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Jacksonville Harbor (Mile Point) Navigation Study
Duval County, Florida

FINAL
INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

APPENDICES

NAVIGATION STUDY FOR
JACKSONVILLE HARBOR (MILE POINT), FLORIDA

DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

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ENGINEERING

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JACKSONVILLE HARBOR (MILE POINT), FLORIDA
APPENDIX A
ENGINEERING

A. INTRODUCTION

1. General. This Appendix presents the discussion of applicable design considerations and construction methods utilized to adequately address the project requirements and to establish a basis for the cost estimates. General requirements for real estate and operation and maintenance are also presented. This Appendix has been prepared in accordance with the applicable policy guidance as contained in ER 1110-2-1150, Engineering and Design for Civil Works Projects; ER 1110-2-1403, Studies by Coastal, Hydraulic, and Hydrologic Facilities and Others; and ER 1110-2-1404, Hydraulic Design of Deep Draft Navigation Projects.

2. Recommended Plan. The recommended NED plan, Alternative VE-3B+F.I.C., combines the reconfiguration of the existing training wall with the creation of a flow improvement channel in Chicopit Bay. The training wall reconfiguration includes removal of the western 3110 feet of existing Mile Point training wall and the construction of a new Western Leg and a relocated Eastern Leg training wall of approximately 4250 feet and 2050 feet, respectively. The Flow Improvement Channel (F.I.C.) consists of dredging a channel 80 feet wide and 6 feet deep for a length of approximately 3623 feet through Western Chicopit Bay. A plan view of the recommended plan is shown on Plate A-3.

The initial plan, Alternative 3B, was modified by the results of a Value Engineering (VE) Study which incorporates the beneficial use of dredged material by creating a salt marsh mitigation area that restores wetlands lost on Great Marsh Island. The original Plan 3B utilized the Buck Island Disposal Area for placement of dredged material which would have resulted in increased cost and loss of capacity in the D/A. A plan view of the Material Placement/Salt Marsh Mitigation Area is shown on Plate A-8. The VE program has also identified concrete structural units for the West Leg training wall that will serve as both initial containment for the mitigation area and on-going shoreline protection beyond the project life of 50 years. The VE Study Reports are provided as Attachments to this Appendix. Further modification of Alternative 3B occurred with the addition of the F.I.C.; refer to Plates A-10 and A-11. Western Chicopit Bay has experienced shoaling as a result of the breakthrough at Great Marsh Island and tidal flushing could be increased by opening a flow channel that was present prior to the breakthrough's occurrence.

A discussion of the plan formulation involved in the selection of the recommended plan is presented in the main portion of this report. All soundings presented in this report are at Mean Low Water (MLW). Jacksonville Harbor is scheduled to be updated to the datum of Mean Lower Low Water (MLLW) in the future once data collection is complete and processed. The project features shall be designed and constructed to MLLW at the time of Plans and Specifications development. This conversion will likely increase stone quantities by a nominal amount.

3. Alternatives. One alternative that remains under consideration at the request of the St. Johns Bar Pilots consists of a proposed widening of the existing channel in the Mile Point reach (Cuts 9 through 19) by varying amounts with disposal of dredged material in Buck Island as shown on Plate A-9. The widening only alternative benefits high powered vessels with a DWT to horsepower ratio of 0.75 or greater. This alternative would allow for alleviation of the restrictions associated with the difficult cross-currents; however, it does not meet the study objective of reducing the effects of the currents on the erosion of the Mile Point shoreline. This Alternative was combined with the recommended plan to further increase safety and navigability of this reach of the project and this combination was carried to the final array of alternatives that can be found in the Main Report.

B. HYDROLOGY AND HYDRAULICS

4. General. The St. Johns River is the longest river in Florida, meandering more than 300 statute miles. The river discharges into the Atlantic Ocean at Mayport in Duval County. The total elevation drop from its headwaters to the Atlantic Ocean is less than 30 feet—an average slope of about one inch per mile.

Over most of its length, the river's average depth is relatively shallow. However, the 26-mile stretch of river from the mouth to downtown Jacksonville (the deepest segment) has an average depth of approximately 30 ft. Many small rivers, creeks, and tributaries feed into the St. Johns River, increasing the overall river flow, and affecting the tidal signal, especially during storm events. Some of the larger rivers and creeks along the lower portion of the St. Johns River include: Pablo Creek, Sisters Creek, Clapboard Creek, and Cedar Point Creek. Others, farther upriver, include: Dunn Creek, Broward River, Trout River, Arlington River, and Ortega River.

The St Johns River runs through the city of Jacksonville, located in northeast Florida. Deep-draft vessels transit as far as downtown Jacksonville, or about 24 miles upriver from the confluence with the Atlantic Ocean. Beyond this point, commercial traffic is light, and comprised mostly of tug-assisted barges.

The effect of tides on the river is significant. Tidal influences are prevalent from the mouth of the river to slightly more than 100 statute miles upriver, near Georgetown, where the tide becomes negligible. The exact point where the river becomes non-tidal will constantly change, depending on the strength of the tide signal (e.g., spring or neap tides), and the interaction of the tide with the variable river flow. Tidal effects have been reported as far south as Lake Harney, upstream of De Land.

The total flow in the lower reaches of the river is comprised of about 80%-90% tide-induced flow, with the remaining flow caused by wind, freshwater inflow (from tributaries and rain), and industrial and treatment plant discharges. The river flow generally increases downstream, with the highest flows occurring at the mouth of the river. The total discharge of the river will often exceed 200,000 cfs. Freshwater flows within River is seasonal, generally following the seasonal rain patterns with higher flows occurring in the late summer to early fall, and lower flows occurring in the winter months. The average annual non-tidal freshwater discharge at the river mouth is approximately 15,000 cfs.

The main area of interest in this study centers on the intersection of the St Johns River and the Intracoastal Waterway (IWW). This area is known as Mile Point. The IWW crosses the main channel of the St Johns River at an angle of approximately 45^{o} from the north, out of Sisters Creek. From the south, it crosses at an angle almost parallel to the main channel flow out of Pablo Creek, with flow usually running in the opposite direction of flow in the river. The intersection of the St Johns River and the IWW is subject to cross-currents in the upper depths of the river due to the significant flow rates coming out of Pablo Creek and the large confluence angle with the St Johns River.

Pablo Creek is a navigable waterway that experiences flows in excess of 55,000 cubic feet per second during ebb tide, as measured with Acoustic Doppler Current Profile (ADCP) surveys. This flow coming from the south, out of Pablo Creek can exceed 25% of the total flow of the St. Johns River at Mile Point. In addition, the confluence angle of these two waterways is more than 130 degrees. As the St. Johns River flows in a southeasterly direction during ebb flow, Pablo Creek's flow collides with the river in a northwesterly direction. This combination of high flow and extreme confluence angle causes a deflection of the main channel flows to the northeast.

ADCP surveys clearly show that during flood tide, the majority of the flow (and fast moving water, >5fps) is concentrated toward the southern bank of the river (outer bend) with very slow moving water along the northern bank (inner bend). This is the flow distribution one would expect to see at a river bend. However, during the ebb tide the flow distribution is drastically shifted/deflected to the north. Fast moving water flows can be seen along the northern shoreline, with water moving significantly faster along the northern (inner) bend compared to the southern (outer) bend where the Federal Channel is located. One must consider that the north bank at Mile Point is on the inside of the river bend, where normally sedimentation, not erosion, usually occurs. The unique geometric configuration of this intersection of the IWW and the St Johns River, which produces a dramatic shift in the St Johns River's currents, is the only logical explanation for the extreme cross-currents experienced at this turn. This phenomenon can be visibly seen at the project site, has been measured with multiple ADCP surveys, is reproduced in both two- and three-dimensional modeling, and verified by the St Johns River Bar Pilots. These dangerous cross-currents are the reason for the Bar Pilots' navigation restrictions.

On the southern bank of the St Johns River at Mile Point, the Mile Point Training Wall, also known locally as the "Little Jetties", exists in a deteriorated state. Past records indicate the Mile Point Training Wall was constructed prior to 1910. An examination of the training wall was performed in 1928. According to that examination, the training wall ranged in height from an original design height of 6 feet above mean low water (MLW) to areas with a height of only 0.5 feet above MLW. Maintenance work around 1931 rebuilt the training wall to an original design elevation of 6 feet above MLW. Work began under contract on April 21, 1931 and resulted in the repair of 5,990 linear feet of the training wall. Over 18,000 tons of granite averaging in weight from 1,000 to 1,500 pounds per stone was placed in the Mile Point Training Wall. Currently, the training wall is in a deteriorated state. At high water, only a few sections of the training wall are visible above the water line. Many sections of the training wall are submerged even at low water.

In the recent past, homeowners on the north bank of the river at Mile Point have seen severe erosion of their property and are seriously concerned about future property losses. The homeowners have speculated that this erosion is caused by hydrodynamic effects of dredging done by U.S. Corps of Engineers in the past, installation of the large Atlantic Marine dry dock, as well as by the deterioration of the Little Jetties training wall. Also of concern in this area is the breakthrough of Great Marsh Island on the southern bank of the St Johns at Mile Point, allowing water to flow directly from the St Johns River into nearby Chicopit Bay. This has caused severe shoaling in parts of Chicopit Bay. At low tide, the water depth in some parts of the bay is less than six inches deep.

5. Sea Level Rise. Relative sea level (RSL) refers to local elevation of the sea with respect to land, including the lowering or rising of land through geologic processes such as subsidence and glacial rebound. It is anticipated that sea level will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea-level change on design, construction, operation, and maintenance of coastal projects, the U.S. Army Corps of Engineers (USACE) has provided guidance in the form an Engineering Circular, EC 1165-2-211. EC 1165-2-211 provides both a methodology and a procedure for determining a range of sea level change estimates based on global sea level change rates, the local historic sea level change rate, the construction (base) year of the project, and the design life of the project. Three estimates are required by the guidance, a Baseline estimate representing the minimum expected sea level change, an Intermediate estimate, and a High estimate representing the maximum expected sea level change. The local rate of vertical land movement is found by subtracting regional MSL trend from local MSL trend. The regional mean sea level trend is assumed equal to the eustatic mean sea level trend of 1.7 mm/year. Therefore at Mile Point, there is 0.70 mm/year of subsidence. Adjusting equation (2) to include the historic global mean sea-level change rate of +1.7 mm/year results in updated values for the variable b being equal to 2.36E-5 for modified NRC Curve I (Intermediate), 6.20E-5 for modified NRC Curve II, and 1.005E-4 for modified NRC Curve III (High).

$$\textit{Equation 2: } E(t) = 0.0017t + bt^2$$

Equation (3) of EC 1165-2-211 Appendix B calculates eustatic sea level change over the life of the project. E(t) is eustatic sea level change and b is a constant provided in EC 1165-2-211; t_1 is the time between the project's construction date and 1986 and t_2 is the time between a future date at which one wants an estimate for sea-level change and 1986 (or $t_2 = t_1$ + number of years after construction (Knuuti, 2002)). For example, if a designer wants to know the projected eustatic sea-level change at the end of a project's period of analysis, and the project is to have a fifty year life and is to be constructed in 2015, t_1 = 2015 – 1986 = 29 and t_2 = 2065 – 1986 = 79.

$$\textit{Equation 3: } E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

Modifying equation (3), to include site-specific sea level change data, results in an equation for Relative Sea Level (RSL). This equation is used to estimate Baseline, Intermediate and High sea level change values over the life of the project.

$$RSL(t_2) - RSL(t_1) = (e+M)\ (t_2 - t_1) + b(t_2^2 - t_1^2)$$

$RSL(t_1)$ and $RSL(t_2)$ are the total RSL at times t_1 and t_2, and the quantity $(e + M)$ is the local change in sea level in m/year that accounts for the eustatic change as well as uplift or subsidence. The quantity *(e+M)* is found from the nearest tide gage with a tidal record of at least 40 years.

Based on historical sea level measurements taken from NOS gage 8720218 at Mayport, Florida, the historic sea level rise rate *(e+M)* was determined to be 2.40 +/- .31 mm/year (0.0076 ft/year) (http://tidesandcurrents.noaa.gov/sltrends/index.shtml). The project base year was specified as 2015, and the project life was projected to be 50 years. Table 1 shows the results of equation (3) every five years, starting from the base year of 2015. From this table, the average baseline, intermediate, and high sea level change rates were found to be +2.40 mm/year (0.0079 ft/year), +4.95 mm/year (0.0162 ft/year), and +13.25 mm/year (0.0435 ft/year), respectively.

Projecting the three rates of change to the year 2065, which corresponds to a 50-year project life, provides us with a predicted low level rise of 0.12 m or approximately 0.39 feet, an intermediate level rise of 0.25 m or approximately 0.81 feet, and a high level rise of 0.66 m or approximately 2.17 feet.

In order to assess the impact that either the low level (0.39 feet), the intermediate level (0.81 feet) or the high level (2.17 feet) of predicted sea level rise may have on this project it is first important to understand the function of the affected structure. A training wall by definition is a wall built along the bank of a river or estuary parallel to the direction of flow to direct and confine the flow. With that definition in mind it should be noted that a training wall is not a coastal protection structure and the function and performance of the wall is measured by its ability to "train" river currents; therefore, as long as the water surface level is below the crest of the structure, the structure is performing at 100% design capacity. The structure design crest elevation of +7.5 feet (+2.29 m), MLLW, represents a height of 2.55 feet (0.77 m) above Mean Higher High Water (MHHW) and a height of 0.36 feet (0.11 m) above the highest observed water level (NOAA Tidal Bench Mark Station ID #8720218 at Mayport). Thus the impact of the low and intermediate level increases of 0.39 feet and 0.81 feet, respectively, would be inconsequential to the performance of the structure and the high level increase of 2.17 feet would only affect the performance of the structure during low probability events that exceeded the MHHW level by more than 0.38 feet. Even during such low probability events, the structure will perform its intended purpose to train the river currents with the exception of that very small portion of the water column above the structure's crest. In addition, if over time the actual measured changes in relative sea level are closer to the Scenario III amounts or greater, then the structure's performance can easily be brought back to an optimal level by increasing the crest elevation by up to a foot without major expense although the crest width would have to decrease slightly to do so.

6. Currents. In addition to the severe erosion experienced in the Mile Point area, dangerous crosscurrents are a major concern to deep-draft commercial navigation. Meetings with the St. Johns Bar Pilot's Association have highlighted the difficult and intense nature of the crosscurrents at the confluence of the St. Johns River with Sisters Creek to the north and Pablo Creek to the south. The area of the river where the IWW crosses the St. Johns River produces currents that can actually turn an inbound and under powered ship around. In addition, the U.S. Coast Guard describes the junction of the IWW with the St. Johns River as one of particular concern, subject to strong and unpredictable crosscurrents at various stages of tide.

To avoid those difficult ebb flow crosscurrents, the St. Johns Bar Pilots and the Captain of the Port have enacted a restriction which requires vessels with a draft greater than 33 feet to wait on a flood tide before entering or leaving the harbor. The sponsor, the Jacksonville Port Authority, has requested the Corps of Engineers to recommend measures that will allow the St. Johns Bar Pilots and the Captain of the Port to remove those restrictions.

7. Methodology. The project alternative plans were evaluated using a St. Johns River circulation model in addition to ship simulator studies. The circulation models were developed by Corps of Engineers staff, using the hydrodynamic models RMA-2 and RMA-10. Current velocities and flow fields were developed for all alternatives using the two-dimensional model RMA-2. The recommended plan, relocation of the Mile Point Training Wall was determined to be the most effective and feasible plan. This alternative was then verified using the three-dimensional model RMA-10. Further details of this analysis are available in the Hydraulics and Hydrology Attachment. Outputs from the hydrodynamic models were then used as inputs into the ship simulator studies detailed in the Hydrodynamic Model Report (Attachment A).

8. Effects of Recommended Plan. Numerical hydrodynamic modeling of the proposed channel improvements and recommended features for the Mile Point project shows changes to current vectors (velocities and direction) under flood and

ebb tide. Numerical modeling results indicate that the dangerous crosscurrents exiting the IWW southern channel under ebb tide will be redirected to more closely parallel the alignment of the Federal navigation channel instead of being focused toward the erosion prone areas along the northern shoreline of Mile Point. This reduction in crosscurrents should allow for the restriction of ebb tide transit for deep-draft vessels to be lifted. Examination of the maximum flood and ebb tide current vectors indicate that flow velocity magnitudes within the Federal navigation channel are very similar between the existing and with-project condition and in isolated areas of the Mile Point turn are about 1 feet/sec less under the with-project condition. This comparison suggests that little or no significant net increase in shoaling rates will occur within the Jacksonville Harbor Federal channel over existing project conditions.

A natural shift of the Intracoastal Waterway at the entrance to Pablo Creek will be expected as a result of the realignment of the training wall. Lower water velocities will increase the opportunities for sedimentation on the western side of the entrance. Higher velocities along the eastern side have the potential to scour and undermine the location of the new training wall; therefore this training wall will be designed with significant scour protection.

It is anticipated that the new realignment of the Mile Point Training Wall will produce flows coming out of the IWW that are more aligned with the Federal navigational channel. This should cause a drop in water velocity magnitude in the areas north of the navigational channel at Mile Point, as seen in Figures 19 and 20 of the Hydraulics and Hydrology Attachment.

Little or no significant net increase in shoaling of the Intracoastal Waterway or the Federal Navigational channel is predicted as a result of the reconfiguration of the Mile Point Training Wall.

C. GEOTECHNICAL

9. General. The geotechnical investigations and the geologic conditions encountered within the scope of study of the Feasibility Report are presented in an Attachment to this Appendix. The Attachment includes preliminary core boring locations and associated analytical data. The current level of field work completed pertains to the Feasibility Study. Additional investigations with borings will be needed to enhance the data to bring it to Plans and Specifications (P&S) standards.

D. DESIGN AND CONSTRUCTION

10. General. A project location map is shown on Plate A-1 and a vicinity map is shown on Plate A-2. The proposed project plan is shown on Plate A-3 and typical sections of the relocated Training Wall East and West Legs are provided on Plate A-7. Other plan details are provided on Plates A-4, A-5, A-6, A-8, A-10 and A-11.

11. Structure Removal and Required Excavation. The western most 3110 feet of the existing training wall will be removed and the entire mouth of San Pablo creek at its confluence with the St. Johns River will be dredged to -12 feet MLW plus 1 foot of allowable overdepth. Total estimated quantity of material to be excavated is up to approximately 889,000 cubic yards (cy). All usable stone material recovered from the existing training wall will be stockpiled for use in the East Leg of the relocated training wall and all other material excavated will be placed as beneficial use in the Salt Marsh Mitigation Area and as foundation for the relocated training wall legs. It is estimated that approximately 14,600 cy of armor stone can be recovered for reuse purposes; however, additional geophysical exploration is needed to more precisely ascertain the exact quantities of stone available for reuse.

12. Side Slopes. The design side slopes were derived from historical project information, an analysis of the materials to be dredged and existing channel topography. For estimating excavation volumes, side slopes along the channel length with predominantly SP material have been excavated to 1V:3H. Existing boring data in the area to be excavated for this project show SP material.

13. Overdepth. An additional 1-foot of allowable overdepth is included in the estimated excavation quantities. The allowable overdepth would be included to provide for inaccuracies in the dredging process.

14. Relocated Training Wall. Design of the relocated training wall legs was predicated on an analysis of the original design, repair designs, current velocities from hydrodynamic modeling (further explained in Attachment A, Hydrodynamic Model Report), and predicted wave heights generated from ship traffic. Existing ships are defined as Panamax vessels with a Length Overall (LOA) of 950 feet and a beam of 106 feet. In order to account for the likelihood of larger vessels using Jacksonville Harbor in the future with or without deepening of the harbor once the Panama Canal expansion is complete, a vessel of 984 feet LOA and a beam of 122 feet was considered. A previous study of Chicopit Bay from 1997 identified that at any given speed the future vessels produce between one-half foot and 1-foot higher waves than existing vessels due to the increased beam/length of entry ratio. The result is a recommended design wave height of 5 feet for the East Leg and 3 feet for the West Leg. Maximum current velocities of approximately 5 feet per second (fps) are expected to occur as a result of the project although it is anticipated that the current velocities along the West Leg will decrease over time once the entire project is constructed. The East Leg training wall incorporates a larger scour apron (25') than the West Leg (10') due to the predicted permanent shift of stronger currents in Pablo Creek towards the east especially during the ebb tide. Channel migration of the IWW is anticipated and realignment of the channel to deep water may become necessary. The relocated East Leg consists of building approximately 2050 feet of training wall tying into the existing structure on Helen Cooper Floyd Park and the West Leg consists of building approximately 4250 feet of training wall across the breakthrough at Great Marsh Island. Estimated quantities associated with the East Leg are 26,900 cubic yards (cy) of armor stone and 11,900 cy of bedding stone and for the West Leg are 5,670 cy of concrete (567 units at 10cy/unit) and 32,000 sy of geotextile fabric for bags and tubes to be filled with 40,500 cy of excavated material.

Both legs will incorporate the use of a total of approximately 34,900 square yards of filter fabric. Refer to Plate A-7 for training wall typical sections and Table.

The project area is very dynamic and due to the complex hydrologic processes the conditions are subject to change over relatively short periods of time. Additional survey data and data densification will be needed to refine the design template during the Preconstruction, Engineering and Design (PED) phase along the entire alignment of the relocated training wall West and East Legs. The templates presented in Plate A-7 are considered typical and the final structure design could vary based on actual existing bottom conditions at time of PED development.

15. Flow Improvement Channel. Due to shoaling in Chicopit Bay, likely caused by the breakthrough at Great Marsh Island, historic flow paths from Mt. Pleasant and Greenfield Creeks to Pablo Creek have been greatly diminished. In order to restore this flow path and increase flushing of sediments and tidal exchange in Chicopit Bay, a flow improvement channel will be constructed in conjunction with the training wall relocations and restoration of Great Marsh Island. The flow improvement channel would be constructed to a depth of -6 feet MLW plus 1-foot of allowable overdepth to account for the inaccuracies of dredging. The channel will be 80 feet in width and approximately 3623 feet in length. These dimensions are predicated primarily on an analysis of historical conditions that existed prior to the breakthrough of Great Marsh Island. A total of up to approximately 72,000 cubic yards would be removed from the F.I.C. and all dredged material will be placed in the designated Material Placement Area to expand the acreage of the salt marsh restoration.

16. Disposal Area. It is anticipated that all of the construction material not recovered for reuse would be placed in the Salt Marsh Mitigation Area as a beneficial use dredged material. Refer to Plate A-3 for the approximate location of the Material Placement/Mitigation Area and Plate A-8 for the site plan. As mitigation for the relocated East Leg of the training wall the creation of approximately 18.2 acres of both high marsh and low marsh will be required. By using the remainder of the material to be excavated for the project a total of approximately 53 acres of marsh will be created. It is anticipated that the construction of the marsh will take place in 2 phases. Phase 1 will consist of the material placement from required project excavation that is anticipated to be performed primarily by hydraulic means and phase 2 will follow after a period of time to grade the material to the correct elevations, create tidal flow channels, and plant vegetation. The phasing of this construction is important to allow for evaluation of the actual final quantity of material placed in the site, the consolidation of the dredged material and settlement of underlying materials. An adjustment of the acreages of high marsh versus low marsh may be needed to balance the material that is actually placed within the site. During initial material placement it will be necessary to contain the dredged material to allow for settlement and dewatering of the dredge slurry. Containment will be accomplished on the north side by the new West Leg of the training wall, on the south side by the use of geotube(s) filled with dredged material and on the east and west by use of removable water dams. The water dams will be set to an elevation of approximately +7.5 feet MLW in order to prevent the loss of dredged material into the surrounding existing wetlands on the east and west. The geotube(s) on the south will be set to an elevation of approximately +5 feet MLW which corresponds to

the MHHW level and will allow for retention of dredged material within the disposal area, clarification of the dredge slurry and subsequent return of decant water to the environment. Final fill elevation is not precisely known due to the large number of variables involved with the construction process; however, they should not exceed +2.5 MLW. Additional surveys and geotechnical exploration will be needed during the PED phase to refine design parameters and revise quantity requirements. Additional details regarding the mitigation requirements and restoration plans are provided in Appendix D of this report.

17. Construction Procedure. For cost estimating purposes, it is anticipated that landside excavators would be utilized to remove material on Helen Cooper Floyd Park above the waterline and a 16 inch cutter-suction dredge would be used to remove material to elevation -13 feet MLW in addition to performing the dredging of the F.I.C. to -7 feet MLW. A crane and barge(s) would be required for removal of existing stone from the segment of training wall to be removed and for placement of the relocated training wall East and West Legs. Areas of deep water along the relocated training wall alignments will need to be filled and possibly surcharged prior to stone placement in order to provide structure foundation. Sequence of overall construction will be at the discretion of the Contractor except that the construction of the West Leg Training Wall will be required prior to material disposal in the Great Marsh Island restoration area and the construction of the F.I.C. will be the last order of work. A follow-on contract will be required to perform final restoration of Great Marsh Island including final grading for areas of low and high salt marsh, tidal channels and planting.

E. RELOCATIONS

18. General. The project sponsor would be required to assume the costs of all relocations and alterations.

19. Utilities. There are no known submarine crossings of local or long distance phone, cable television, electrical, sewerage or drinking water lines in the project vicinity as noted in the Jacksonville Harbor Feasibility Study dated September 1998 (see Plate A-12). During a site visit in 2008 it was noted that a wastewater outfall pipe exists that discharges into the St. Johns River near the east end of the existing training wall on Helen Cooper Floyd Park that was not identified during the 1998 study. It appears that this outfall pipe lies well outside the Federal Project and training wall relocation footprint.

