initial quantity of approximately 2,000,000 cy in base year 2017. The quantity of material to be dredged, and associated placements sites, are shown in Table 5-1 :

Table 5-1: New construction quantities and placement sites

Item	Quantity (cubic yards)	Placement	Classification
Dredging Volumes			
(Federal)			
Entrance Channel	285,404	nearshore	Sand and Silty Sands
Entrance Channel	145,767	ODMDS	Rock, Interfingering Layers
Inner Harbor	910,129	ODMDS	Rock, Interfingering Layers
Inner Harbor	112,950	Seagrass Mitigation (Turtle Cove)	Sand and Silty Sands
Advance Maintenance	172,700	nearshore	Sand and Silty Sands
Advance Maintenance	12,000	ODMDS	Rock, Interfingering Layers
Settling Basin	258,000	ODMDS	Rock, Interfingering Layers
(Non-Federal)			
Port of Palm Beach Slip 3	71,415	ODMDS	Rock, Interfingering Layers
TOTAL DREDGING QUANTITIES	**1,968,365**		
Hardbottom Mitigation Construction			
Provide and place limestone boulders	25,100	Singer Island Artificial Reef Site	Quarried Limestone
North Jetty Stabilization			
PZC25 Sheetpile	200 LF, pile length = 63.5 feet		
*Rock is defined as: Thinly bedded and moderatelt hard limestone and sandstone			
*Interfingering layers are defined as: layers of sand, silty sand, limestone and sandstone			

6 DREDGED MATERIAL DISPOSAL SITE CAPACITY AND USAGE

Summary of Past PA:

Most of the dredging in Palm Beach Harbor has been in navigable waters of the United States. Historically, four areas were in use for disposal of dredged material as follows:

a. In an {interim} ocean dredged material disposal site (ODMDS);
b. On the beach south of the inlet;
c. On Peanut Island; and
d. Along a near shore area south of the inlet.

Interim ODMDS: Existing records from 1970 to 1984 indicate the dredged material from the channel and turning basin maintenance went into an ODMDS with a depth of 17 feet. The sand transfer plant moved material from north of the inlet to south of the inlet.

Beach: From 1984 to 1996, suitable material from the maintenance of the project went on the beach. The State of Florida and the sponsor want to put as much suitable material as possible on the beach. Roughly 395,000 cy of material went on nearby beaches {permitted template} from 1991-1995. Sediment testing in the past indicates that channel shoal material is suitable for beach disposal. No pollutants or unacceptable amount of fines are in that material to prevent beach placement. As long as the material is suitable, beach disposal is good for over 20 years in order to keep material in the littoral drift. Renourishment of the beach is important also as mitigation for the inlet impacts on the littoral drift material.

Peanut Island: Peanut Island is an artificial island comprising about 5.8 million cubic yards of dredged material. It has two owners, the Florida Inland Navigation District (FIND) and the Port of Palm Beach. FIND owns the northern portion of Peanut Island, while the Port of Palm Beach owns the southern portion of the island.

Beneficial Use: Beneficial uses are dredged material to improve the environment usually involves fill for habitat restoration. A borrow pit with depths of 30 feet and located 2.5 miles west of the project was identified but is currently filled to capacity.

Programmed Maintenance Dredging Summary: The programmed amount of dredged material averages 100,000 cy each year, from 1996 to 2005, and the annual maintenance cost is projected to be $1.7 million.

Assessment of the 1996 PA:

Disposal Options – Will remain the same as PA 1996. Only new difference is new construction and new advance maintenance construction.

The interim ODMDS site has been replaced with a new ODMDS site, located approximately 4.5 miles east of Lake Worth Inlet. The new ODMDS has not been used to date. The permitted beach template and nearshore area still remain active. The FIND site on Peanut Island is unlikely to be of use to the USACE, and it of limited capacity. The Port of Palm Beach owns the southern portion of Peanut Island, but capacity is limited. To be of use, this site would need to be expanded by dike raising, and the cost would likely be cost prohibitive.

Updated List:

a. In the new ocean dredged material disposal sites (ODMDS);
b. On the beach south of the inlet;
c. Along a near shore area south of the inlet;
d. Midtown Beach Placement
e. Beneficial use options

ODMDS: This site is permitted by EPA, but would require testing the first time it goes online with a project. It can currently accept 500,000 cy per event. The 2004 SMMP[5] states the following: "The capacity of the Palm Beach Harbor ODMDS has not been determined. Modeling conducted by the Coastal Engineering Research Center (CERC) was conducted for a single project volume up to 500,000 cubic yards. Therefore, use of the ODMDS will be restricted to 500,000 cubic yards of dredged material per project. Projects in excess of 500,000 cubic yards of dredged material will require additional capacity studies prior to utilization of the ODMDS."