F. SHIP SIMULATION STUDY

20. Discussion. The Report for the ship simulation study is provided in Attachment C. Development of the simulation database, model verification, alternatives testing, study conclusions, and associated recommendations are included in the report. The information provided is essential for a complete understanding of the likelihood that

an engineering solution can be provided that will lessen or eliminate the threats to navigation safety at Mile Point during ebb flow in the federal channel. Two important components of the simulation study documentation are not included in the paragraphs that follow. The testing ship track plots and the pilot post-simulation analysis question and comment sheets are not provided for review. The track plots and comment sheets are considered to be proprietary intellectual information by the St Johns Bar Pilots Association. A copy of this information is held in confidence by ERDC and the District Office (Philip Sylvester 904-232-1142). In response to a request from Headquarters, additional ship simulation work was initiated in June of 2009 to test the feasibility of a widener in Training Wall Reach as a solution to vessel controllability issues at Mile Point. Proof of Concept documentation related to that work is provided in Attachment D.

G. OPERATION AND MAINTENANCE

21. General. The Federal Government would be responsible for operation and maintenance of the navigation improvements proposed in this report upon completion of the construction contract. The Federal Government currently maintains the existing project. The contractor would be responsible for all maintenance during the construction contract.

22. Estimated Annual Cost. Due to existing current velocities, the Jacksonville Harbor and Intracoastal Waterway channels in the project vicinity presently require little to no maintenance. According to operations managers in CESAJ-OD-N this reach of the Jacksonville Harbor project is maintenance dredged approximately every 5 years and the IWW reaches DU-1 through DU-7 have required no maintenance in the past 50 years. Based on model investigations and current measurements, the resulting bottom current velocities from the relocated training wall legs and excavation and removal of a portion of the existing Training Wall and entire surrounding area to -13 feet MLW are of such magnitude to expect little deposition to occur in either of the channels. It may however become necessary to realign the Intracoastal Waterway to the east if deposition occurs along the West Leg of the relocated training wall.

The Chicopit Bay Flow Improvement Channel is also not expected to require maintenance dredging. As shown in Figures 16 and 17, on pages 22-23 of the main report, prior to the breakthrough of Great Marsh Island, a natural channel exists in the same location as the proposed Flow Improvement Channel. These historical maps show water depths up to 10 feet due to tidal flushing of Chicopit Bay as well as freshwater runoff from the neighboring creeks. Once Great Marsh Island is restored, the water from Greenfield and Mount Pleasant Creeks, as well as the large volume of water within Chicopit Bay's tidal prism will flush in and out through the Flow Improvement Channel. It is reasonable to expect the water velocities in the channel to be sufficient to prevent shoaling within the channel.

Historically the training walls along the St. Johns River have performed well and required very little maintenance. The White Shells Training Wall has received no maintenance since 1931 and is not scheduled for any maintenance in the near term, the St. Johns Bluff Training Wall received no maintenance between 1931 and 1996 (65 years), the Bartram Island Training Wall received no maintenance between 1931 and 1998 (67 years) and the Mile Point Training Wall received no maintenance for a period of 70 years between 1931 and 2001. Therefore, with proper design and construction it is anticipated that no maintenance of the relocated training wall legs will be required over the project life of 50 years.

23. Navigation Aids. The U.S. Coast Guard (USCG) would be responsible for providing and maintaining navigation aids. Warning signs and lights that are within the training wall reach designated to be removed will no longer be needed once construction has been completed and will be removed along with that portion of the training wall. There are additional range lights and channel markers that will require relocation and the USCG has provided an estimated cost for this effort. These costs are incorporated into the MCACES estimate in the Cost Engineering Appendix.

H. QUANTITIES AND COST ESTIMATES

24. Summary of Quantities. A summary of the major construction items are presented in Table A-2 below. Mitigation construction quantities are discussed in the Mitigation Plan, Appendix D.

25. Summary of Costs. The estimates of first cost for construction of the NED Plan (VE-3B+FIC) were prepared using MCACES software and are presented in the Cost Engineering Appendix. The estimate includes a narrative, a summary cost, and a detailed cost showing quantity, unit cost, and the amount for contingencies for each cost item. The costs of the non-construction features of the project are also included in the cost estimate. Costs are currently provided assuming beneficial use of disposal material at Great Marsh Island.

The costs have been prepared for an effective date of February 2011.

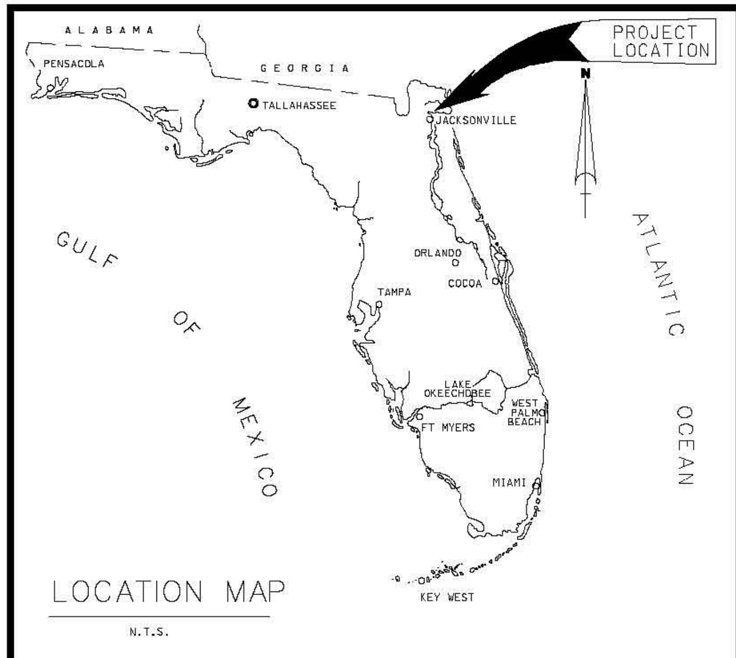
Table A-1: Regional Sea Level vs. Year- Mile Point

	Baseline (Historic)			Intermediate (NRC Curve I)			High (NRC Curve III)		
	Year	mm	ft	Year	mm	ft	Year	mm	ft
Base Year	2015	0.0	0.00	2015	0	0.00	2015	0	0.00
	2020	12.0	0.04	2020	19.4	0.06	2020	43.7	0.14
	2025	24.0	0.08	2025	40.0	0.13	2025	92.3	0.30
	2030	36.0	0.12	2030	61.8	0.20	2030	146.0	0.48
	2035	48.0	0.16	2035	84.8	0.28	2035	204.8	0.67
25 Year	2040	60.0	0.20	2040	109.0	0.36	2040	268.5	0.88
	2045	72.0	0.24	2045	134.3	0.44	2045	337.3	1.11
	2050	84.0	0.28	2050	160.8	0.53	2050	411.1	1.35
	2055	96.0	0.31	2055	188.5	0.62	2055	490.0	1.61
	2060	108.0	0.35	2060	217.4	0.71	2060	573.8	1.88
50 Year	2065	120.0	0.39	2065	247.4	0.81	2065	662.7	2.17

TABLE A-2
Summary of Construction Quantities

Item	Quantity
Clearing and Grubbing	13 acres
Excavation Area	
- Upland Removal and Disposal	67,000 cubic yards
- Dredging and Disposal	822,000 cubic yards
Flow Improvement Channel	
- Dredging and Disposal	72,000 cubic yards
Mitigation/Placement Area	
- Geotextile tube Containment 3 tubes at 1400' each	4200 linear feet
- Water Dam Containment	3275 linear feet
West Leg Training Wall	
- Filter Fabric	20,300 square yards
- Filter/Bedding Stone	5,000 cubic yards
- Concrete Structural Units (567 units at 10cy/unit)	5,670 cubic yards of 5000 psi marine grade, fiber reinforced, pH neutral concrete
- Foundation Fill (from excavation area) with Geotextile Bags/Tubes	40,500 cubic yards plus 32,000 sy of bags/tubes
East Leg of Training Wall	
- Existing TW Stone Removal and Reuse	14,600 cubic yards
- Filter Fabric	22,500 square yards
- Filter Stone	11,900 cubic yards
- Armor Stone	12,300 cubic yards*

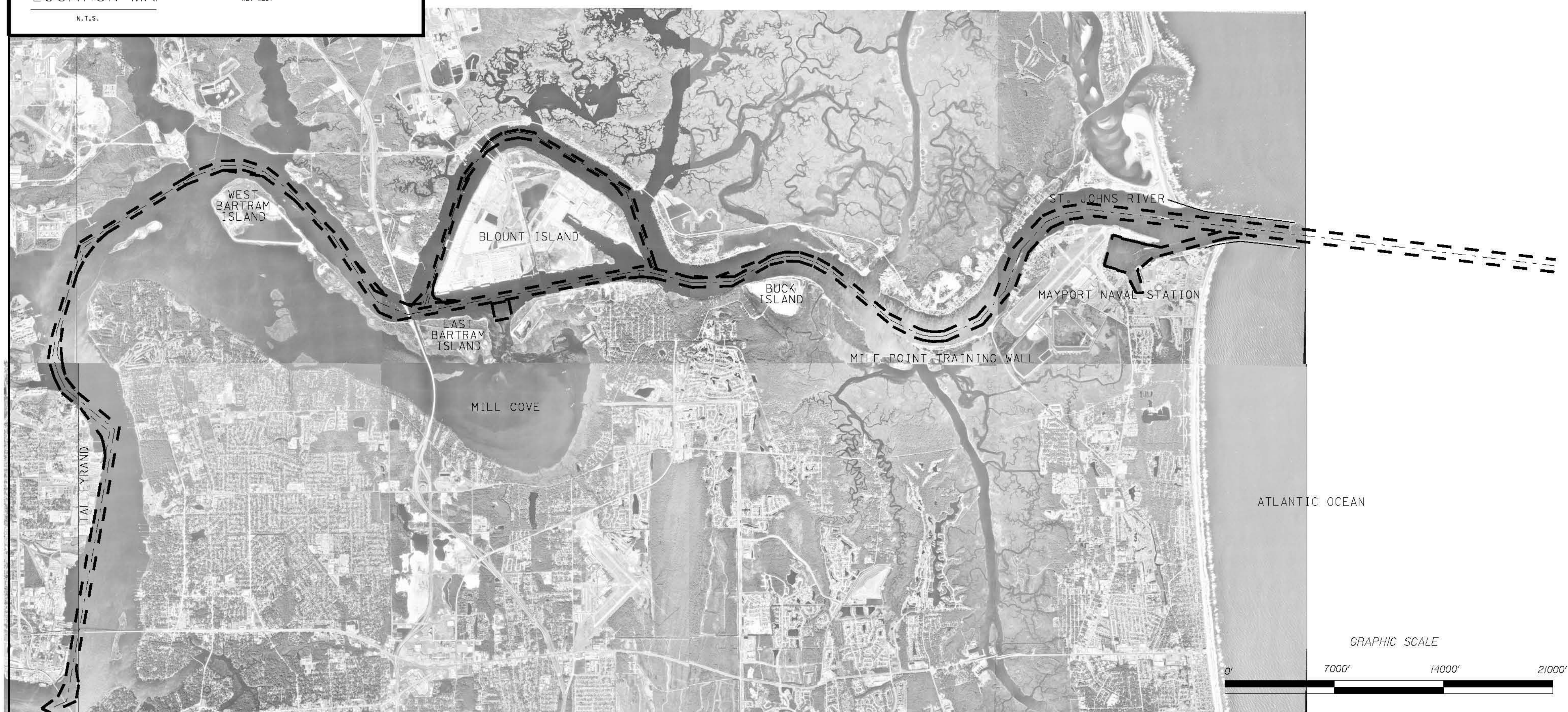
*total required in structure is 26,900 cy including reused material



LOCATION MAP

N.T.S.

JACKSONVILLE HARBOR



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ENGINEERING APPENDIX

JACKSONVILLE HARBOR NAVIGATION STUDY (MILE POINT)
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
PROJECT LOCATION MAP

PLATE
A-1

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JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
PROJECT VICINITY MAP - EXISTING PROJECT

PLATE
A-2

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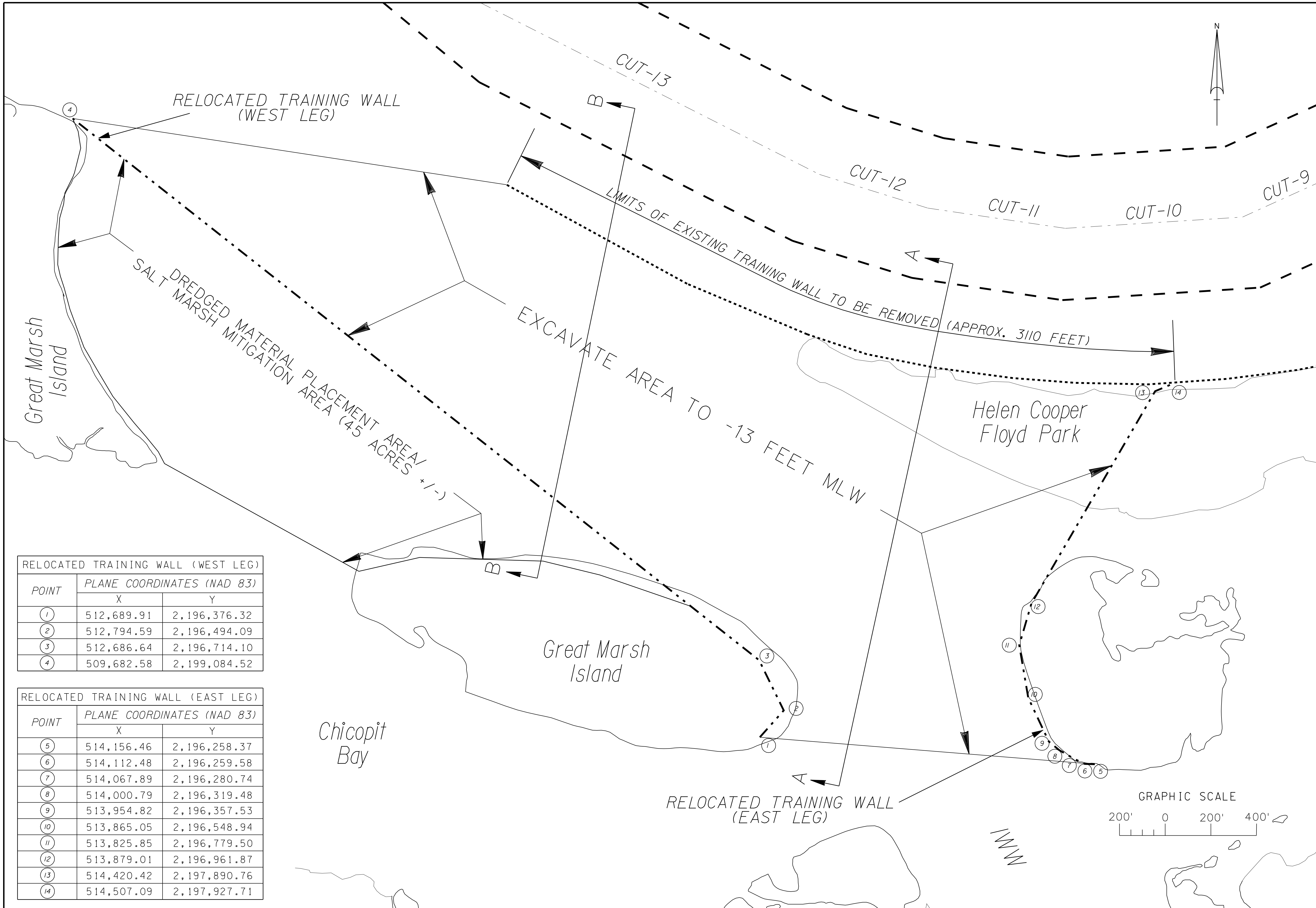
JACKSONVILLE HARBOR NAVIGATION STUDY (MILE POINT)
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
PROJECT VICINITY MAP - RECOMMENDED PLAN

PLATE
A-3



RELOCATED TRAINING WALL (WEST LEG)		
POINT	PLANE COORDINATES (NAD 83)	
	X	Y
1	512,689.91	2,196,376.32
2	512,794.59	2,196,494.09
3	512,686.64	2,196,714.10
4	509,682.58	2,199,084.52

RELOCATED TRAINING WALL (EAST LEG)		
POINT	PLANE COORDINATES (NAD 83)	
	X	Y
5	514,156.46	2,196,258.37
6	514,112.48	2,196,259.58
7	514,067.89	2,196,280.74
8	514,000.79	2,196,319.48
9	513,954.82	2,196,357.53
10	513,865.05	2,196,548.94
11	513,825.85	2,196,779.50
12	513,879.01	2,196,961.87
13	514,420.42	2,197,890.76
14	514,507.09	2,197,927.71

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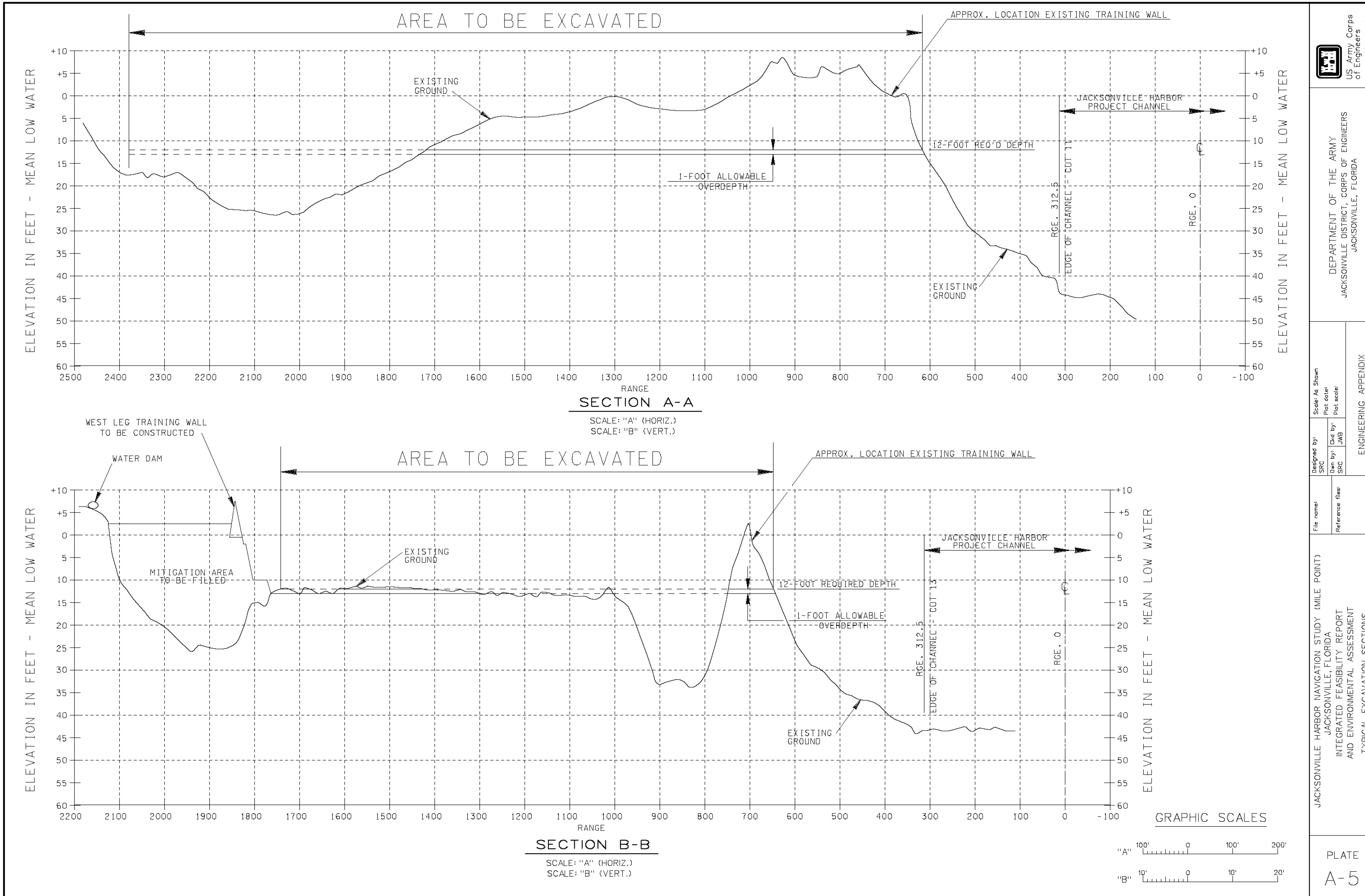
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT

ALTERNATIVE VE-3B - PLAN

PLATE
A-4


AREA TO BE EXCAVATED
APPROX. LOCATION EXISTING TRAINING WALL
EXISTING GROUND
JACKSONVILLE HARBOR PROJECT CHANNEL
12-FOOT REQ'D DEPTH
1-FOOT ALLOWABLE OVERDEPTH
RGE. 312.5
EDGE OF CHANNEL - CUT 11
RGE. 0
ELEVATION IN FEET - MEAN LOW WATER
RANGE
SECTION A-A
SCALE: "A" (HORIZ.)
SCALE: "B" (VERT.)
WEST LEG TRAINING WALL TO BE CONSTRUCTED
WATER DAM
MITIGATION AREA TO BE FILLED
12-FOOT REQUIRED DEPTH
EDGE OF CHANNEL - CUT 13
SECTION B-B
GRAPHIC SCALES
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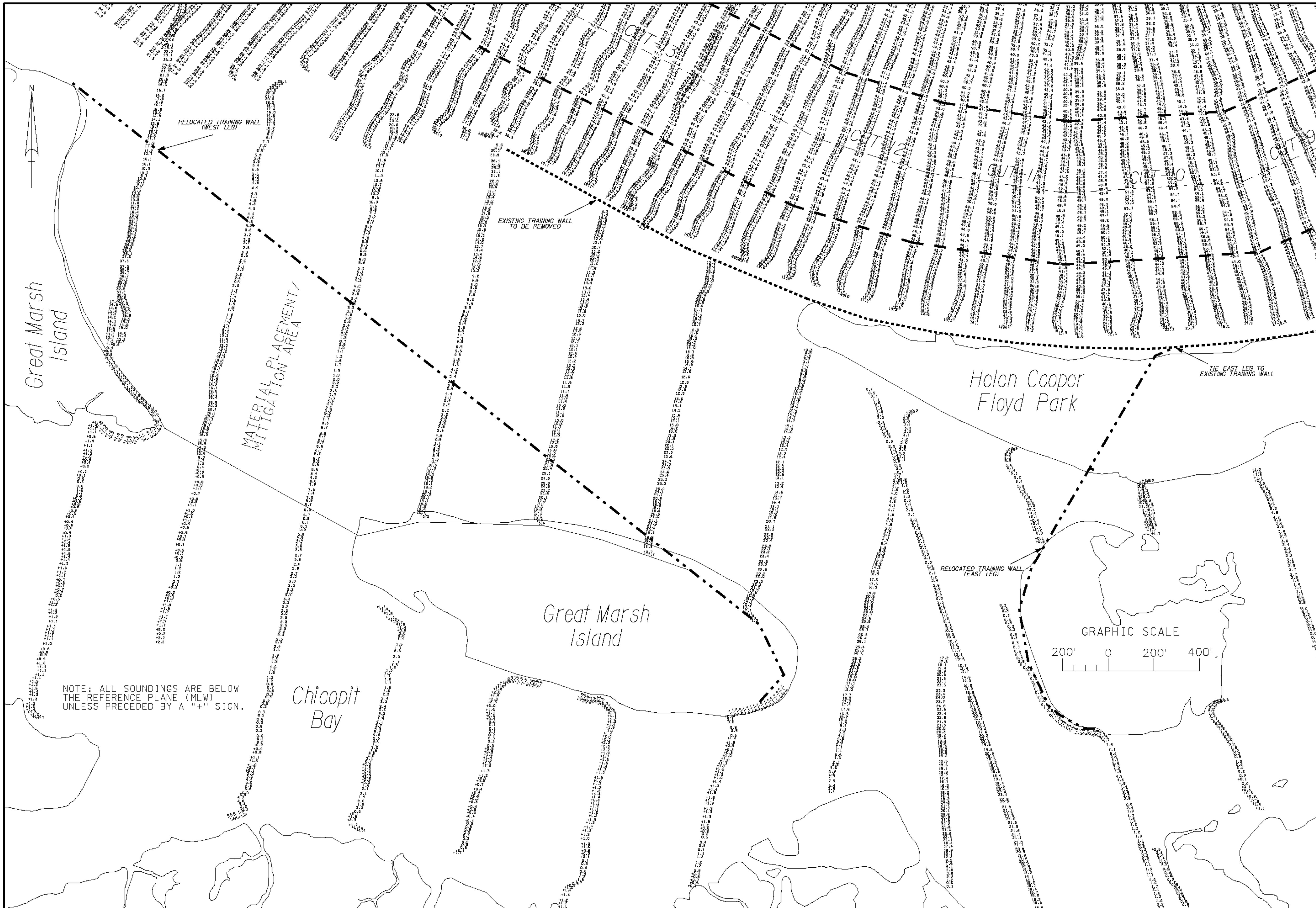
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
TYPICAL EXCAVATION SECTIONS
PLATE
A-5



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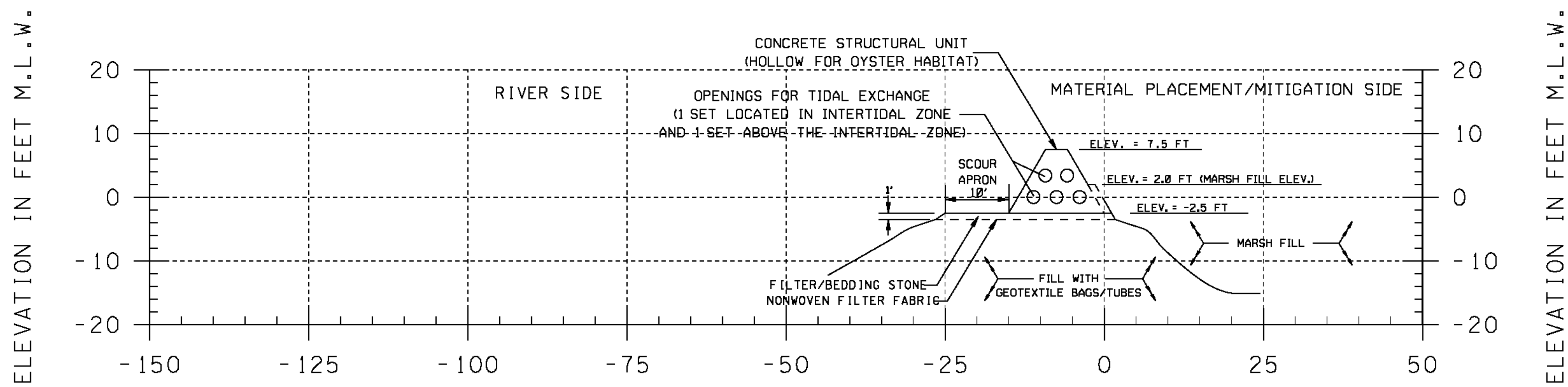
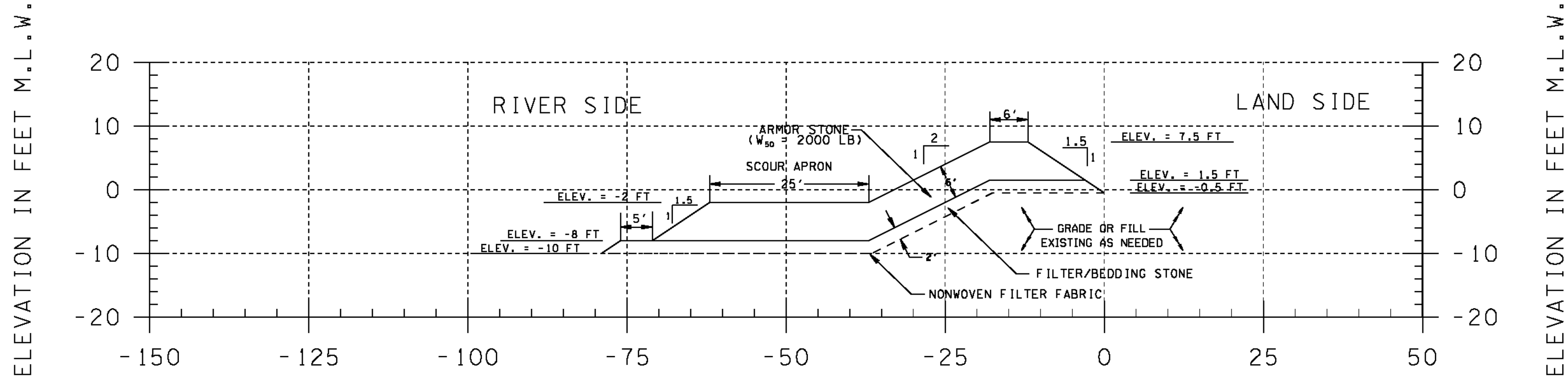
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
ALTERNATIVE VE-3B - BATHYMETRY

PLATE
A-6



WEST LEG TRAINING WALL TYPICAL SECTION



EAST LEG TRAINING WALL TYPICAL SECTION

NOTES:

1. FILTER FABRIC TO EXTEND UP LAND SIDE SLOPE FACE TO ELEV. +5 MLW.
2. FINAL SECTION WILL VARY ALONG ALIGNMENT BASED ON EXISTING CONDITIONS AT TIME OF P&S SURVEY.

GRAPHIC SCALE

10' 5' 0 10' 20'

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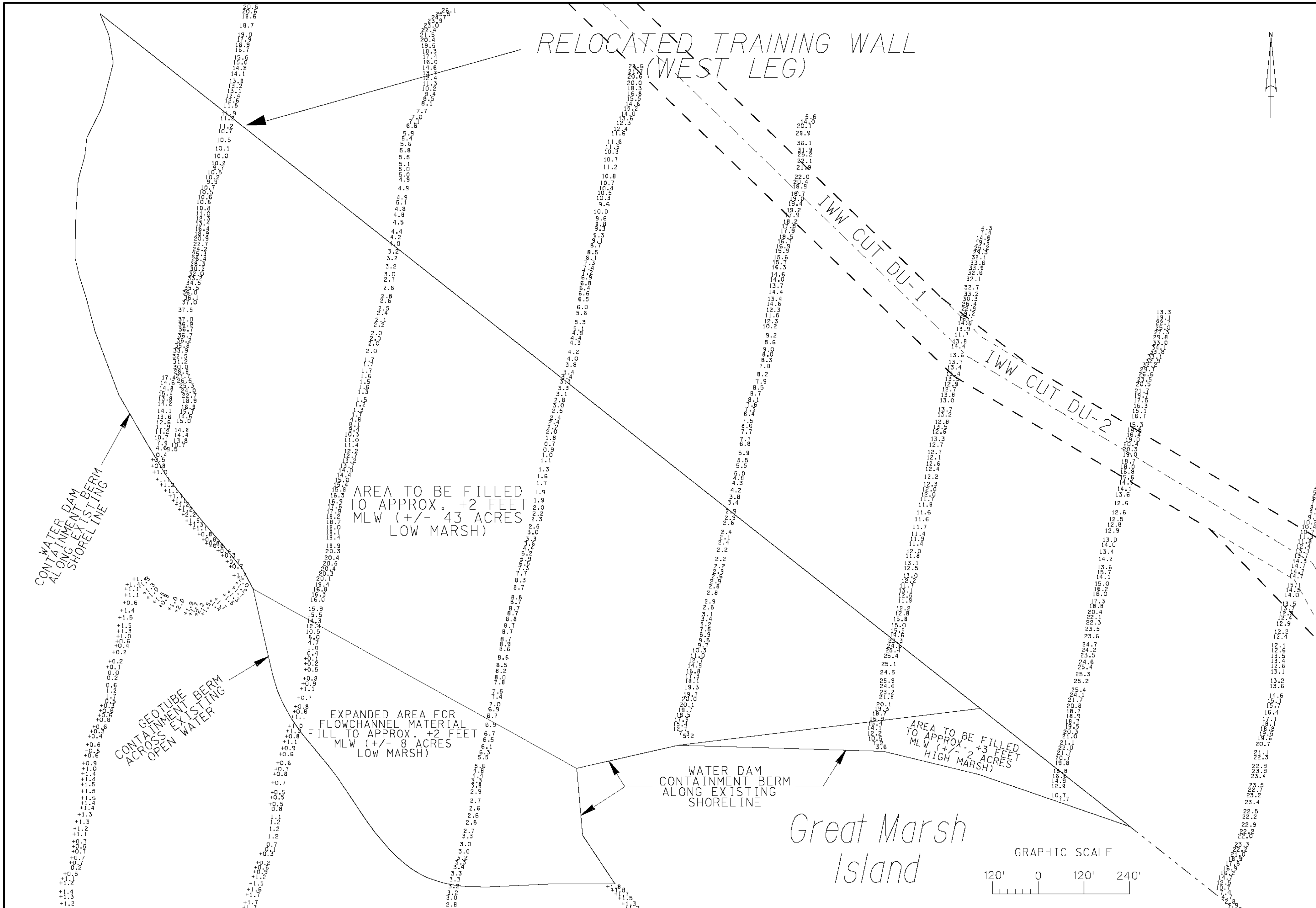
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
RELOCATED TRAINING WALL EAST AND
WEST LEGS TYPICAL SECTIONS

PLATE
A-7



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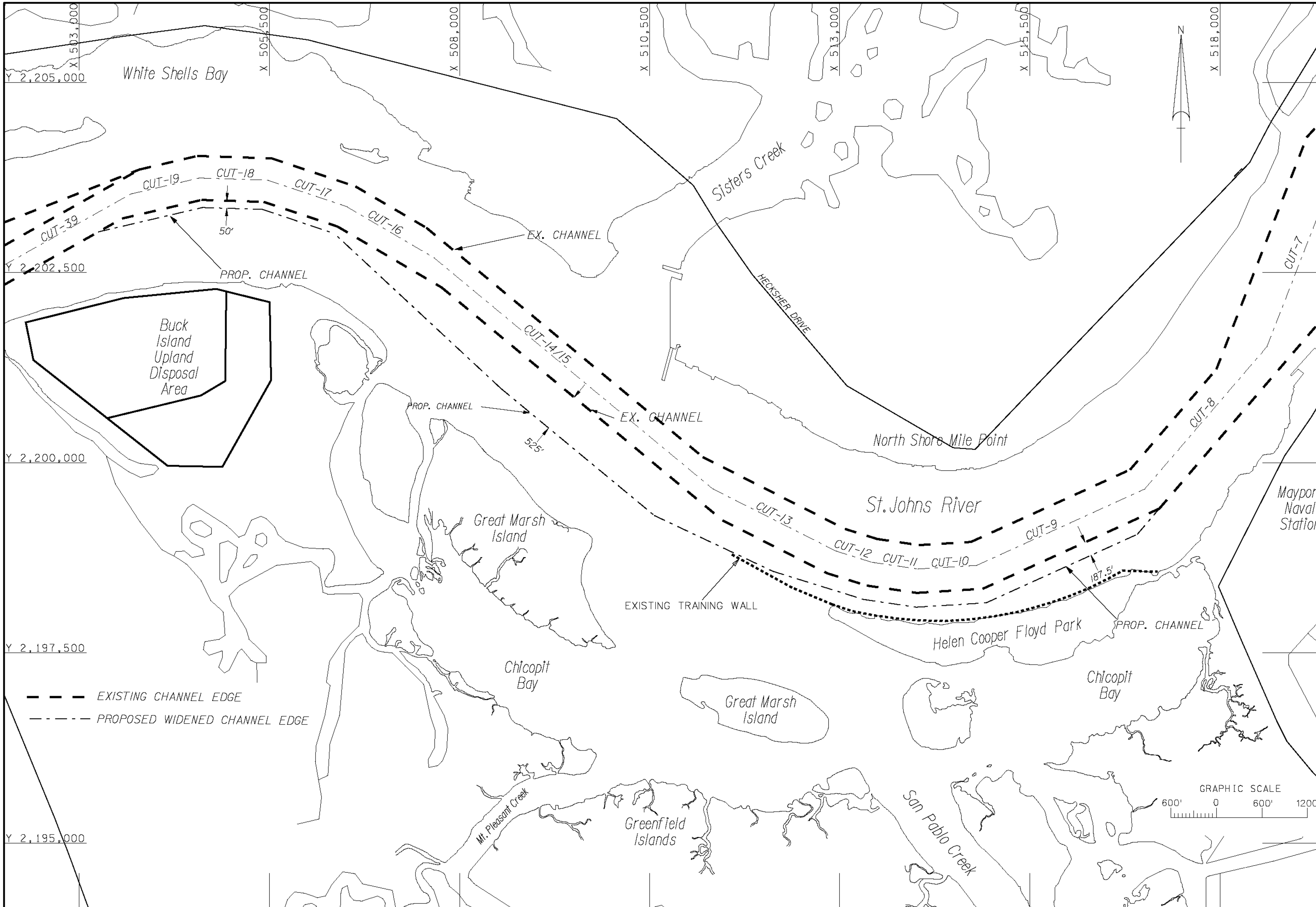
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
MATERIAL PLACEMENT/MITIGATION AREA - SITE PLAN

PLATE
A-8



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ENGINEERING APPENDIX

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JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
ALTERNATIVE 2 - PROPOSED WIDENED CHANNEL PLAN

PLATE
A-9

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ENGINEERING APPENDIX

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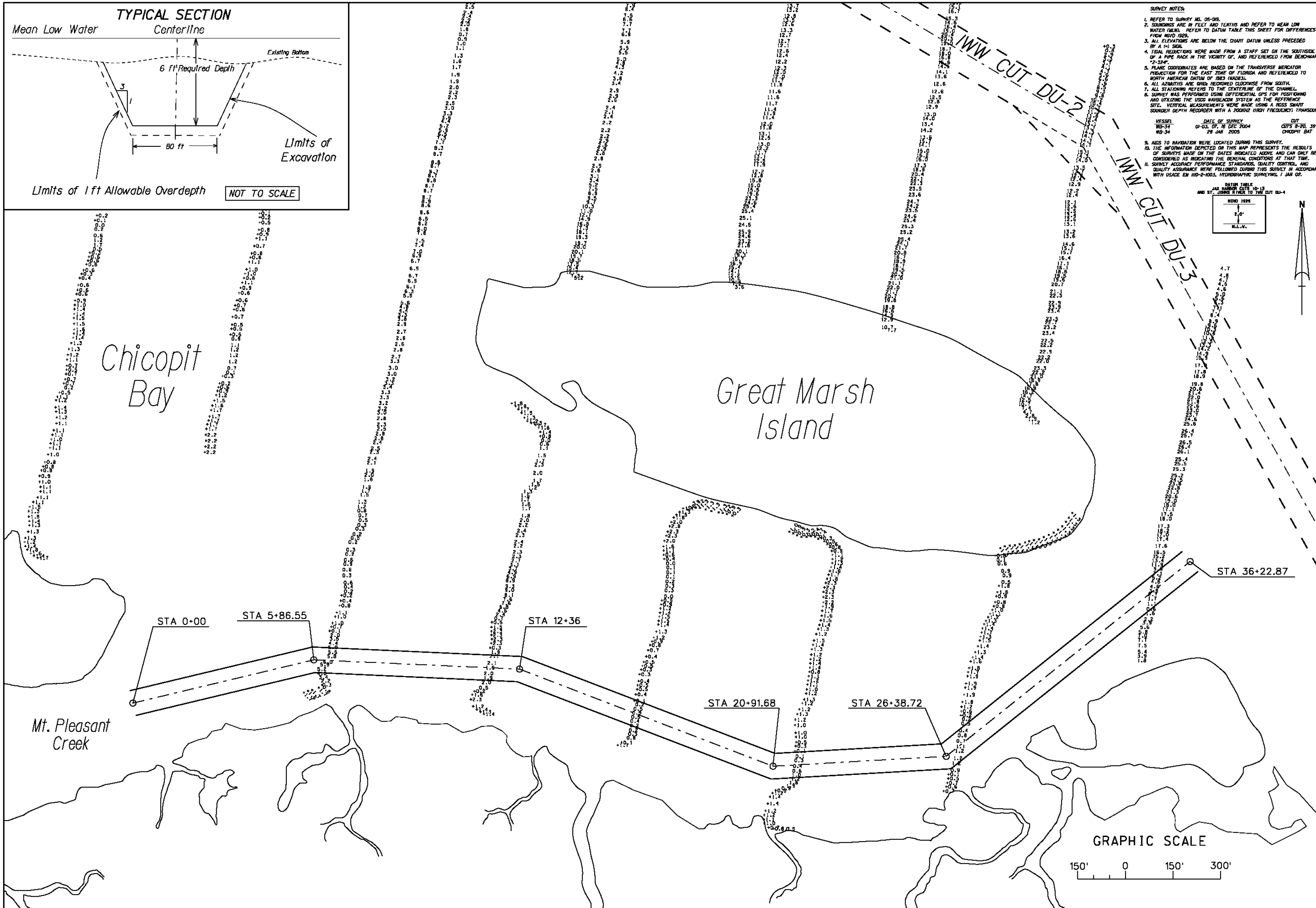
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
PROPOSED FLOW IMPROVEMENT CHANNEL
VICINITY MAP

PLATE
A-10



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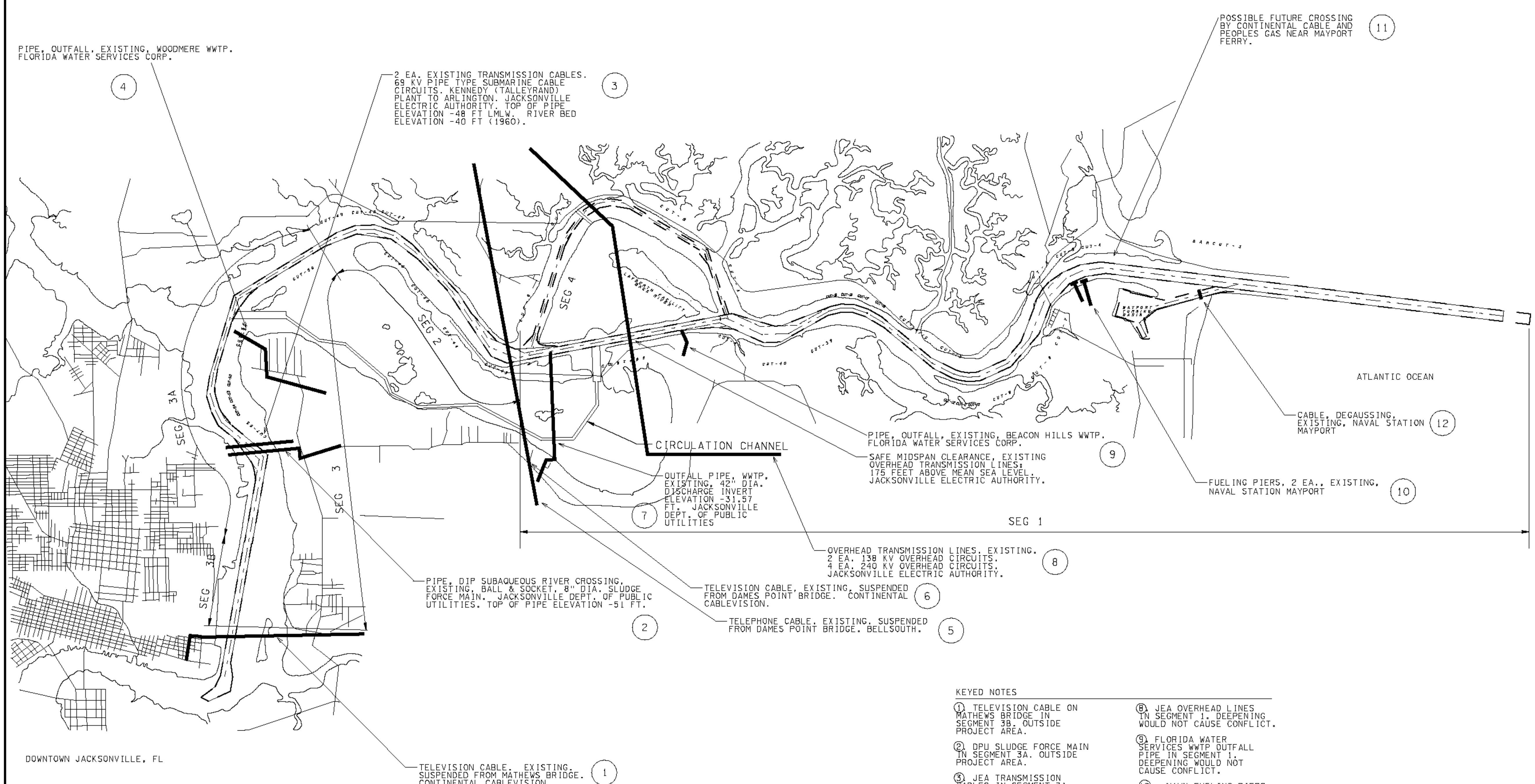
ENGINEERING APPENDIX

JACKSONVILLE HARBOR NAVIGATION STUDY (MILE POINT)
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
PROPOSED FLOW IMPROVEMENT
CHANNEL PLAN AND TYPICAL SECTION

PLATE
A-11



KEYED NOTES

1. TELEVISION CABLE ON MATHEWS BRIDGE IN SEGMENT 3B. OUTSIDE PROJECT AREA.

2. DPU SLUDGE FORCE MAIN IN SEGMENT 3A. OUTSIDE PROJECT AREA.

3. JEA TRANSMISSION CABLES IN SEGMENT 3A. OUTSIDE PROJECT AREA.

4. FLORIDA WATER SERVICES WWTP OUTFALL IN SEGMENT 3A. OUTSIDE PROJECT AREA.

5. BELLSOUTH CABLE IN SEGMENT 1. DEEPENING WOULD NOT CAUSE CONFLICT.

6. CONTINENTAL CABLEVISION LINES IN SEGMENT 1. DEEPENING WOULD NOT CAUSE CONFLICT.

7. DPU WWTP OUTFALL PIPE IN SEGMENT 1. DEEPENING WOULD NOT CAUSE CONFLICT, BUT CIRCULATION CHANNEL CONSTRUCTION WOULD.

8. JEA OVERHEAD LINES IN SEGMENT 1. DEEPENING WOULD NOT CAUSE CONFLICT.

9. FLORIDA WATER SERVICES WWTP OUTFALL PIPE IN SEGMENT 1. DEEPENING WOULD NOT CAUSE CONFLICT.

10. NAVY FUELING PIERS IN SEGMENT 1. DEEPENING WOULD NOT CAUSE CONFLICT.

11. POSSIBLE FUTURE CATV, GAS CROSSING NEAR MAYPORT FERRY IN SEGMENT 1. FUTURE FACILITIES SHOULD BE DESIGNED TO PREVENT CONFLICT.

12. DEGAUSSING EQUIPMENT UNDER BED OF CHANNEL LEADING TO MAYPORT TURNING BASIN. COE STATIONING 37+74.13. NAVAL STATION MAYPORT.

NO SCALE

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ENGINEERING APPENDIX

JACKSONVILLE HARBOR NAVIGATION STUDY (MILE POINT)
JACKSONVILLE, FLORIDA
INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT

UTILITIES PRESENT BY RIVER SEGMENT - 1998

PLATE
A-12

HYDRODYNAMIC MODEL REPORT

ATTACHMENT A

JACKSONVILLE HARBOR (MILE POINT) NAVIGATION STUDY
DUVAL COUNTY, FLORIDA

NUMERICAL HYDRODYNAMIC MODEL

(DRAFT)

1. INTRODUCTION. This report describes the modeling performed to provide recommendations for reducing or relocating the difficult crosscurrents during the ebb flow at the confluence of the St. Johns River with the Intracoastal Waterway (IWW) and the analysis to determine the source of the Mile Point erosion problem. The St. Johns Bar Pilots and the Captain of the Port (USCG) have enacted a restriction which requires vessels with a draft greater than 33 feet to wait on a flood tide before entering or leaving the harbor to avoid the difficult ebb flow currents.

The objectives of the proposed feasibility study involve the use of available information and hydrodynamic modeling to evaluate navigation improvements at the confluence of the Intracoastal Waterway with the St. Johns River along Training Wall Reach and Mile Point Lower Range and Turn of Jacksonville Harbor.

The objectives for the Mile Point navigation study include:

- Identify measures that reduce and/or relocate the difficult and erosive Intracoastal Waterway crosscurrents so that the St. Johns Bar Pilots and the Captain of the Port (USCG) agree to remove restrictions on deep draft navigation traffic;

- Determine the cause of the catastrophic shoreline failures at Mile Point; and

- Evaluate the hydrodynamic effects of the measures.

2. LOCATION. Mile Point is located in Duval County, Florida. It consists of about 5000 feet of shoreline located along the north shore of the St. Johns River and east of the IWW.

3. BACKGROUND. Heckscher Drive Community Club (HDCC) homeowners requested that the Corps determine the cause for the loss of land along the Mile Point shoreline. A meeting with the St. Johns Bar Pilot's Association highlighted the difficult and intense nature of the crosscurrents at the confluence of the St. Johns River with Sisters Creek to the north and Pablo Creek to the south. According to the St. Johns Bar pilots, the area of the river where the IWW crosses the St. Johns River produces currents that can actually turn an inbound and under powered ship around. The U.S. Coast Guard describes that area as one of particular concern. It describes the junction of the IWW with the St. Johns River as subject to strong and unpredictable crosscurrents at various stages of tide.

To avoid those difficult ebb flow crosscurrents, the St. Johns Bar Pilots and the Captain of the Port have enacted a restriction which requires vessels with a draft greater than 32 feet to wait on a flood tide before entering or leaving the harbor. The sponsor, the Jacksonville Port Authority, has requested the Corps to recommend measures that will allow the St. Johns Bar Pilots and the Captain of the Port to remove those restrictions.

A House Resolution, adopted March 1998 for Mile Point, Florida, authorized the Secretary of the Army to conduct a study at Jacksonville Harbor, Florida Federal navigation project to determine whether any modifications are advisable at this time with particular reference to erosion of Mile Point shoreline. Congress added funding in the appropriations for Fiscal Year (FY) 2000 to begin the reconnaissance study. The feasibility study proceeded under that authorization.