During USACE coordination with EPA throughout this feasibility study (2012), EPA noted that the original purpose of the ODMDS was for maintenance material, and that the current estimated 1.4 million cubic yards which would be dredged and placed in the ODMDS for the NED plan is beyond the intent of the ODMDS design. As a result, per conversations with EPA, for USACE is in the process of conducting a modeling study to look at the distribution of the proposed material (rock and sediments) to determine the resulting footprint on the seafloor and associated mounding, and the results will be known prior to (pre-construction, engineering, and design) PED phase. Should materials exceed the ODMDS footprint, site expansion could be determined necessary. Based on the existing site configuration and conditions at the Palm Beach ODMDS and the amount of proposed dredged material from the tentatively selected plan, it is not likely (low risk) that an ODMDS expansion would be necessary for this site.

In addition, prior to disposal in the ODMDS, the USACE will assess the dredged material to determine if it meets the Ocean Dumping Criteria in 40CFR226, in accordance with the 2009 Palm Beach ODMDS SMMP.

Beach: The State of Florida and the sponsor want to put as much suitable material as possible on the beach. Sediment testing in the past indicates that channel shoal material is suitable for beach disposal. No pollutants or unacceptable amount of fines are in that material to prevent beach placement. Renourishment of the beach is important also as mitigation for the inlet impacts on the littoral drift material.

The placement of beach quality material from R-76 to R-79 (above the MHW line to vegetation) is currently being done for operation and maintenance material and will likely continue to be done in the future; however, placing material above the MHW line for the new feasibility project would incur large real estate costs, which would not make it a least cost placement options. Therefore, this option is not considered to be part of the tentatively selected plan.

Nearshore: The nearshore can accept a lesser percent of fines than the beach and is a valuable way to keep sand in the natural system while abiding by state standards. Near shore quality sand would be placed in the near shore (below the MHW line) between DEP range monuments R-76 to R-79. This is a least cost placement option and also allows beneficial use of the material for recreation and wildlife, which is an incidental benefit. The nearshore can accept all sandy material from the new project, as well as ongoing maintenance material.

Beneficial Use: Several beneficial use areas exist within the lagoon area and capacities greatly vary. However, there is not one particular beneficial site which would be able to accept all of the material for the new construction project. For this reason, beneficial use sites will be considered when capacity,

[5] The SMMP was updated in 2009 with revisions, but this requirement was transferred with the update.

material type, and availability are appropriate. Beneficial use sites are a part of the base plan when they are least cost.

The placement of beach quality material from R-76 to R-79 (above the MHW line to vegetation) is currently being done for operation and maintenance material and will likely continue to be done in the future; however, placing material above the MHW line for a new project would incur large real estate costs, which would not make it a least cost placement options. Therefore, this option is considered beneficial use for the new construction project.

Other opportunities exist in the project vicinity such as the filling of anoxic deepwater holes in Lake Worth Inlet Lagoon, creation of habitat for submerged aquatic vegetation such as seagrasses and/or placement or at the Mid-Town beach placement area. It is not anticipated that these alternative forms of disposal will result in any cost savings to the project; however, if cost increases are considered small or if there is a non-federal interest in paying for any increased cost difference, these alternatives are preferable and could be further developed and incorporated into the project during the pre-construction, engineering, and design phase (PED).

7 ENVIRONMENTAL COMPLIANCE

An Environmental Assessment (EA) on the effects of maintenance dredging the project and disposal of materials is on file with the U.S. Environmental Protection Agency (EPA). An Environmental Impact Statement (EIS) is integrated into the report for the new construction project. In the project area, wildlife includes a wide variety of shore and sea birds, small mammals, reptiles, amphibian and fishes. Threatened-to-endangered species that are often found in the project area are listed below: Mammals (manatee); Birds (Bald eagles, Red-cockaded woodpecker, Eastern brown pelican); Reptiles (American crocodile, Alligator, Green sea turtle, Loggerhead sea turtle).

Manatees frequent the heated water discharge area at the Florida Power and Light Company's Riviera Beach Station located just south of the project. Some of those manatees could pass areas undergoing maintenance dredging. Maintenance dredging contracts for the area include cautionary requirements for manatees.

8 CONCLUSIONS

Preliminary assessment of the Palm Beach Harbor plan for disposal of the shoal material indicates no major problems for the foreseeable dredging cycle. Future dredging cycles for the existing federal project and project induced shoaling may use the areas including the beach, nearshore, ODMDS, and beneficial use sites, when appropriate and when cost increment is paid for by a non-federal sponsor. Almost all the material from the entrance channel is suitable for beach placement. Future placement of most material is likely to continue going on the beach as the State and sponsor strongly support that method. The beach disposal area has not had a capacity problem in th past and is not likely to have one in the next 20 years or more. The ODMDS and nearshore have sufficient capacity for the new construction dredging.

The economic viability of Palm Beach Harbor is not in question at the present time. Continued maintenance is essential to the movement of cargo through terminals in the harbor. Port related industries have a significant investment in terminals and infrastructure to handle the tonnage volume.

Environmental compliance does not appear to be in question. Water Quality Certification (WQC) is current with periodic environmental assessments.

9 RECOMMENDATIONS

Continued maintenance of this project is warranted on the basis of project usage and indicators of economic productivity, sufficient potential disposal capacity, and maintenance activities in compliance with current applicable laws and regulations for the next 20 years. Therefore, no additional dredged material management plan is necessary beyond this assessment.