4. Modeling. Model simulation of existing and modified or proposed conditions at Mile Point is a design process. Ship simulation of wind and current characteristics were performed by the Engineering Research and Development Center (ERDC) at Vicksburg for the proposed alternatives. SAJ constructed and applied 2-D and 3-D TABS models of the area. The 2-D model, originally developed by Resource Management Association, known as RMA-2 was used to evaluate various modifications to the jetties. The 3-D TABS model known as RMA-10 was also used. The SAJ models were used to develop water current (both magnitude and direction) output for existing condition and the proposed alternatives. Flow fields under tidal ebb and flood conditions were developed for each alternative. Problems addressed in the model include the alternatives discussed in the following section. The Water Resources Branch coordinated with the St. John's Bar Pilots, the Captain of the Harbor Pilots and the Coast Guard to estimate the desired velocity reductions of the ebb tide currents that would allow for the removal of the navigation restrictions in place.

Mile Point alternatives were evaluated using a St. Johns River circulation model extending from the ocean boundary near Mayport, Florida to Palatka, Florida (Figure 1). An existing 2-D model was expanded to 3-D using multiple horizontal layers. The 3-D model (Figure 2) extended from Mayport to Blount Island, approximately eight miles upstream of Mile Point. The 2-D model was expanded to adequately represent the storage volumes of the Intracoastal Waterway north and south of the St. Johns River. The existing conditions model was verified with existing flow data and computed tidal stages. The average net flow (4475 cfs) for the St. Johns River at Buffalo Bluff was used in the 2-D model. The Advanced Circulation model (ADCIRC) of the St. Johns River, developed by Taylor Engineering, Inc., was used to corroborate the attainment of good hydrodynamic results by the RMA-2 model. The qualitative effect that each practical alternative will have on shoaling in the main channel was determined.

Identified alternatives to address the ebb tide navigation restrictions within the Federal channel are:

1. Construct a groin field with groins extending from Mile Point north shoreline towards the Federal channel. Assume 6 groins about 150 feet long and 15 feet wide at the top spaced about 420 feet apart.
2. Construct a submerged weir across the IWW from the Mile Point Training Wall to the Great Marsh Island.
3. Hydrodynamically model the Mile Point (Little Jetties) Training Wall at its current condition and its original design length.
4. Short Cut Turn Widener and 150 ft Training Wall Reach Widening.
5. Open the landward end of the Mile Point Training Wall to restore flow back through Chicopit Bay. Past hydrodynamic model testing involved two different opening widths, one 6 feet deep by 150 feet wide and the other 6 feet deep by 350 feet wide.
6. Hydrodynamically model the current condition of White Shells Training Wall opposite Back Island along north shoreline and its original design dimensions.
7. Relocate Mile Point Training Wall.

Investigations took place to try to determine to what extent existing Federal navigation improvements, actions by others, and natural conditions are responsible for the current shoreline erosion problems:

1. Mile Point. Investigate the erosion of the north shoreline.
2. White Shells Training Wall. Investigate the erosion, deterioration, overtopping and breakthroughs at the training wall.
3. Ward's Bank Training Wall. Investigate the erosion and deterioration of the training wall near the carrier basin at the U.S. Naval Station Mayport.
4. Huguenot Park. Investigate shoreline erosion near the landward end of the north jetty.
5. Investigate the erosion potential at Chicopit Bay caused by the proposed shoreline restoration at Mile Point.

Project alternatives were evaluated and compared with existing condition runs. Channel current profiles of direction and velocity at 1-meter intervals were made using an Acoustic Doppler Current Profiler (ADCP). ADCP data during spring tide are available for March 21, 2000 and new data were collected on October 27, 2004.

There is a substantial amount of available recent (2003) bathymetric data. Survey data was presented in a digital format compatible with CADD. The project vertical datum is mean low water (MLW) and the horizontal datum is North American Datum 1983 (NAD 83). All surveys were done in feet.

(a) 1998 hydrographic surveys on Jacksonville Harbor indicated depths of 38 to 40 feet in the St. Johns River area over a bottom width of 500 to 650 feet.

(b) New bank to bank surveys (2003) were performed to cover the same area as 1998 surveys plus an additional 1 mile upstream and downstream. In addition, surveys were also performed to cover ½ mile up the Atlantic Intracoastal Waterway.

4.1. 2-D Modeling Approach and Data.

In this study the changes in current velocities of the proposed plans were tested using a two-dimensional hydrodynamic model. The hydrodynamic model used in this study employs the Galerkin finite element formulation to solve the vertically averaged Reynolds form of the Navier-Stokes equations with hydrostatic assumption applied. These equations are commonly known as the vertically integrated shallow water equations. The hydrodynamic model, known as RMA2-WES was originally written by Dr. Ian King and William Norton of Resource Management Associates (RMA) in Lafayette, California, under contract to the U.S. Army Corps of Engineers (USACE). The model is maintained and has been enhanced by personnel of the USACE Waterways Experiment Station (WES) in Vicksburg, Mississippi. The version used in this study was RMA2-WES 4.35.

The numerical model RMA2-WES was chosen for this study for several reasons. First, the finite element method permits the modeler to develop an unstructured mesh to define the channel geometry. The lower St. Johns River has many tributaries and secondary channels that are difficult to discretize in the sense of a structured, index based grid. The finite element method uses freely connected three-sided and four-sided elements that are knitted together by means of an element connection table, thus permitting the modeler more flexibility to resolve important geometric features that may be required to accurately compute the flow field. Second, a vertically averaged description of the hydrodynamics was sufficient to answer the questions that were posed concerning the relative impacts of the engineering alternatives on cross currents in the navigation channel at Mile Point. Third, RMA2-WES has been successfully applied to a variety of estuarine and riverine modeling studies conducted by the USACE.

The alternatives for the Jacksonville Harbor at Mile Point were compared against a base simulation of the existing conditions. The St. Johns River Mesh was built using data from a variety of sources. The bathymetric data used to generate most of the numerical mesh were digitized from the National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, National Ocean Survey (NOS) Nautical Chart No. 11491 and NOS Chart No. 11492. The bathymetry of the navigation channel was obtained from the most recent hydrographic surveys available at the Jacksonville District.

The mesh for the existing (base) condition (Figure 3) has 8,999 elements and 24,873 nodes. The depths in reference to the mean low water (MLW), range from -8 ft (= elevation of +8 ft MLW) on the training walls to 83 ft between the jetties. Maximum depths at the offshore boundary are near 80 ft. Most of the navigation channel is 40 ft deep, except for the Blount Island Channel which is 30 ft, and the Terminal Channel to Drummond Creek Range with depths varying from 34 to 38 ft. The rest of the mesh from Jacksonville to Buffalo Bluff is 15 ft deep and is composed of one-dimensional elements. More resolution was added to the navigation channel and adjacent areas around Mile Point than the rest of the grid to decrease errors within the study area. The average surface area of individual elements in the navigation channel at Mile Point is about 30,000 ft^2.

The modeled hydrodynamic boundary conditions were the same for the base and the proposed alternatives. The water discharge into the system was constant. The stream discharge applied in the St. Johns River at Buffalo Bluff was 4475 cfs, the historical mean.

The offshore boundary was defined to be 12 miles away from the coastline and extended 9 miles north and south of the St. Johns River entrance. The boundary condition was applied only on the north and south edge and consisted of a dynamically varying water surface elevation that represents the tidal fluctuations at sea. The tide selected for the runs was the spring tide of 21 March 2000. A period of large tidal range was chosen in order to provide the strongest currents for the ship simulator tests. The period of the initial simulation was 144 hrs, starting 0000 hr on 16 March 2000, which allowed the model to stabilize before the occurrence of the spring tide. This practice is commonly referred to as model spin up. The 144 hrs were divided into 15 minutes time steps. The predicted tide data was obtained from published records by NOAA NOS for the gages located at the Nassau River entrance and Jacksonville Beach (Figure 4).

4.2. 2-D Hydrodynamic Model Verification

The parameters available to adjust the model are channel bed roughness and eddy viscosity. The roughness is controlled by assignment of the Manning's *n* coefficient values. The assignment of the coefficient values is accomplished by associating a material type with each of the element in the mesh. Several different material types can be defined to describe the different physiographic regions of the estuary. For this model, the material types represent either regions of a specific range of depth or an obstruction to the natural flow of the water. A Manning's n coefficient value of 0.025 was assigned to most of the mesh, except near the top of the training wall. The top of the jetty is hydraulically much rougher than the rest of the model domain, so it was assigned a value of 0.20.

The eddy viscosity or turbulent exchange coefficient E describes the degree to which small scale turbulent flow features dissipate energy in the flow field. A high eddy viscosity coefficient indicates high levels of turbulent energy dissipation. This parameter accounts for small scale flow features that are not specifically resolved by the numerical mesh. Therefore, the value of eddy viscosity is a function of both the local flow field and the local grid size. As a rule of thumb, eddy viscosity is often assigned according to a grid Peclet number criterion. The grid Peclet number is defined as[1]:

$$P = (\rho V \Delta x)/E_{ij}$$

where

ρ = density, slugs/ft^3

V = velocity along a particular streamline, ft/s

Δx = mesh spacing, ft

E_{ij} = eddy viscosity where i is momentum turbulent exchange in j-direction, lbf•s/ft^2

A Peclet number less than 50 is desirable for numerical stability. By fixing the value of Peclet numbers, eddy viscosities were calculated automatically by the model. A Peclet value of 30 was assigned to greater part of the mesh, 40 was assigned to shallow marsh areas, and values of 70 and 100 were assigned to the jetty to compensate for the numerical instability created by the rapid change in the velocity of water passing over the structure.

To verify the hydrodynamic model, the results were compared to prototype data collected by ERDC personnel. The prototype data available include flow discharge and velocity profiles at several cross sections or ranges during an average time of ten hours. There are data available for nine ranges during 21 March 2000. Also, the water surface elevation was measured around Mile Point during the same period. The spin up time of the model was approximately five days; therefore, real time comparison between the model and the prototype was made for the sixth day of simulation which corresponds to 21 March 2000 (spring tide).

Tide fluctuations from the model and prototype at Mile Point are compared in Figure 5. The shape and the range of the tidal wave of the model is a satisfactory match to the prototype. The water surface in the model at Mile Point is lower than the prototype by approximately 0.7 ft; the reason for the difference being that the model boundary condition was developed using predicted tide data instead of the actual measurement. The actual tide is influenced by winds inducing varying effects that depend upon the speed, duration, and direction of the wind field. Therefore, the effect of winds was not accounted for in the simulation model. Wind effects were omitted because the objective of this study was to compare the impacts of the proposed alternative plans on tidal currents in the navigation channel. By choosing one wind field for simulation it is possible that the effects of the alternatives on the tidal currents could be obscured because wind effects are actually transient in nature.

During spring tide, prototype flow data were collected at nine locations (Figure 6). Flow discharges from the model and prototype are presented in figures 7, 8, and 9 for the St. Johns River at Mile Point, Pablo Creek, and Sisters Creek, respectively. In general, maximum flows were reproduced and the shape of the flow discharge curves is similar between prototype and model. The timing of the flows at Sisters Creek was one aspect of the calibration where the results were less than optimal; the modeled discharge curve seems to lag the prototype by approximately half hour. The difference can be attributed by the simplification of the river geometry for numerical simulation. In particular, the expansive tidal marshes on the north side of the river, contiguous to Sisters Creek, were schematized for the purpose of this simulation. These marshes have a marked, if unknown, effect on the timing of the tide as it propagates through the system. As expected, the velocities in the model were consistent with a depth-averaged value of the velocities measured in the prototype.

4.3. Results from Modeled Alternatives (2-D)

1) Groin field consisting of groins extending from Mile Point north shoreline towards the Federal channel – Six groins about 150 feet long and 15 feet wide at the top spaced about 420 feet apart were introduced in the model (Figure 10). The groin field was effective at reducing the currents adjacent to the north Mile Point shoreline, but no significant reduction of cross currents within the navigation channel was observed.

2) Submerged Weir – A submerged weir with a crest elevation of -14.0 ft, MLLW, was located to connect the tip of the Mile Point training wall with Great Marsh Island (Figure 11). The purpose of the weir was to reduce the outflow rate from Pablo Creek during ebb. As expected, 2D modeling results showed no significant effects on cross currents within the navigation channel. The proposed crest elevation is the highest it can be without impairing navigation, but is not high enough to limit tidal flow.

3) Rebuild Mile Point Training wall (Figure 12) – The existing training wall has subsided and now has several sections permanently under water. Rebuilding the wall was considered as an alternative since the flow of water over the structure was thought to be contributing to cross currents within the navigation channel. Modeling of this alternative resulted in no

significant impact to cross currents. The ADCP survey measured a maximum flow of approximately 1,500 cfs over the training wall, less than five percent of the maximum ebb flow measured out of Pablo Creek.

4) 150 ft Training Wall Reach Widening (Figure 12) – Widening of the navigation channel in the reach just upstream from the junction of Pablo Creek with the main St. Johns River was considered to reduce the intensity of the currents and add more space to improve navigation maneuverability. Since the adjacent area to be incorporated to the navigation channel is already relatively deep, the insignificant changes to the magnitude of the currents that were detected in the 2D model are not surprising.

5) Short Cut Turn Widener + 150 ft Training Wall Reach Widening (Figure 12) – Short Cut Turn is located just upstream from Training Wall Reach. Extending the proposed 150 ft widener further north into the turn did not provide significant changes to the magnitude of the currents.

6) Rebuild White Shells Training Wall opposite Buck Island along north shoreline to its original design dimensions (Figure 12) – No significant changes to the currents within the navigation channel were observed after rebuilding the training wall.

7) Eastern Chicopit Bay Diversion (Figure 13) – A canal was proposed to redirect flow to the east through Chicopit Bay. Currently the cross currents in the navigation channel are produced by the ebb flow from Pablo creek entering the main navigational channel perpendicularly. The purpose of the diversion is to reduce the magnitude of the existing cross currents by reducing the amount of ebb flow at that particular location. Various canal sizes were tested up to a depth of 30 feet and a bottom width of 200 feet. This configuration reduced the amount of ebb flow by approximately fifty percent, but the magnitude of the cross currents inside the navigation channel was reduced by less than twenty five percent. The angle of the cross currents did not change significantly.

   The construction of such a large diversion canal in an environmentally sensitive area and the additional cost of having to build a bridge to maintain access to the existing park without obtaining significant relief from cross currents makes this alternative impractical.

8) Relocate Mile Point Training Wall – Reconfiguration of the intersection of Pablo Creek with the St. Johns River was performed by relocating the Mile Point Training Wall as presented in Figure14. Ebb flow from Pablo Creek is currently concentrated at the tip of the Mile Point jetty and enters the main St. Johns River navigation channel perpendicular to the main flow

direction. The purpose of the training wall relocation is to redistribute the ebb flow to intersect the main navigation channel further east where the currents will be parallel to the channel.

Modeling of this alternative demonstrated a significant change in the distribution and direction of the currents within the navigation channel. Cross currents were completely eliminated inside the navigation channel during maximum ebb. The ebb currents along the bendway followed a trajectory parallel to the navigation channel. Flood currents did not seem to be negatively affected by the new configuration of the training wall. The magnitude of the currents remained similar to existing conditions.

4.4. 3-D Model Results

A 3-D model was developed to validate the only alternative found to be effective at reducing cross currents, the relocation of the training wall at Mile Point.

The 3-D numerical hydrodynamic model used in this project is known as RMA10-WES. The model was originally developed under contract to Waterways Experiment Station, now known as ERDC, by Dr. Ian King of Resource management Associates of Suisun City, CA. The version known as RMA10-WES has been modified significantly by ERDC personnel. A summary of technical specifications of the model is given:

a) Galerkin finite element formulation;
b) Unstructured mesh composed of bricks, tetrahedral elements, prism, and pyramids in 3-D, triangles and quadrilaterals in 2-D (horizontal averaging or vertical averaging), and line elements in 1-D;
c) Mixed interpolation scheme for pressures and velocities (linear and quadratic);
d) Z – based vertical coordinate transform;
e) Governing equations of the nonlinear Reynolds Form of the Navier-Stokes equations, including baroclinic forcing, wind forcing, tidal forcing, Coriolis effect, and bed friction;
f) Three-dimensional, two-dimensional vertically averaged, two dimensional laterally averaged, and one-dimensional approximations within the same numerical mesh;
g) Time integration via an implicit Crank-Nicholson finite difference operator;
h) Eddy viscosity formulation for horizontal turbulence closure;
i) Mellor-Yamada Level 2 vertical turbulence closure model;
j) Non-linear acceleration and friction terms for the governing equations;

k) Newton-Raphson iteration for the solution of the non-linear system of equations;
l) Frontal solver for the solution of the matrix equations; and
m) Two algorithms available for wetting and drying of 2-D vertically averaged elements.

The numerical mesh used for the 3-D model was cropped from the 2-D model (Figure 2). A reduced horizontal domain was necessary to accommodate additional horizontal layers (elements) without demanding extraordinary computing capacity. The 3-D mesh consisted of 51,580 nodes and 18,785 elements evenly distributed among five horizontal layers. Differing from the dynamic 2-D modeling approach, the 3-D modeling of the tentatively selected alternative was performed in steady state using flows and stages obtained from the 2-D Model as boundary conditions. The boundary inflows during maximum ebb were: 160,000 cfs, 44,000 cfs, and 25,000 cfs at St. Johns Bluff, Pablo Creek, and Sisters Creek, respectively.

The results obtained from the 3-D model confirmed the effectiveness of relocating the training wall at Mile Point. As with the 2-D model, this alternative shows a significant change in the distribution and direction of the currents within the navigation channel (figures 15 through 18). Cross currents were completely eliminated inside the navigation channel during maximum ebb and the ebb currents along the bendway follow a trajectory parallel to the navigation channel. Flood currents in the navigational channel were not negatively affected by the new configuration of the training wall. As shown in figures 19 and 20 the relocation of the training wall will rearrange the flow field at the intersection of St. Johns River with Pablo Creek. Stronger currents in the IWW will shift towards the east, following the new training wall. Therefore, the IWW navigational channel may have to be slightly relocated to accommodate new channel depths.

5. Erosion

There are four shoreline locations along the St. Johns River where erosion is occurring.

5.1. Mile Point

The Intracoastal Waterway or Florida East Coast Canal (FECC) started as a private waterway 5-foot deep and 50-foot wide from the St. Johns River to Miami that was completed in 1912. The dimensions of the project were never effectively maintained, resulting in traffic of vessels having less that 4-foot draft. The Canal was transferred to the United States by local interests and the Corps of Engineers completed construction of an 8-foot deep, 100-foot wide waterway in 1935. Up to that point hydrographic surveys and maps of the area (Figure 21), when compared to surveys and maps dating back to 1910, show a stable sand bar at Mile Point and no significant changes or evidence of erosion at Great Marsh Island. The sand bar at Mile Point is a typical feature in riverine morphology. Sand bars are usually formed on the inside bank of a river bend as slow water velocities tend to deposit sediment material transported by river currents. A deeper channel is naturally maintained on the outside of the river bend where high velocities tend to concentrate. Other than the construction of the FECC, the only significant modification of the River was the Mile Point Training Wall, which was constructed prior to 1910.

A hydrographic survey dated 1965 shows degradation of the submerged portion of the sand bar at Mile Point. Also, aerials at the time (Figure 22) show a considerable expansion of the channel between the west end of the Mile Point Training Wall and Great March Island. The entire expansion was caused by the extraordinary erosion of a portion of Great Marsh Island's north shoreline adjacent to the training wall. The erosion of Great Marsh Island's north shore continued until a breakthrough of the island (Figure 23) occurred in the late 1990's causing shoaling that prevented access to Mt. Pleasant and Greenfield Creeks. Although erosion of the submerged sand bar at Mile Point started earlier, erosion of the sandy beach began to be noticed by local residents in the late 1960's. The beach vanished and erosion continued producing five slope failures over a fifteen year period between 1986 and 2000. Currently there is a scour area up to 60 feet deep north of the navigational channel at Mile Point Lower Range and Turn; depths in the channel are only about 42 feet. Depths between 30 to 40 feet can be found within 40 to 50 feet of the Mile Point north shoreline in some areas.

5.2. Other Erosion Sites

White Shells Training Wall (Figure 24) deteriorated through the years to the point where overtopping and multiple breakthroughs occurred. The basin behind the training wall had experienced sedimentation as a result of being isolated from the St. Johns River on the south by the training wall and the disposal of dredged material, and from Cedar Point and Hannah Mills Creeks on the north by the construction of Heckscher Drive in the late 1920's. The location of the White Shells Training Wall shares similar conditions experienced at the location of the Mile Point Training Wall, which has experienced similar deterioration and had to be restored in the past. Both structures are exposed to a differential in water pressure and the resulting flow infiltration produced by holding water from both sides twice every day as a result of tidal fluctuations.

The erosion and deterioration of the Ward's Bank Training Wall near the carrier basin at the U.S. Naval Station at Mayport and the erosion of the north shoreline at Huguenot Park near the landward end of the north jetty is caused by the estuarine tidal dynamics (Figure 25). The change in the soil pore pressure caused by the constant and significant tidal stage fluctuation at the river entrance debilitates the river banks.

These three sites are particularly susceptible to erosion since they were artificially filled in and their soils have not been naturally consolidated as in other areas of the river. All the eroding sites were under water during the beginning of last century (Figure 26). Also, the White Shells Training Wall and the north shoreline at Huguenot Park are located on the outside bank of the river bend where erosive currents tend concentrate.

5.3. Effects of Relocating the Training Wall at Mile Point

A natural shift of the Intracoastal Waterway at the entrance to Pablo Creek will be expected as a result of the realignment of the training wall. Lower water velocities will increase opportunities for sedimentation on the western side of the entrance while higher velocities at the east have the potential to erode and undermine the location of the new training wall (Figures 20 and 21). Significant armoring and scour protection will be utilized for this training wall.

It is anticipated that the new realignment of the Mile Point training Wall will produce flows coming out of the IWW from the south that are more aligned with the Federal navigational channel. This should cause a drop in water velocity in the areas north of the navigational channel at Mile Point, as seen in Figures 19 and 20. We anticipate that this will slow the progressive erosion that has been occurring at the north bank of Mile Point.

No shoaling of the Jacksonville Harbor navigational channel is expected.

6. Conclusions

The U.S. Army Corps of Engineers, Jacksonville District performed numerical modeling of various proposed alternatives to reduce cross currents within the Jacksonville Harbor navigational channel at Mile Point. The cross currents are produced by perpendicular intersection of the Intracoastal Waterway with the St. Johns River at Pablo Creek. Only one alternative, the relocation of the training wall at Mile Point, proved to be effective at reducing the cross currents by realigning ebb flows from Pablo Creek making them parallel to the navigational channel.

A slight eastern shift of the Intracoastal Waterway entrance at Pablo Creek is expected as a result of sedimentation and erosion caused by a change in local currents.

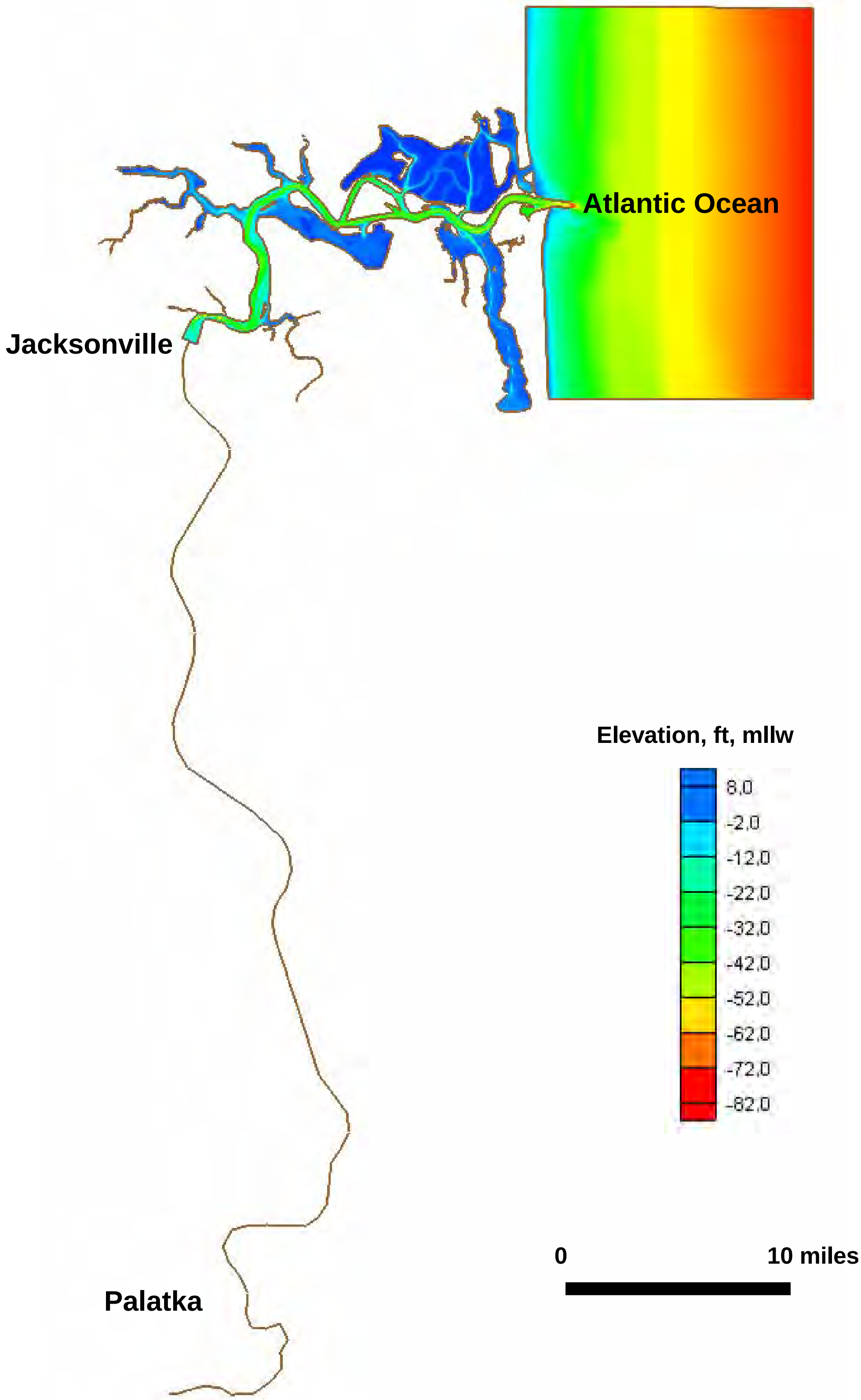


Figure 1. St. Johns River, 2D Hydrodynamic Model

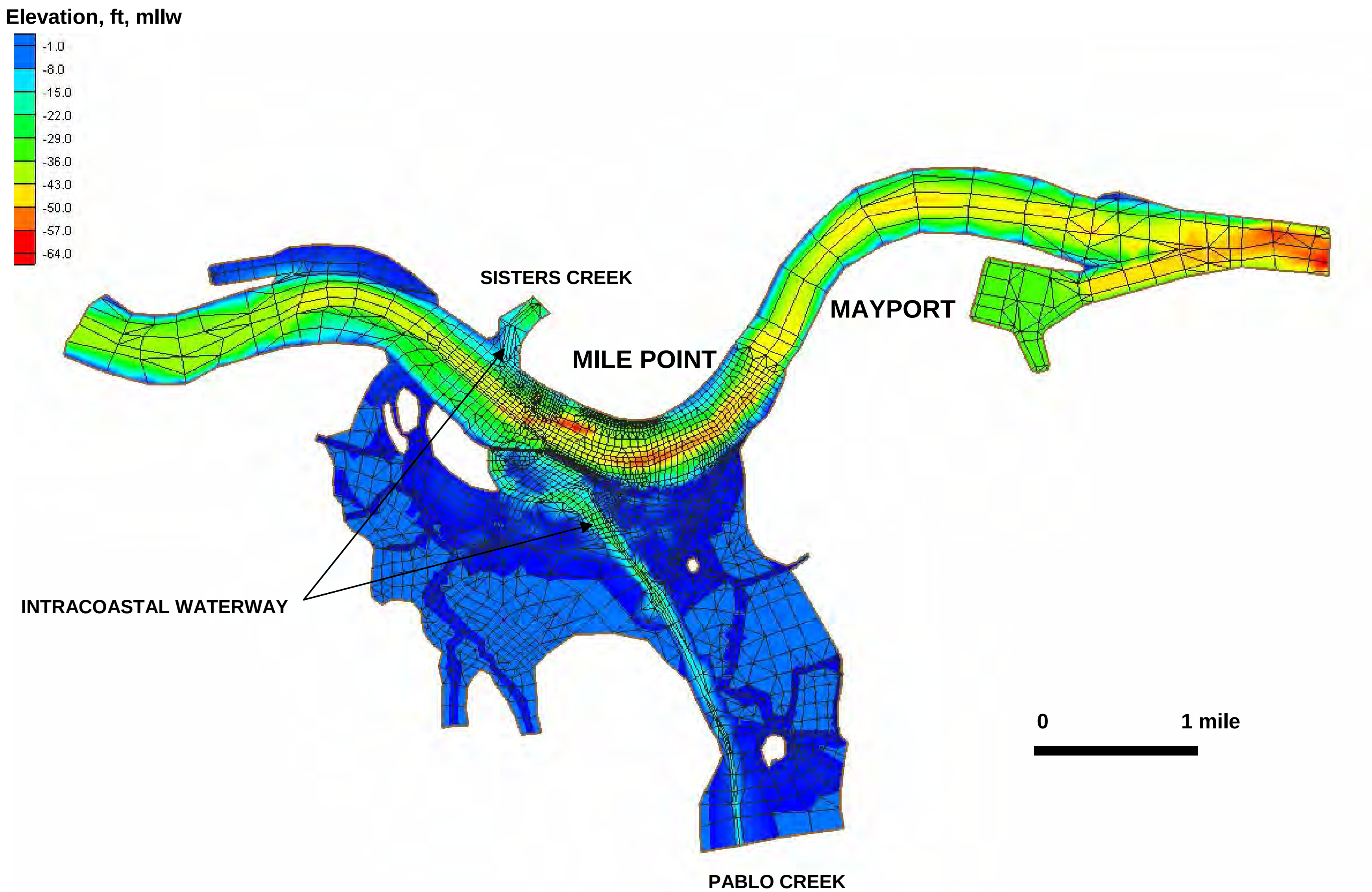


Figure 2. St. Johns River, 3D Numerical Model

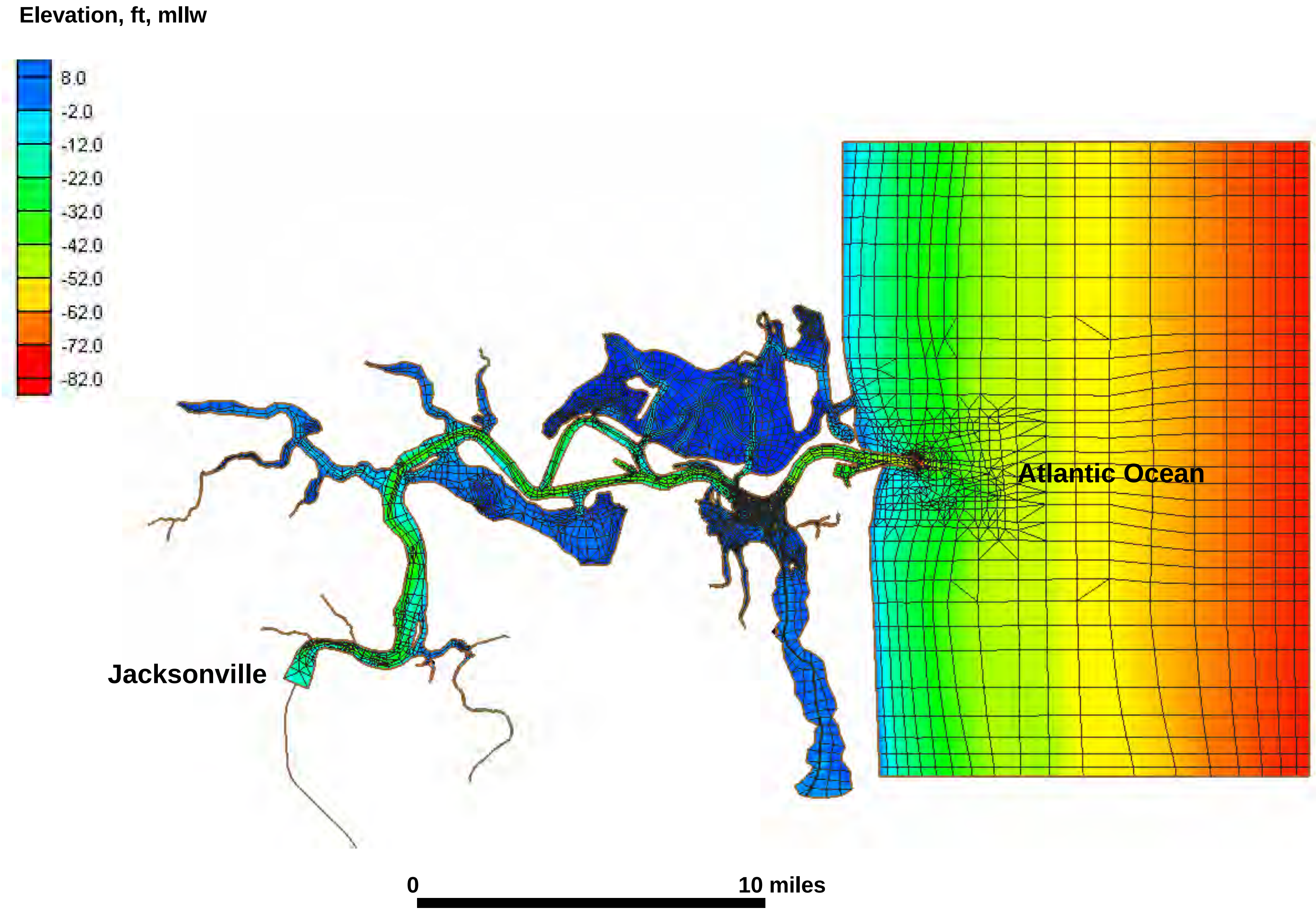


Figure 3. St. Johns River, 2D Numerical Model

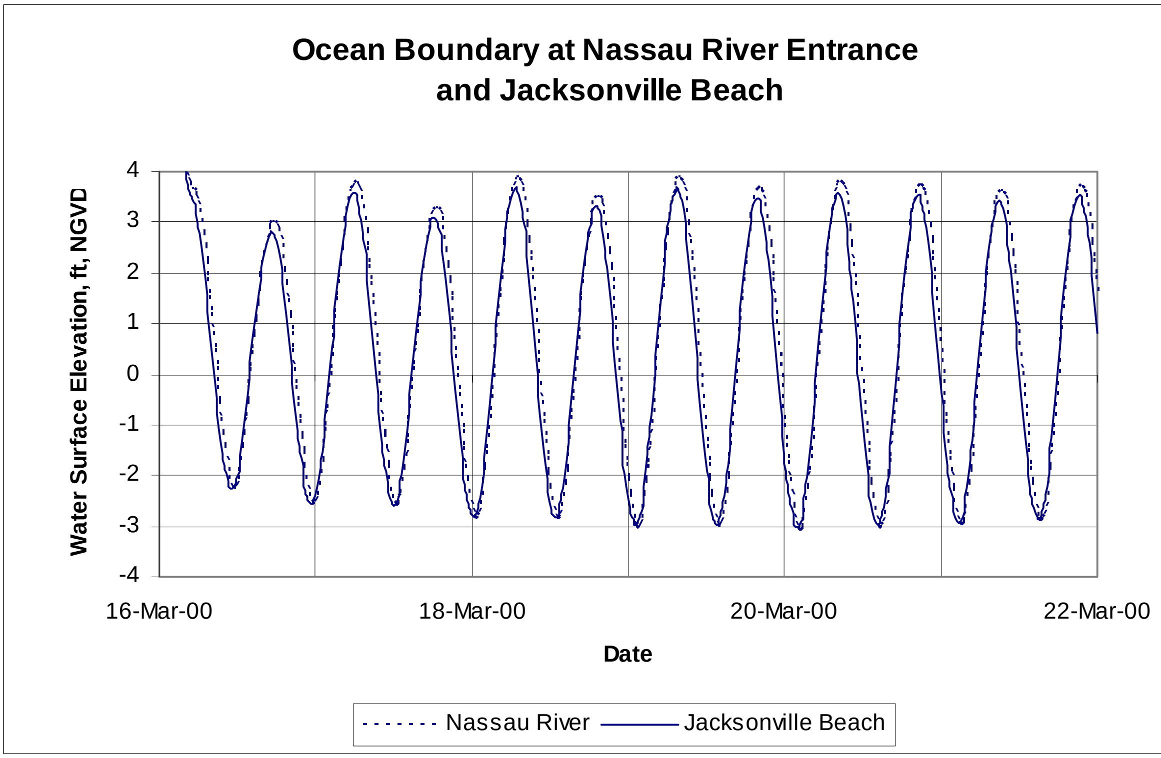


Figure 4. 2D Model, Tidal Boundary

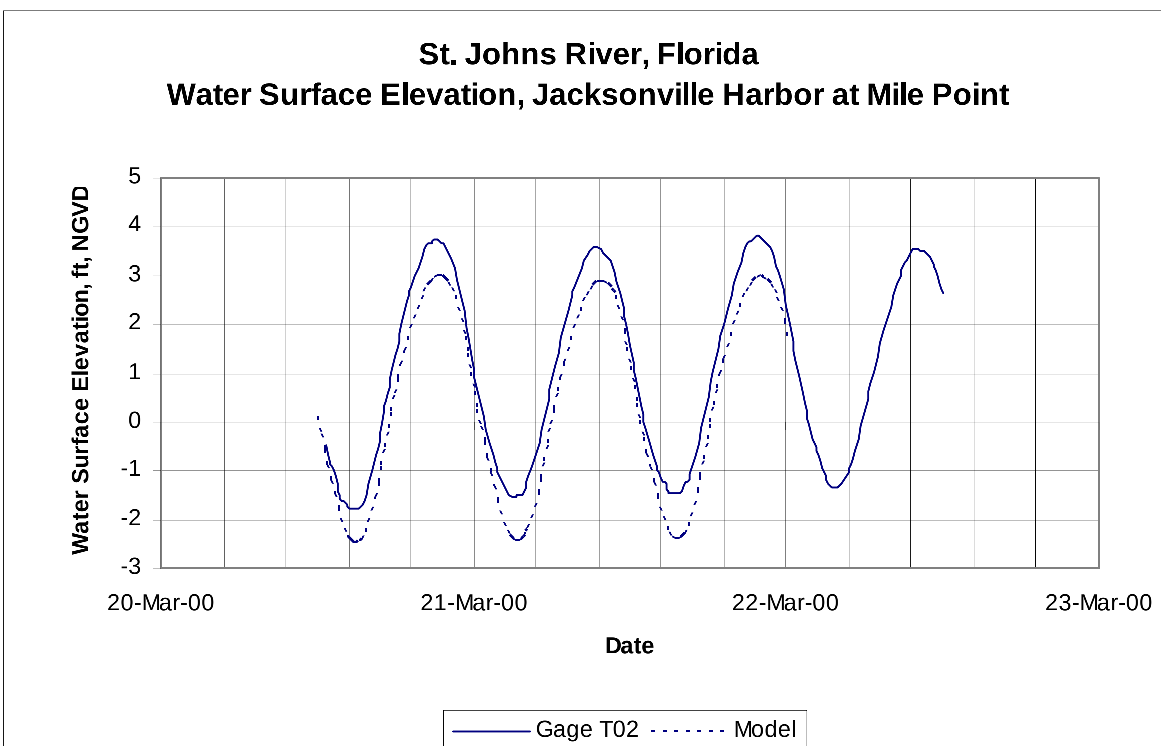


Figure 5. 2D Model, Water Surface Elevation at Mile Point

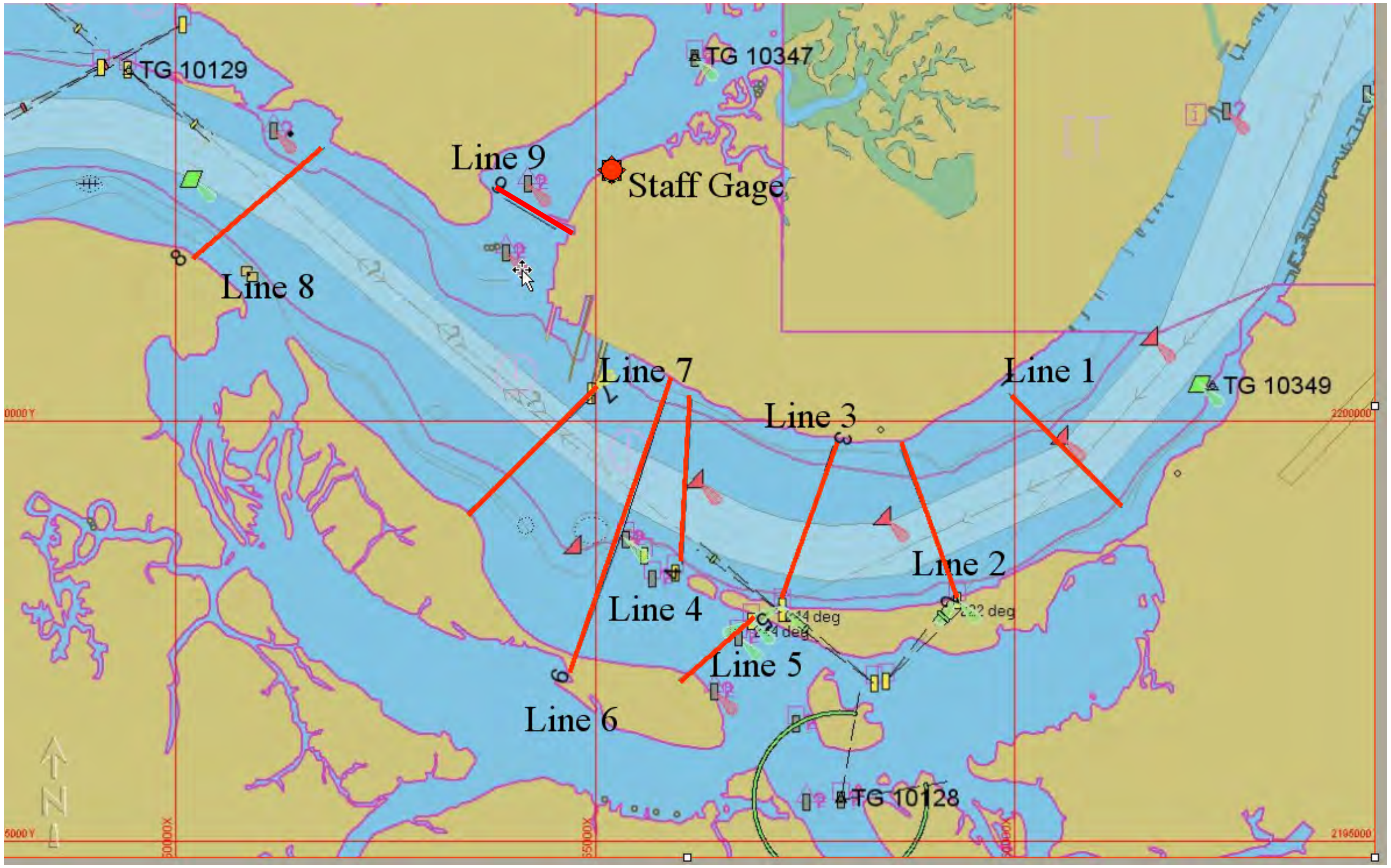


Figure 6. ADCP transect locations and tide gage locations for Mile Point reach data collection.

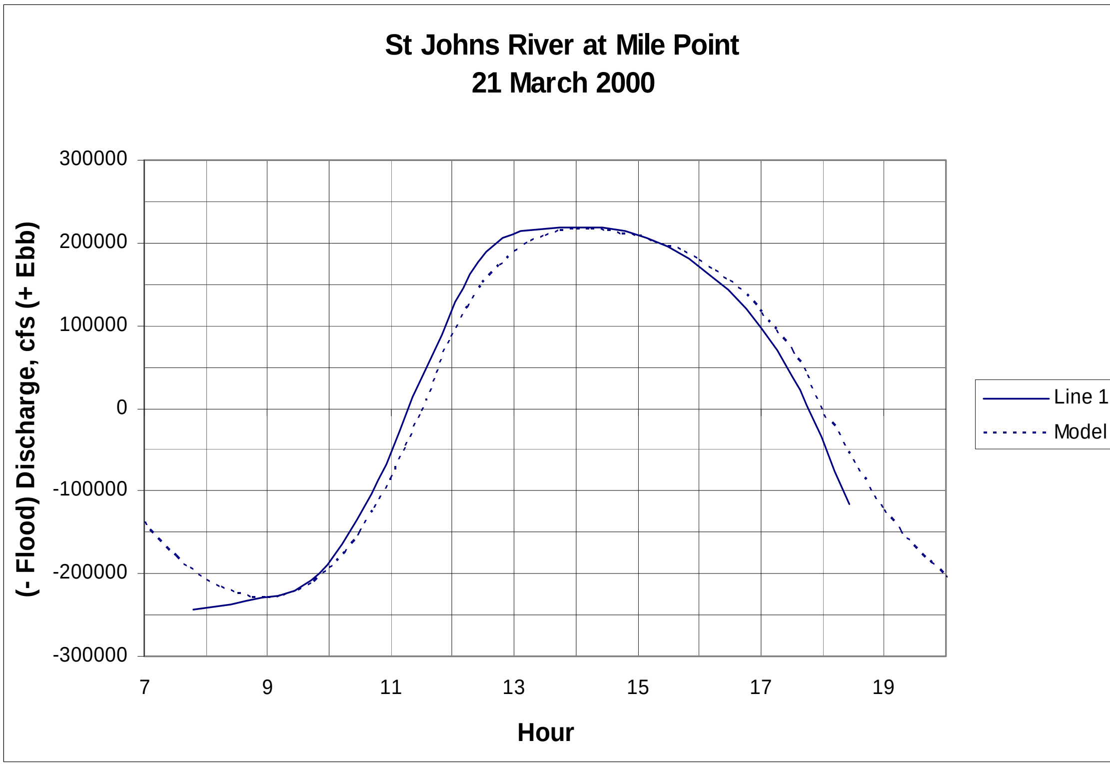


Figure 7. St. Johns River Flow at Mile Point

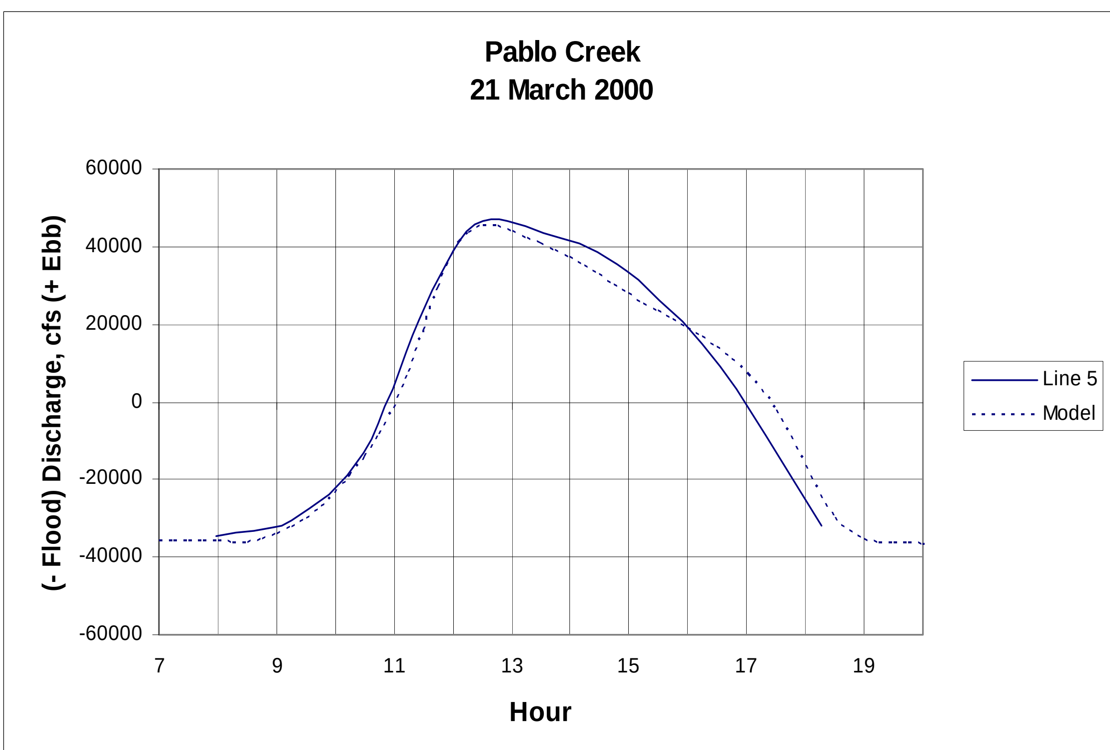


Figure 8. Flow at Pablo Creek

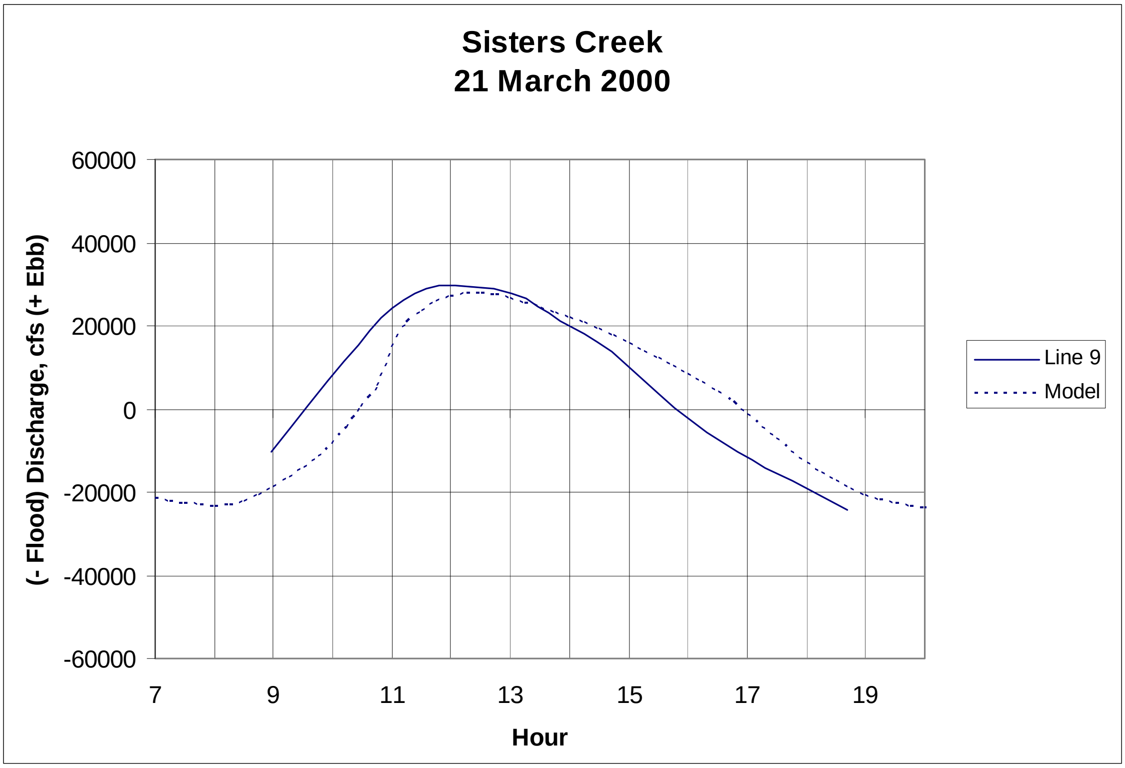


Figure 9. Flow at Sisters Creek

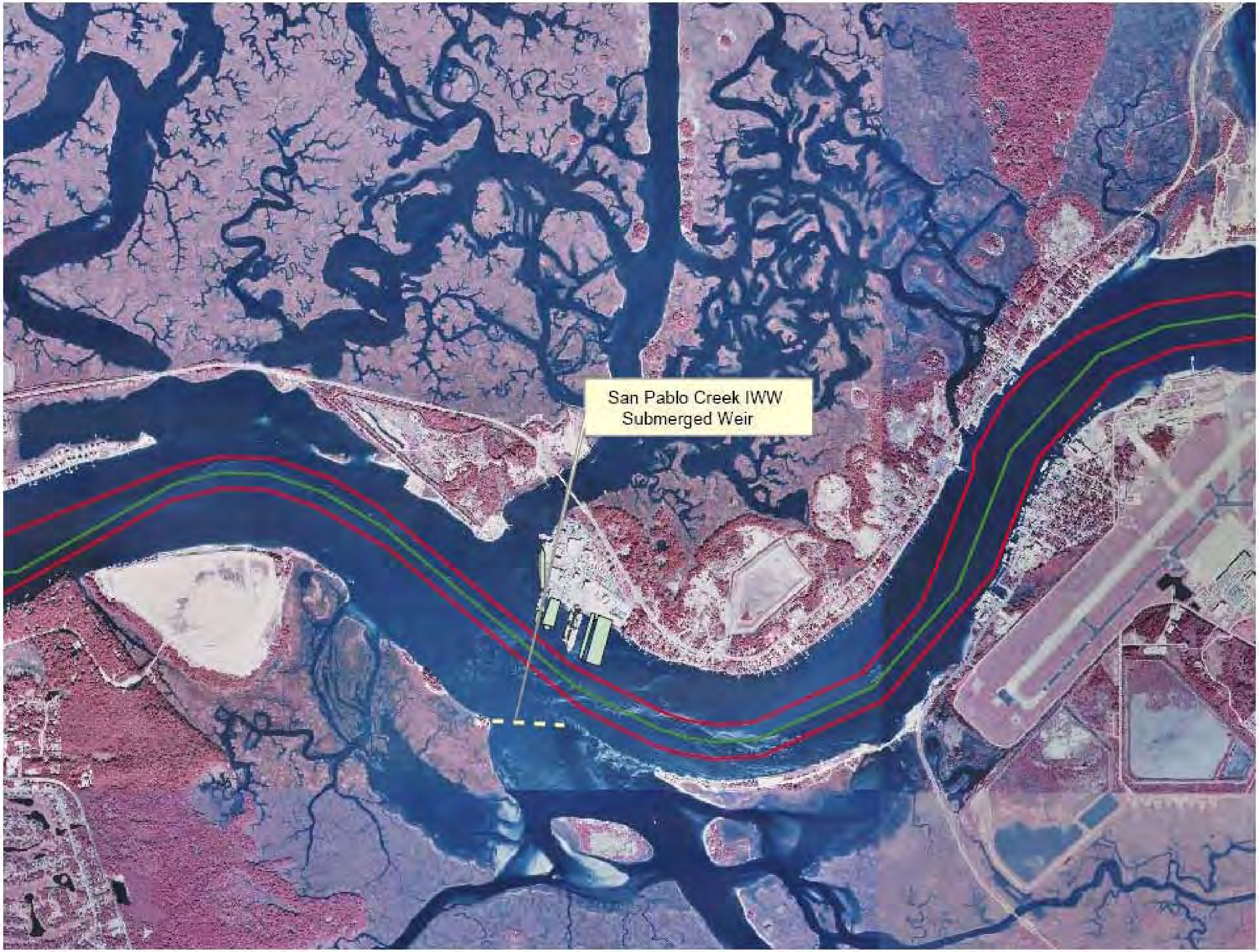


Figure 11. Proposed Alternative: Submerged Weir

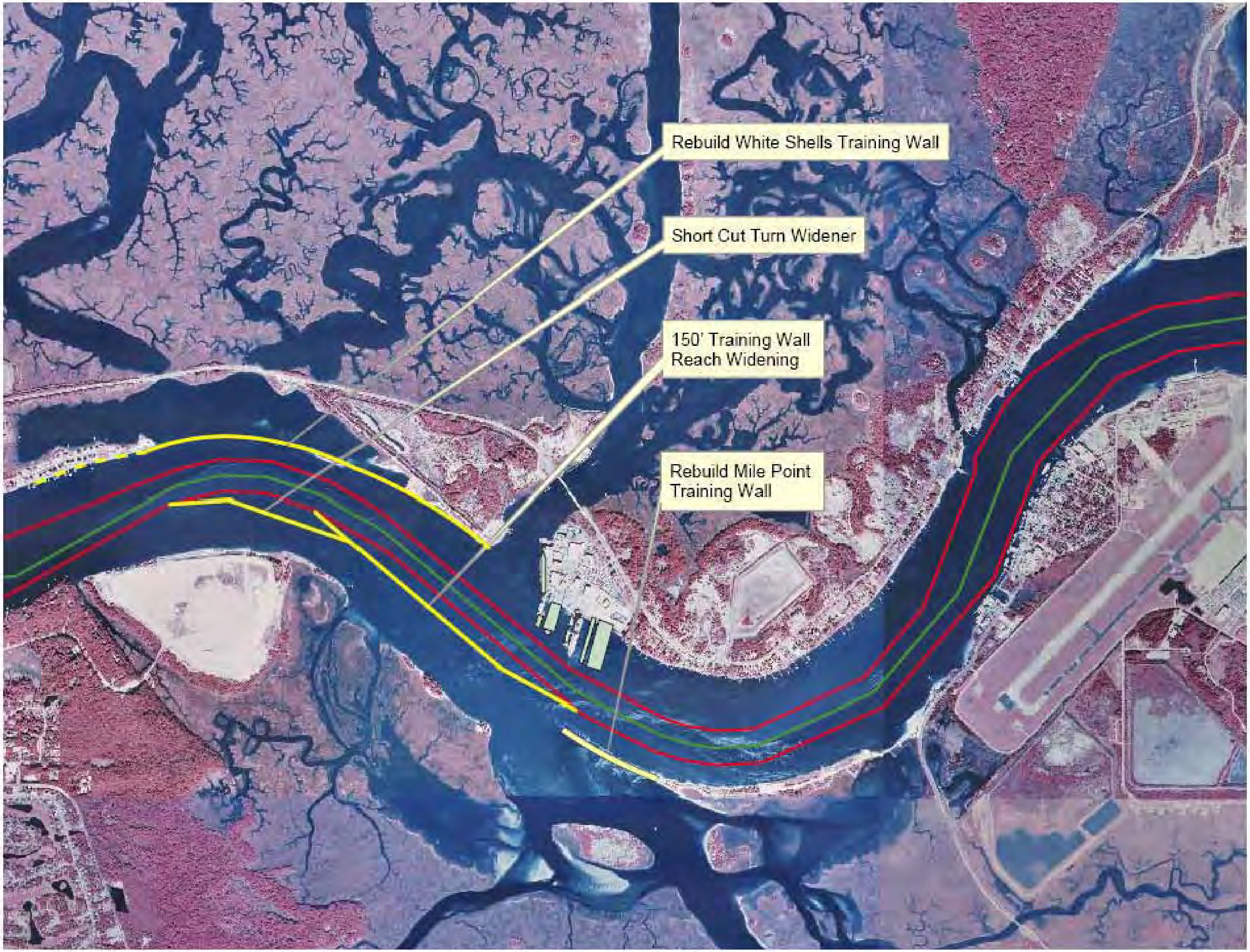


Figure 12. Proposed Alternatives: Rebuild White Shells Training Wall, Short Cut Turn Widener, 150' Training Wall Reach Widener, Rebuild Mile Point Training Wall

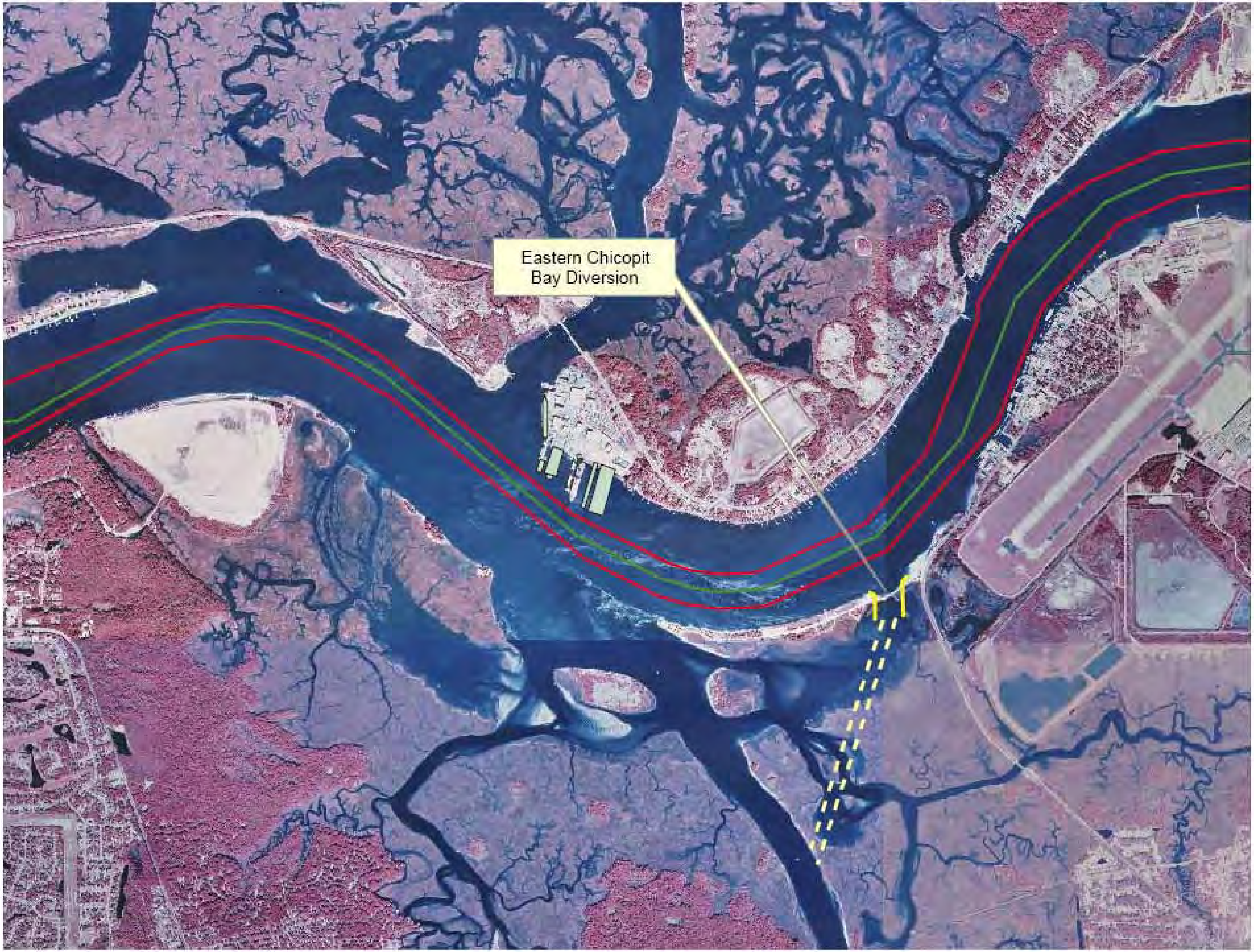


Figure 13. Proposed Alternative: Eastern Chicopit Bay Diversion

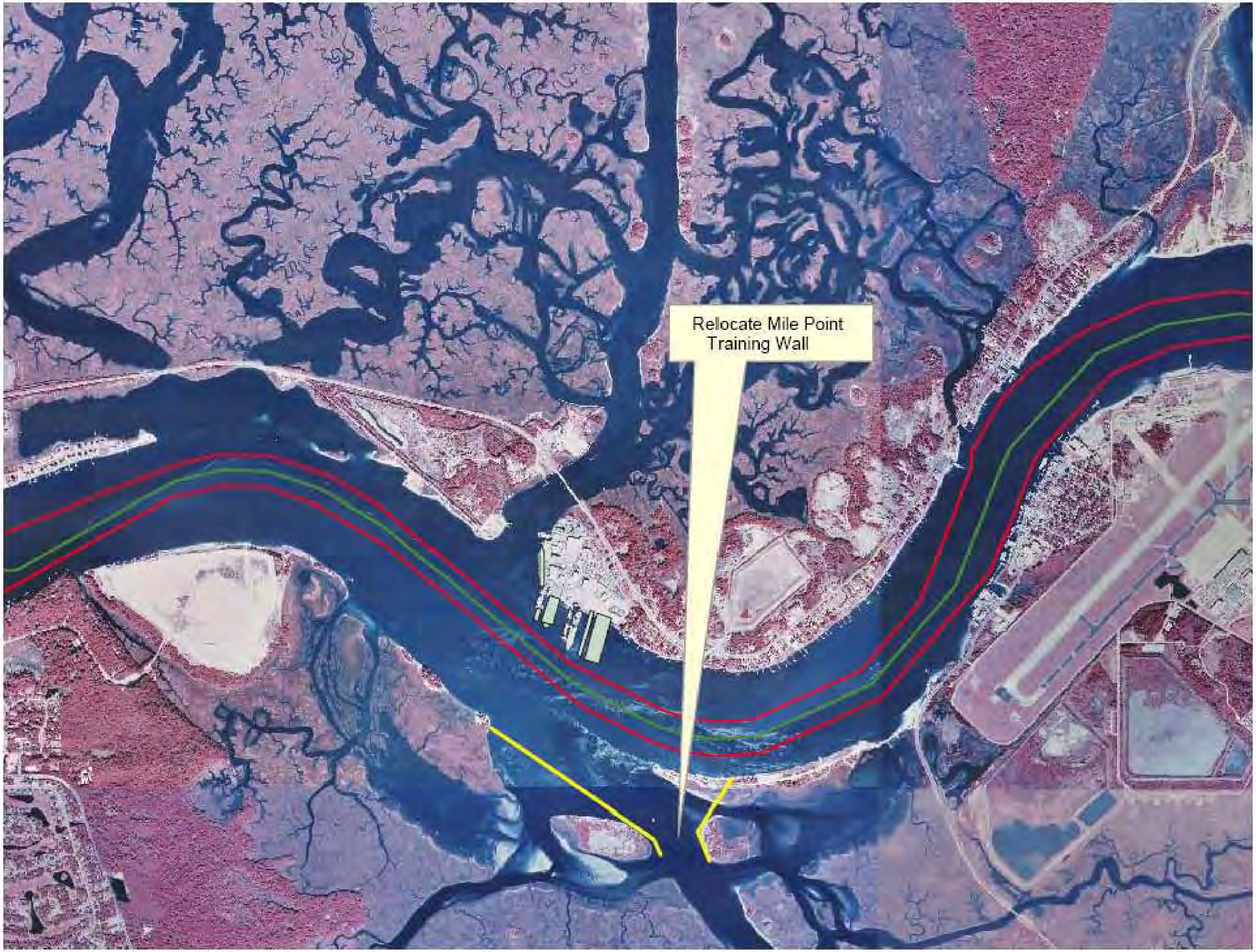


Figure 14. Proposed Alternative: Relocate Mile Point Training Wall

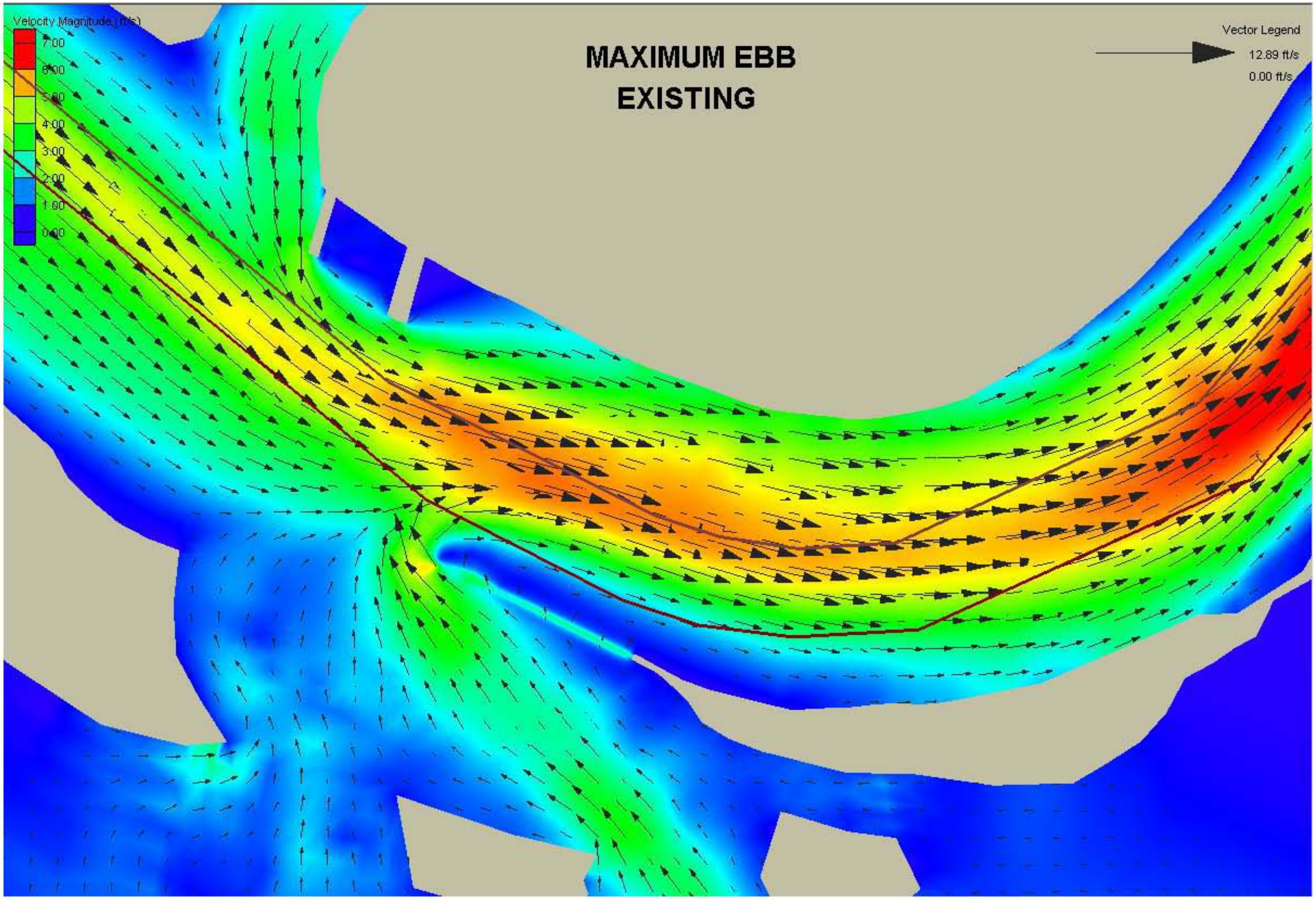


Figure 15. Existing Maximum Ebb Currents at Mile Point, 3D Model

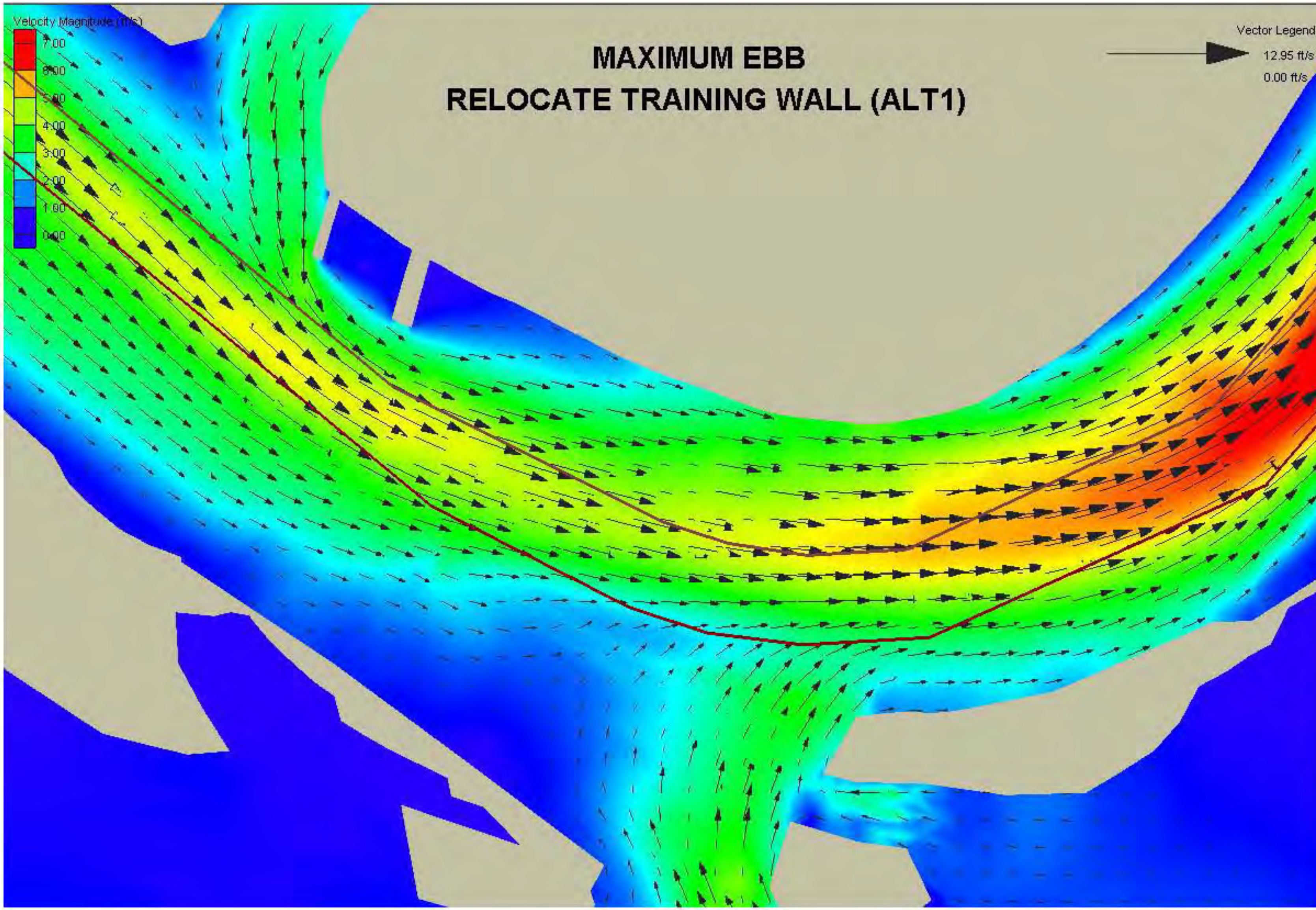


Figure 16. Alternative (Relocate Training Wall) Maximum Ebb Currents at Mile Point, 3D Model

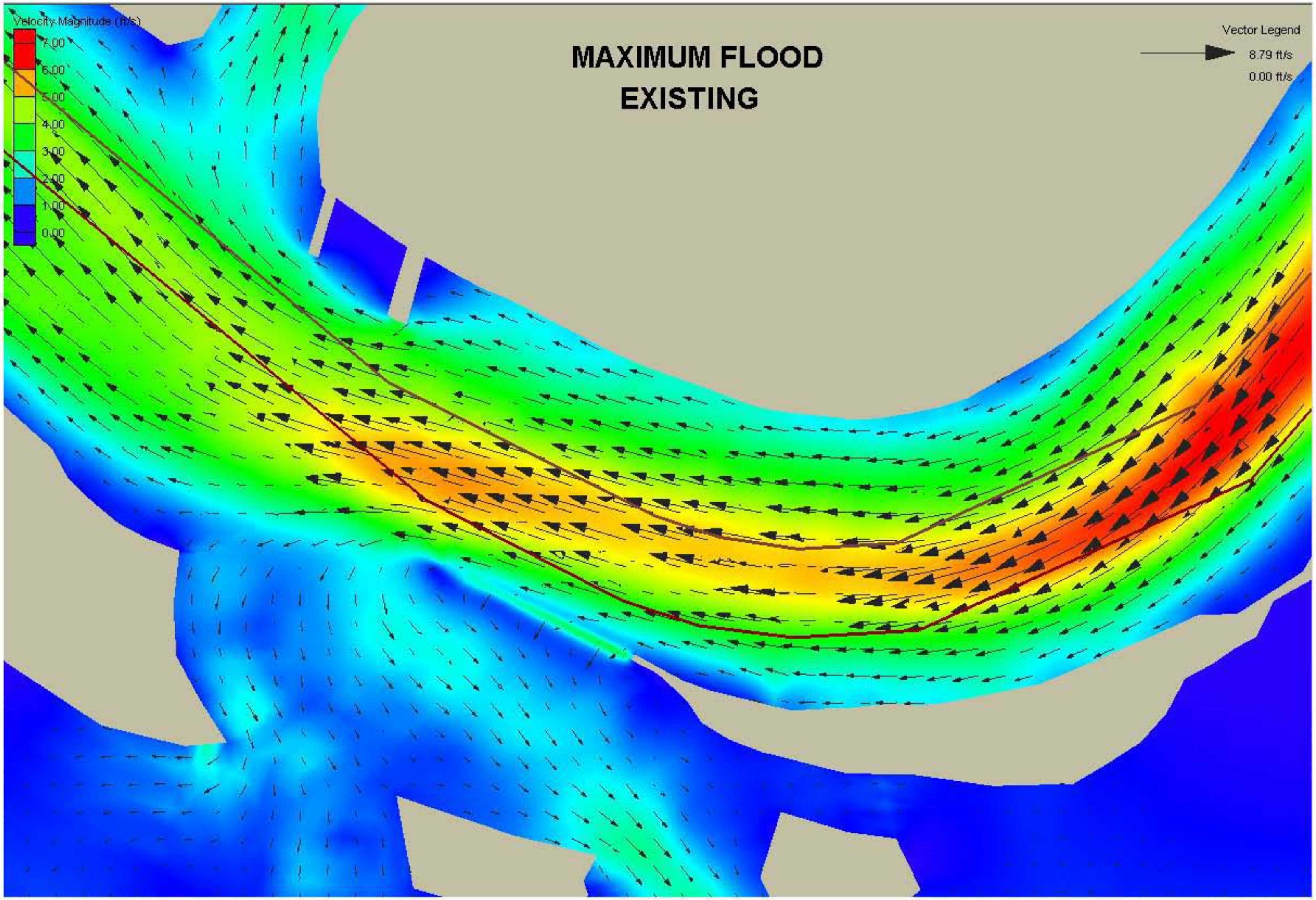


Figure 17. Existing Maximum Flood Currents at Mile Point, 3D Model

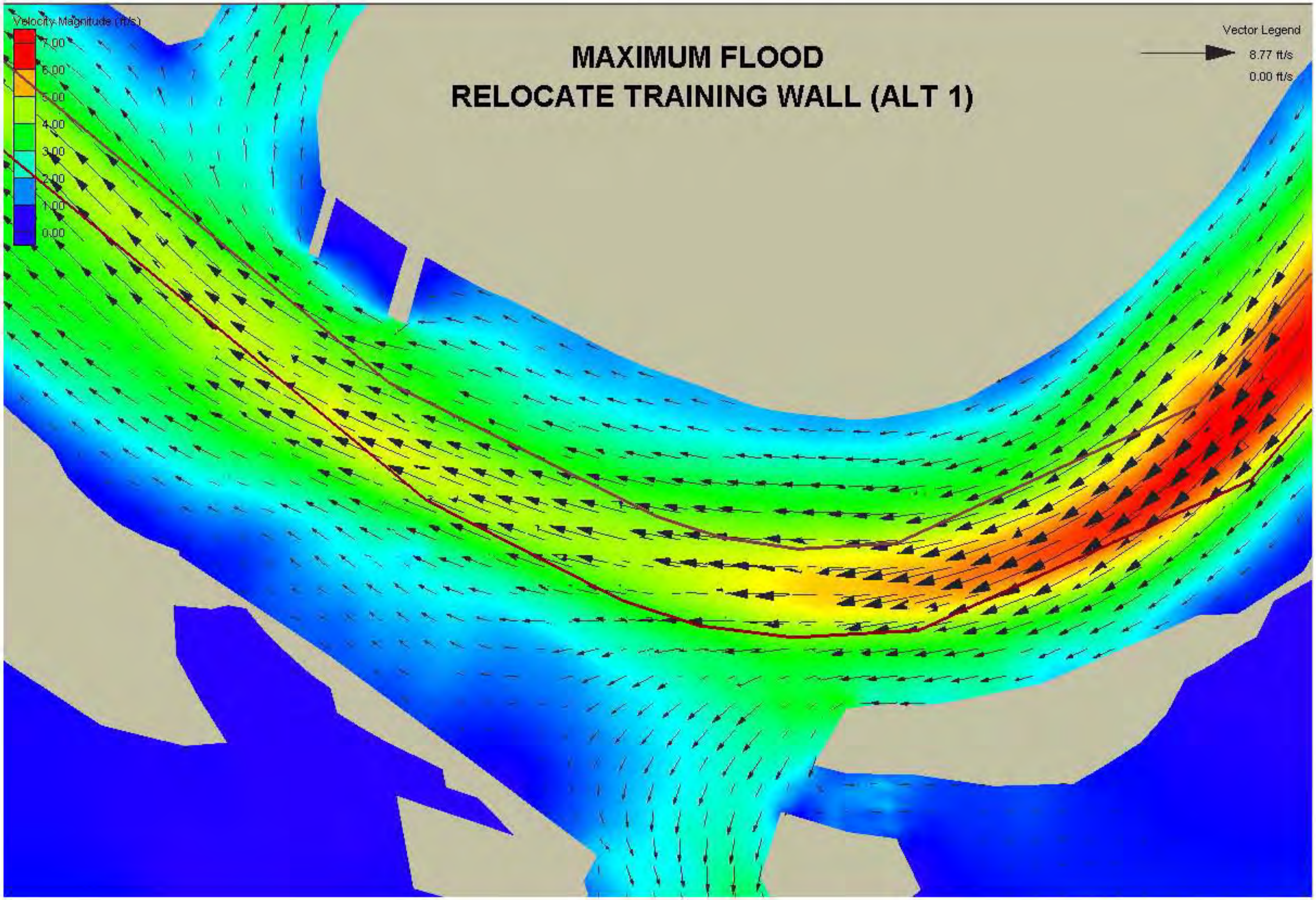


Figure 18. Alternative (Relocate Training Wall) Maximum Flood Currents at Mile Point, 3D Model

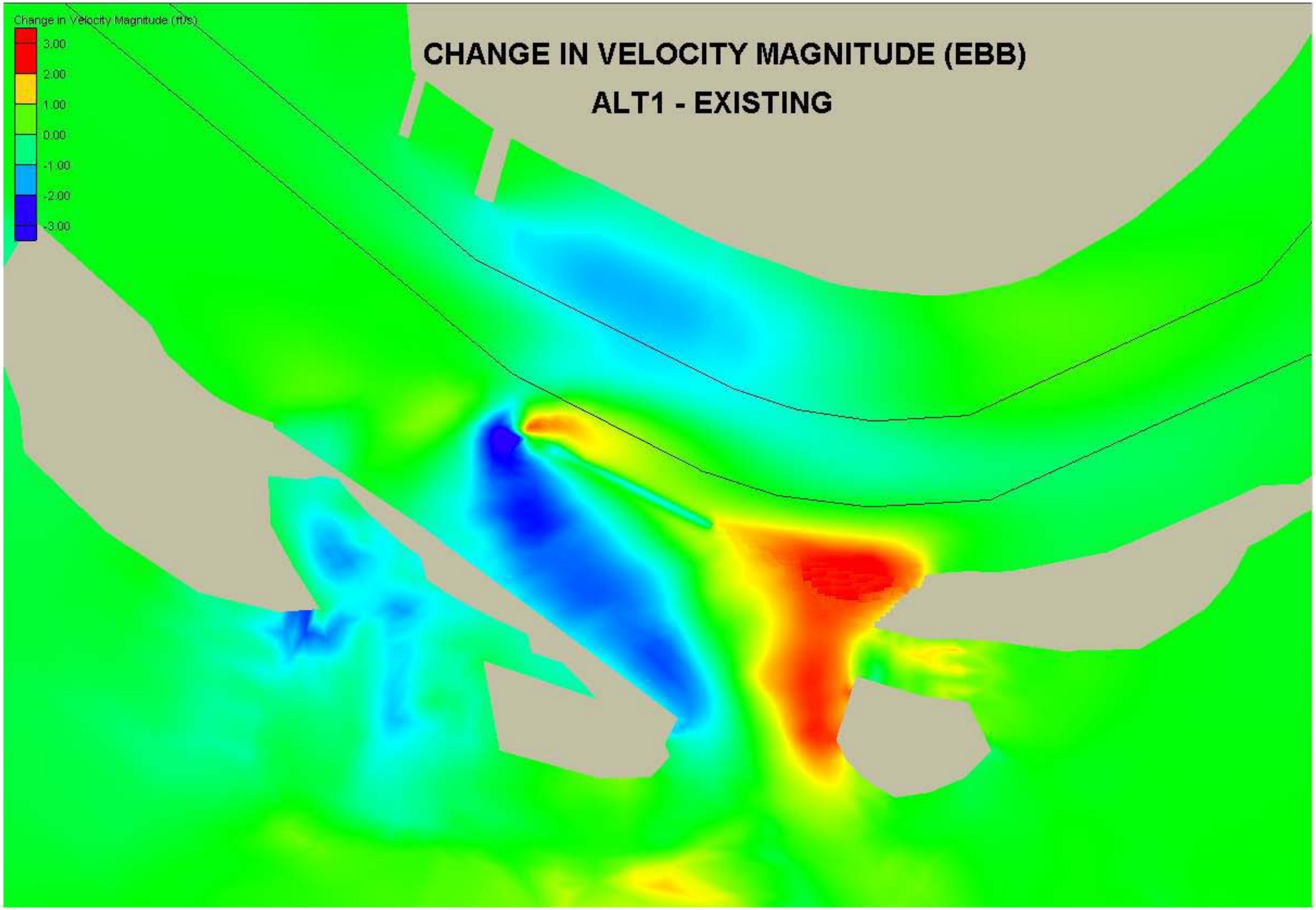


Figure 19. Change in Maximum EBB Water Velocity Magnitude Between Existing and Alternative Conditions

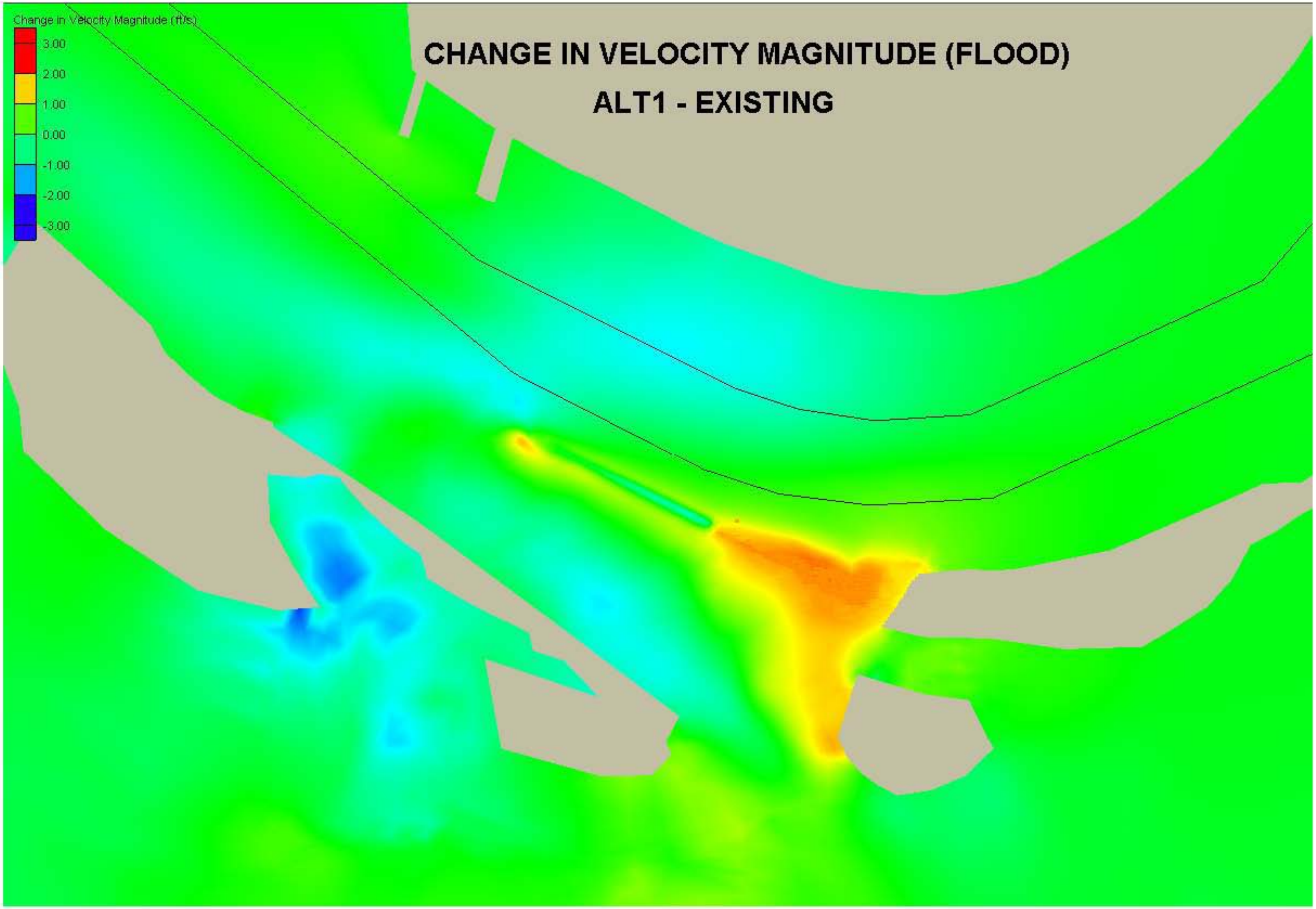


Figure 20. Change in Maximum Flood Water Velocity Magnitude Between Existing and Alternative Conditions

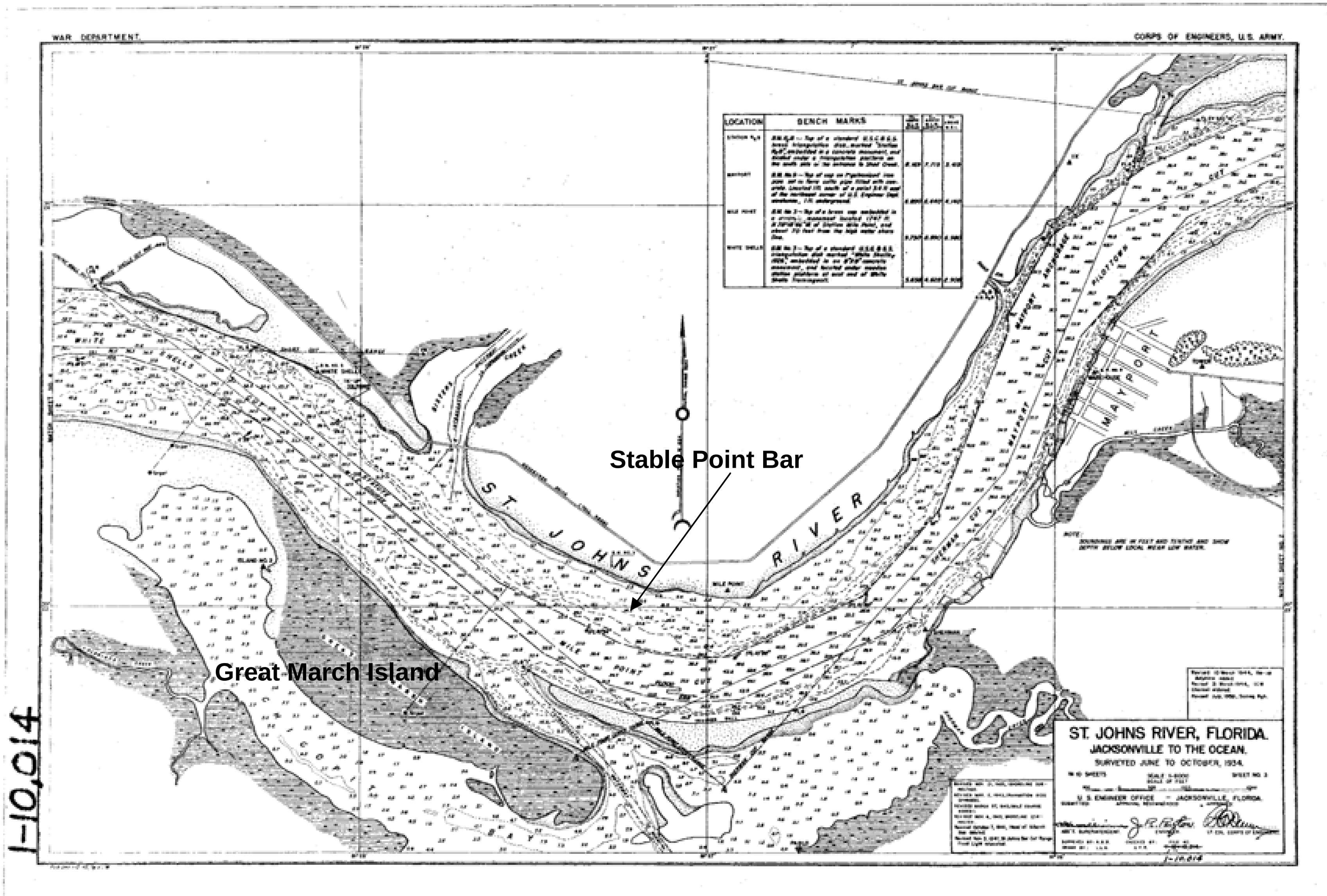


Figure 21. Hydrographic Survey (1934) .

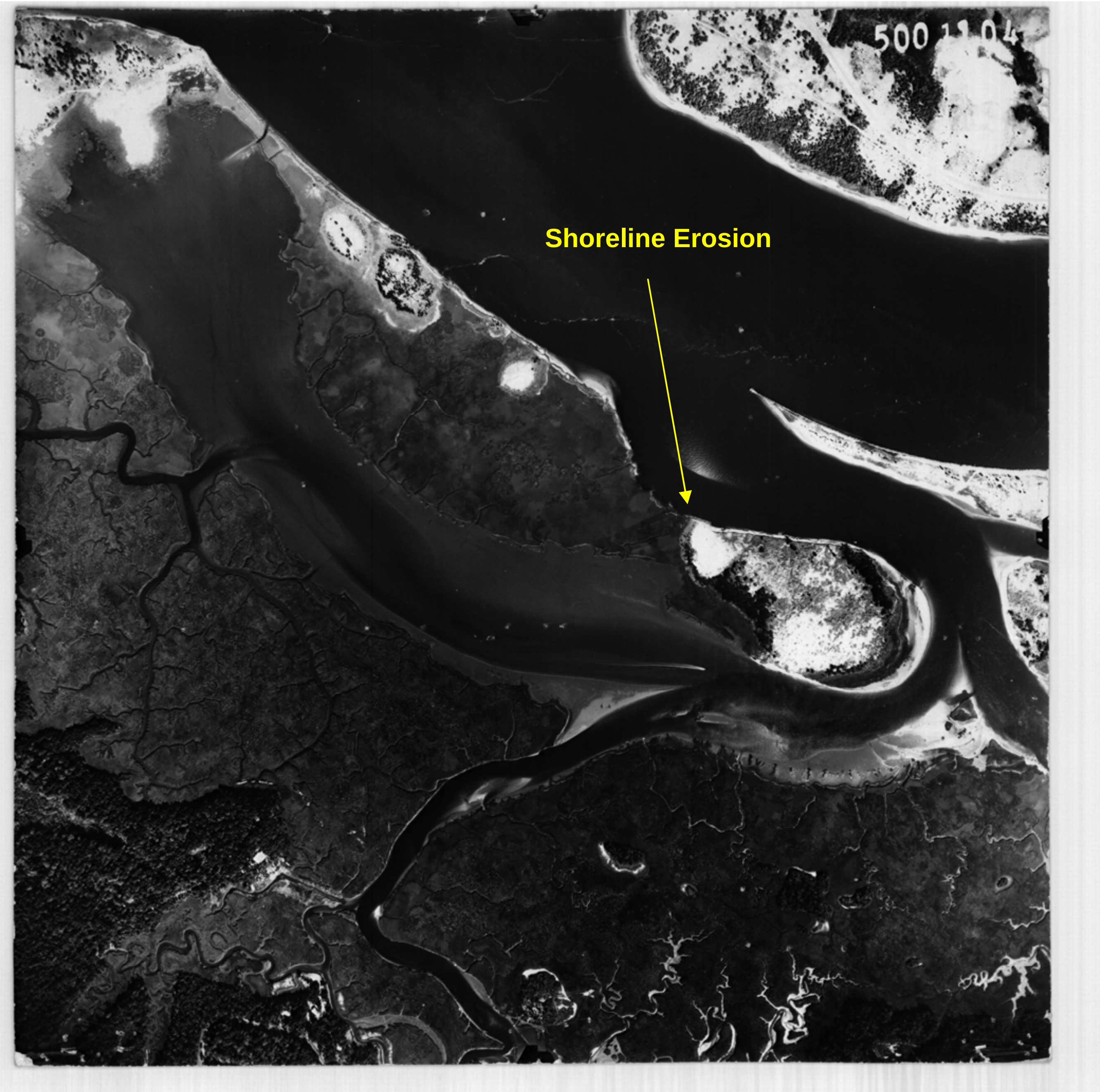


Figure 22. Aerial photo (1962).

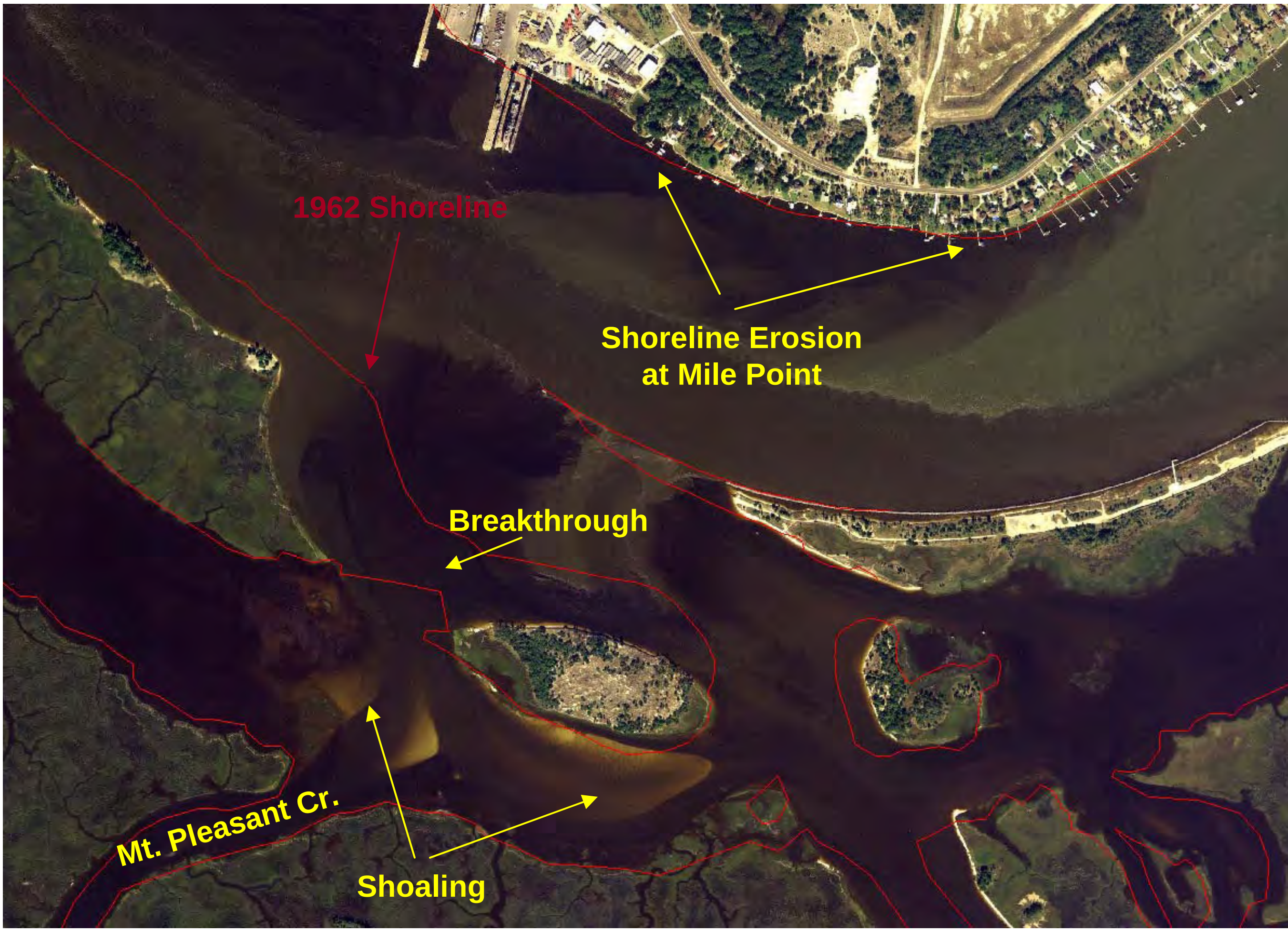


Figure 23. Aerial photo (2004) showing the change in river shoreline at Mile Point and Chicopit Bay since 1962. The erosion of Great Marsh Island's north shoreline continued until a breakthrough of the island occurred in the late 1990's.

Figure 24. Aerial photo (2004) showing the change in river shoreline near White Shells Training Wall since 1962.

Figure 25. Aerial photo (2004) showing the erosion and deterioration of the Ward's Bank Training Wall near the carrier basin at the U.S. Naval Station at Mayport and the erosion of the north shoreline at Huguenot Park near the landward end of the north Jetty since 1962.

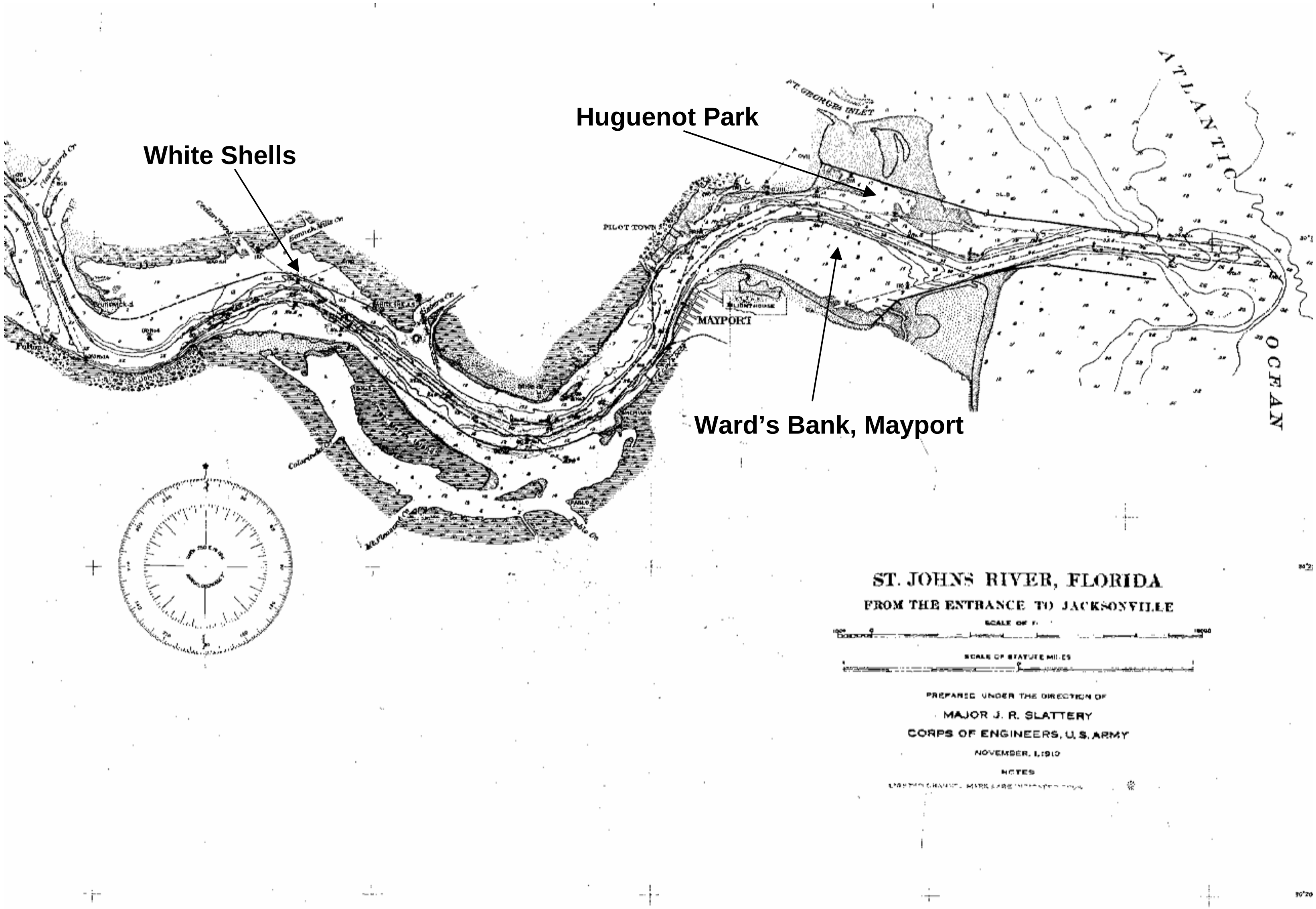


Figure 26. Hydrographic Survey (1913) demonstrates that all the current eroding shoreline sites were under water during the beginning of last century.

GEOTECHNICAL ATTACHMENT

Investigations and Geologic Conditions
Boring Logs and Laboratory Reports

ATTACHMENT B

Mile Point, Jacksonville Harbor, Florida
Feasibility Study

GEOTECHNICAL ATTACHMENT

Table of Contents

MILE POINT FEASIBILITY STUDY
GEOTECHNICAL ATTACHMENT
ENGINEERING APPENDIX SECTION C

1. Introduction

This section provides the results of geologic investigations pertaining to the reconstruction of the intersection of the Intracoastal Waterway with the St. John's River. This reconstruction has several impacts, one to aid navigation and reduce in the impact to vessels from the cross current, and two, the reduction of erosion along the north bank of the St. John's River. This will be accomplished by degradation of the Little Jetty found along the south bank of the St. John's River at the Intracoastal Waterway. The project depth for the degradation and construction of new training walls is proposed to be -13 feet MLW.

2. Geologic Setting

The geologic setting for this project is a tidally influenced major river meander at the intersection with a tributary that drains the salt marsh. This occurs along a nearly flat reach of the St. John's River just before it reaches its mouth. Flow velocities in the river are sufficient to suspend the silt and clay in the vicinity of the project as evidenced by the sediments in the borings in the river. The sand is deposited and the finer material is swept along with the current in the river. Salt marsh sedimentation is characterized by fines of silt and clay suggesting lower carrying capacity and flow velocities.

The topography in the project area consists of relic marine terraces of Pleistocene age. The trend of these terraces is approximately that of the present coastline. The height of the terraces to the south of the Saint Johns River just to the west of the project range from approximately 30 to 50 feet above sea level; the highest point is about 85 feet near Fort Caroline National Monument. North of the river much of the area is covered by saltwater marshes with terrace heights rarely exceeding 30 feet.

Holocene and Pleistocene deposits of predominately sand and clayey sand with localized shell beds mantle the project area. These deposits are underlain by sand, shell, clay, and limestone of Pliocene to late Miocene age.

3. Geotechnical Investigations

The subsurface investigations associated with this project consist of several different periods of investigatory borings. Most are situated in the river channel and are related to the maintenance/deepening of the channel, while there are several borings along the Little Jetty to characterize the material for the previous rehabilitation of the jetty. Six of these Little Jetty borings conducted in 1998 are labeled CB-ML-J98-1 through CB-ML-J98-4 and CB-ML-J98-6 and CB-ML-J98-7 occur where the Little Jetty will be degraded for this project. These borings were completed to approximately -14 feet, mean low water. Most recently there were nine borings completed in 2005 to depths mostly -30 feet with one to -60 feet and another to -54 feet, specifically to investigate erosion and character of materials at the intersection of the Intracoastal Waterway and the St. Johns River. One boring, CB-JHMP05-9 was completed south along the Intracoastal Waterway to elevation -33 feet to verify the sediment character in that area. Plate B-1 shows the borings found in the area of interest and the boring logs and lab analysis are contained at the end of this Attachment.

4. Material Encountered

The material encountered beneath Little Jetty to the planned dredge depth primarily consists of silty sand and poorly graded sand. However, rock can be expected to be incorporated from the jetty armoring. A few lenses of organic silt and clay less than 2 feet thick are represented on the logs in the area of the proposed jetty degradation. The boring completed in the Intracoastal Waterway south of the river encountered soft silt to an elevation of -32.6 feet below mean low water. One foot of silty sand was found below the silt at the bottom of the hole. Adjacent to Great Marsh Island and just east and west of the island, borings encountered poorly graded sand to an elevation of at least -30 feet below mean low water. This suggests that the material to be dredged east of Great Marsh Island is sand, and the material near the proposed mitigation fill area has a thick sand section beneath it.

5. Geotechnical Design Considerations

Two training walls line the margins of the Intracoastal Waterway where the waterway discharges into the St. John's River. Design of the armor gradation for the new training walls is based on the rehabilitated Little Jetty design and incorporates current design wave and flow velocities. The armor layer is to be two stones thick with a W_{50} of 2000 pounds assuming 165 pounds per cubic foot. The D_{50} is 30 inch material.

6. Work to be Completed

Geotechnical investigations will be completed for the PED phase of the project. These investigations are highlighted below.

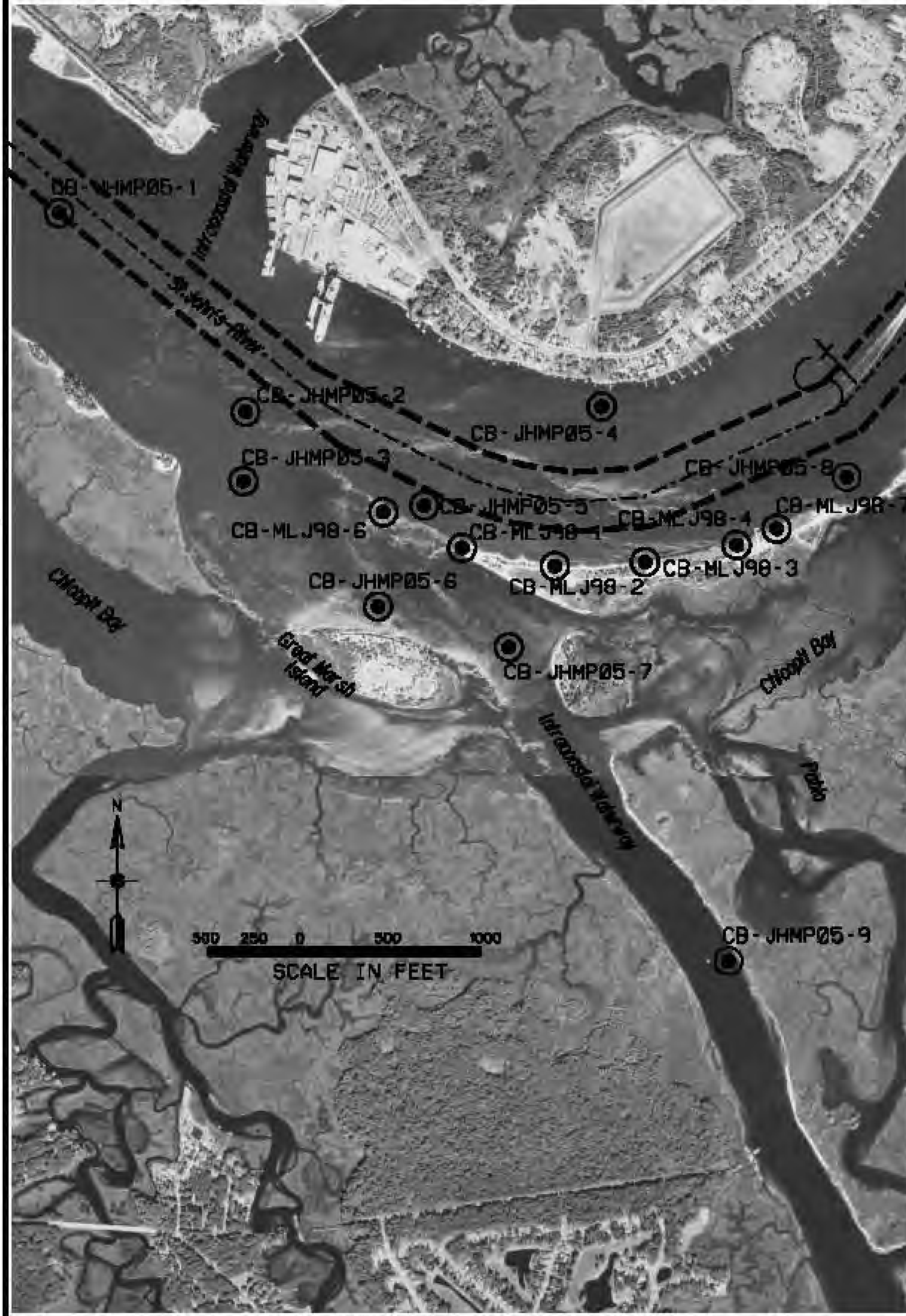
- The proposed wetlands mitigation area west of Great Marsh Island will accept dredged material from degradation of the Little Jetty and from the dredging the channel of the Intracoastal Waterway.

- Geotechnical information is lacking in the immediate area of the proposed wetlands mitigation area and the area to be dredged south of Great Marsh Island.

- The training walls on the east and west sides of the Intracoastal Waterway need to have foundation information gathered to assure a suitable foundation.

GEOTECHNICAL ATTACHMENT

Plate B-1



CB-JHMP05-9 BORING LOCATION AND LABEL

Plate B-1

GEOTECHNICAL ATTACHMENT

Boring Logs from 1998

ATTACHMENT B

Hole No.CB-MLJ98-1

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Mayport Little Jetties	10. SIZE AND TYPE OF BIT: 2 15/16" Tricone
2. LOCATION (Coordinates or Station): X=356,593 Y=2197,921	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: ARDAMAN & ASSOCIATES, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 on ATV
4. HOLE NO. (As shown on drawing title and file number): CB-MLJ98-1	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 13 undisturbed: 0
5. NAME OF DRILLER: C. Wallace	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 2.1
	16. DATE HOLE: STARTED 2/9/98 COMPLETED 2/10/98
7. THICKNESS OF BURDEN: 19.5 Ft.	17. ELEVATION TOP OF HOLE: 5.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 8 %
9. TOTAL DEPTH OF HOLE: 19.5 Ft.	19. SIGNATURE OF GEOLOGIST: ROCKLAND BURR

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS	BLOWS/.5'
5.5	0.0					5.5	
			Sand, fine to medium grained, brown, trace of shell (SP)	80	1	Dry; 4.0	4, 6, 8
2.5	3.0			80	2	Moist; 2.5	5, 5, 5
			Sand, fine to coarse grained, brown, a little shell, trace of shell gravel (SP)	90	3	Water Bearing GWT = 3.4' Start Mud Rotary; 1.0	3, 3, 2
				80	4	-.5	2, 1, 2
-2.5	8.0			50	5	Lost circulation. Set HW casing.; -2.0	4, 3, 4
			Sand, fine grained, gray (SP)	75	6	-3.5	3, 2, 3
				80	7	-5.0	4, 3, 3
-6.0	11.5			70	8		3, 2
-6.5	12.0		Silt, dark gray (ML)			-6.5	2
-8.0	13.5		Sand, fine grained, gray, laminations of silt (SP)	75	9	-8.0	7, 9, 13
			Sand, fine grained, gray, trace of shell (SP)	75	10	-9.5	4, 6, 10
				100	11	-11.0	10, 12, 18
				100	12	-12.5	5, 18, 20
-14.0	19.5			100	13	-14.0	12, 17, 21
			End of Boring at 19.5'				
			Soils are field visually classified in accordance with the Unified Soils Classification System.				

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Mayport Little Jetties	10. SIZE AND TYPE OF BIT: 2 15/16" Tricone
2. LOCATION (Coordinates or Station): X=357,614 Y=2197,719	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: ARDAMAN & ASSOCIATES, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 on ATV
4. HOLE NO. (As shown on drawing title and file number): CB-MLJ98-2	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 13 undisturbed: 0
5. NAME OF DRILLER: C. Wallace	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 4.2
	16. DATE HOLE: STARTED 2/10/98 COMPLETED 2/10/98
7. THICKNESS OF BURDEN: 19.5 Ft.	17. ELEVATION TOP OF HOLE: 4.9 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 91.5 %
9. TOTAL DEPTH OF HOLE: 19.5 Ft.	19. SIGNATURE OF GEOLOGIST: ROCKLAND BURR

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS	BLOWS/.5'
4.9	0.0					4.9	
			Sand, fine to medium grained, brown, trace of shell (SP)	100	1	Moist GWT = 0.7' — 3.4	2, 2, 4
1.9	3.0			100	2	Start Mud Rotary — 1.9	4, 6, 7
.4	4.5		Sand, fine to coarse grained, brown, trace of shell (SP)	100	3	Set HW casing to hold fine sand — .4	5, 6, 8
			Sand, fine grained, brown, trace of shell (SP)	90	4	-1.1	5, 7, 8
				100	5	-2.6	7, 12, 12
				75	6	-4.1	7, 5, 7
				100	7	-5.6	7, 12, 16
				90	8	-7.1	10, 17, 19
				90	9	-8.6	9, 18, 19
				75	10	-10.1	6, 11, 12
			Laminations of Silt	90	11	-11.6	8, 15, 21
				90	12	-13.1	12, 18, 21
-14.1	19.0			90	13		10, 16, 21
-14.6	19.5		Sand, fine grained, gray (SP)			-14.6	
			End of Boring at 19.5'				
			Soils are field visually classified in accordance with the Unified Soils Classification System.				

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MLJ98-3

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 1

1. PROJECT: Mayport Little Jetties	10. SIZE AND TYPE OF BIT: 2 15/16" Tricone
2. LOCATION (Coordinates or Station): X=358,605 Y=2197,764	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: ARDAMAN & ASSOCIATES, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 on ATV
4. HOLE NO. (As shown on drawing title and file number): CB-MLJ98-3	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 13 undisturbed: 0
5. NAME OF DRILLER: C. Wallace	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 3.3
	16. DATE HOLE: STARTED 2/10/98 COMPLETED 2/10/98
7. THICKNESS OF BURDEN: 19.5 Ft.	17. ELEVATION TOP OF HOLE: 3.9 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 78 %
9. TOTAL DEPTH OF HOLE: 19.5 Ft.	19. SIGNATURE OF GEOLOGIST: ROCKLAND BURR

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS	BLOWS/.5'
3.9	0.0				3.9	
2.4	1.5	Sand, fine grained, brown, trace of shell (SP)	75	1	2.4	5, 8, 8
		Sand, fine grained, brown (SP)	100	2	GWT = 0.6' Start Mud Rotary; .9	5, 7, 7
-.1	4.0		100	3	Set HW casing to control silt and fine sand.; -.6	3, 2, 2
-1.6	5.5	Silt, dark gray, lenses of clay (ML); Laminations of Sand	100	4	-2.1	1, 4, 10
		Sand, fine grained, gray (SP)	100	5	-3.6	7, 11, 10
			75	6	-5.1	4, 5, 7
			75	7	-6.6	4, 5, 6
			60	8	-8.1	10, 14, 17
-9.6	13.5		60	9	-9.6	6, 13, 14
		Sand, medium to coarse grained, gray, trace of shell (SP)	75	10	-11.1	6, 6, 7
-12.1	16.0		75	11	-12.6	6, 8, 14
		Sand, fine grained, gray (SP)	60	12	-14.1	11, 17, 20
-15.6	19.5		100	13	-15.6	10, 13, 18
		End of Boring at 19.5'				
		Soils are field visually classified in accordance with the Unified Soils Classification System.				

Scale (ft): 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MLJ98-4

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Mayport Little Jetties	10. SIZE AND TYPE OF BIT: 2 15/16" Tricone
2. LOCATION (Coordinates or Station): X=359,613 Y=2197,952	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: ARDAMAN & ASSOCIATES, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 on ATV
4. HOLE NO. (As shown on drawing title and file number): CB-MLJ98-4	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 13 undisturbed: 0
5. NAME OF DRILLER: C. Wallace	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 5.7
	16. DATE HOLE: STARTED 2/11/98 COMPLETED 2/11/98
7. THICKNESS OF BURDEN: 19.5 Ft.	17. ELEVATION TOP OF HOLE: 5.7 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 74 %
9. TOTAL DEPTH OF HOLE: 19.5 Ft.	19. SIGNATURE OF GEOLOGIST: ROCKLAND BURR

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS	BLOWS/.5'
5.7	0.0				5.7	
4.2	1.5	Sand, fine grained, brown, trace of shell (SP)	90	1	GWT = 0.0'; 4.2	2, 7, 8
		Sand, fine grained, gray, lens of silt (SP)	90	2	Start Mud Rotary; 2.7	4, 9, 10
1.7	4.0		100	3	1.2	5, 8, 7
1.2	4.5	Sand, fine grained, gray (SP)				
.7	5.0	Silt, dark gray (ML)				
-.8	6.5	Sand, fine grained, gray, trace of shell, trace of shell gravel (SP-SM)	75	4	Set HW Casing; -.3	3, 6, 11
-1.8	7.5	Sand, medium to coarse grained, gray, trace of shell, trace of shell gravel (SP)	90	5	-1.8	3, 7, 11
-2.3	8.0	Sand, fine grained, gray (SP)	50	6	-3.3	4, 3, 5
		Sand, fine to medium grained, gray, trace of shell (SP)	75	7	-4.8	8, 8, 9
			75	8	-6.3	3, 4, 5
			80	9	-7.8	4, 4, 5
			60	10	-9.3	3, 3, 4
-10.3	16.0		50	11	-10.8	3, 2, 0
-11.8	17.5	Clay, dark gray (CL)	50	12	-12.3	2, 1, 3
-13.8	19.5	Sand, fine grained, gray (SP)	80	13	-13.8	15, 27, 42
		End of Boring at 19.5'				
		Soils are field visually classified in accordance with the Unified Soils Classification System.				

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

Hole No.CB-MLJ98-6

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Mayport Little Jetties	10. SIZE AND TYPE OF BIT: 2 15/16" Tricone
2. LOCATION (Coordinates or Station): X=355,726 Y=2198,315	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: ARDAMAN & ASSOCIATES, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 on Barge
4. HOLE NO. (As shown on drawing title and file number): CB-MLJ98-6	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 13 undisturbed: 0
5. NAME OF DRILLER: C. Wallace	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: N/A
	16. DATE HOLE: STARTED 2/12/98 COMPLETED 2/12/98
7. THICKNESS OF BURDEN: 19.5 Ft.	17. ELEVATION TOP OF HOLE: -7.8 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 85 %
9. TOTAL DEPTH OF HOLE: 19.5 Ft.	19. SIGNATURE OF GEOLOGIST: ROCKLAND BURR

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS	BLOWS/ .5'
-7.8	0.0					-7.8	
-9.3	1.5		Sand, fine grained, gray (SP)	90	1	Set NW Casing -9.3	5, 3, 2
-10.8	3.0		Sand, fine to coarse grained, gray, a little shell, laminations of silt (SP-SM)	75	2	-10.8	1, 2, 3
-12.3	4.5		Sand, coarse grained, gray, a little shell, trace of shell gravel (SP)	80	3	-12.3	9, 10, 10
			Sand, fine grained, gray (SP)	90	4	-13.8	6, 8, 7
				75	5	-15.3	5, 6, 7
				75	6	-16.8	4, 7, 9
				90	7	-18.3	4, 5, 8
			Laminations of Silt	80	8	-19.8	7, 6, 5
				80	9	-21.3	8, 7, 10
			Laminations of Silt	90	10	-22.8	4, 6, 8
				100	11	-24.3	7, 12, 11
-25.8	18.0			100	12	-25.8	6, 5, 13
-27.3	19.5		Sand, fine grained, gray, trace of shell (SP)	100	13	-27.3	8, 10, 12
			End of Boring at 19.5'				
			Soils are field visually classified in accordance with the Unified Soils Classification System.				

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

DRILLING LOG

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Mayport Little Jetties	10. SIZE AND TYPE OF BIT: 2 15/16" Tricone
2. LOCATION (Coordinates or Station): Y=2198,132 X=360,053	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: ARDAMAN & ASSOCIATES, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 on ATV
4. HOLE NO. (As shown on drawing title and file number): CB-MLJ98-7	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 13 undisturbed: 0
5. NAME OF DRILLER: C. Wallace	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 4.4
	16. DATE HOLE: STARTED 2/12/98 COMPLETED 2/12/98
7. THICKNESS OF BURDEN: 19.5 Ft.	17. ELEVATION TOP OF HOLE: 5.6 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 77 %
9. TOTAL DEPTH OF HOLE: 19.5 Ft.	19. SIGNATURE OF GEOLOGIST: ROCKLAND BURR

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS	BLOWS/ .5'
5.6	.0					5.6	
			Sand, fine to medium grained, brown, a little shell, trace of shell gravel (SP)	100	1	GWT = 1.2' / 4.1	2, 5, 7
				100	2	2.6	8, 11, 10
1.1	4.5			75	3	1.1	9, 7, 9
			Sand, medium to coarse grained, a little shell, a little shell gravel (SP-SM)	50	4	-.4	4, 4, 5
				50	5	-1.9	3, 3, 5
				60	6	-3.4	4, 4, 4
				50	7	-4.9	5, 4, 4
-5.9	11.5			50	8	Set HW Casing to Control Silt / -6.4	3, 7, 1
			Laminations and lenses of silt, clay and fine, dark gray sand (SM)	100	9	-7.9	2, 3, 3
				100	10	-9.4	1, 1, 1
				100	11	-10.9	1, 2, 2
				75	12	-12.4	2, 2, 2
-13.9	19.5			90	13	-13.9	1, 1, 3
			End of Boring at 19.5'				
			Soils are field visually classified in accordance with the Unified Soils Classification System.				

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

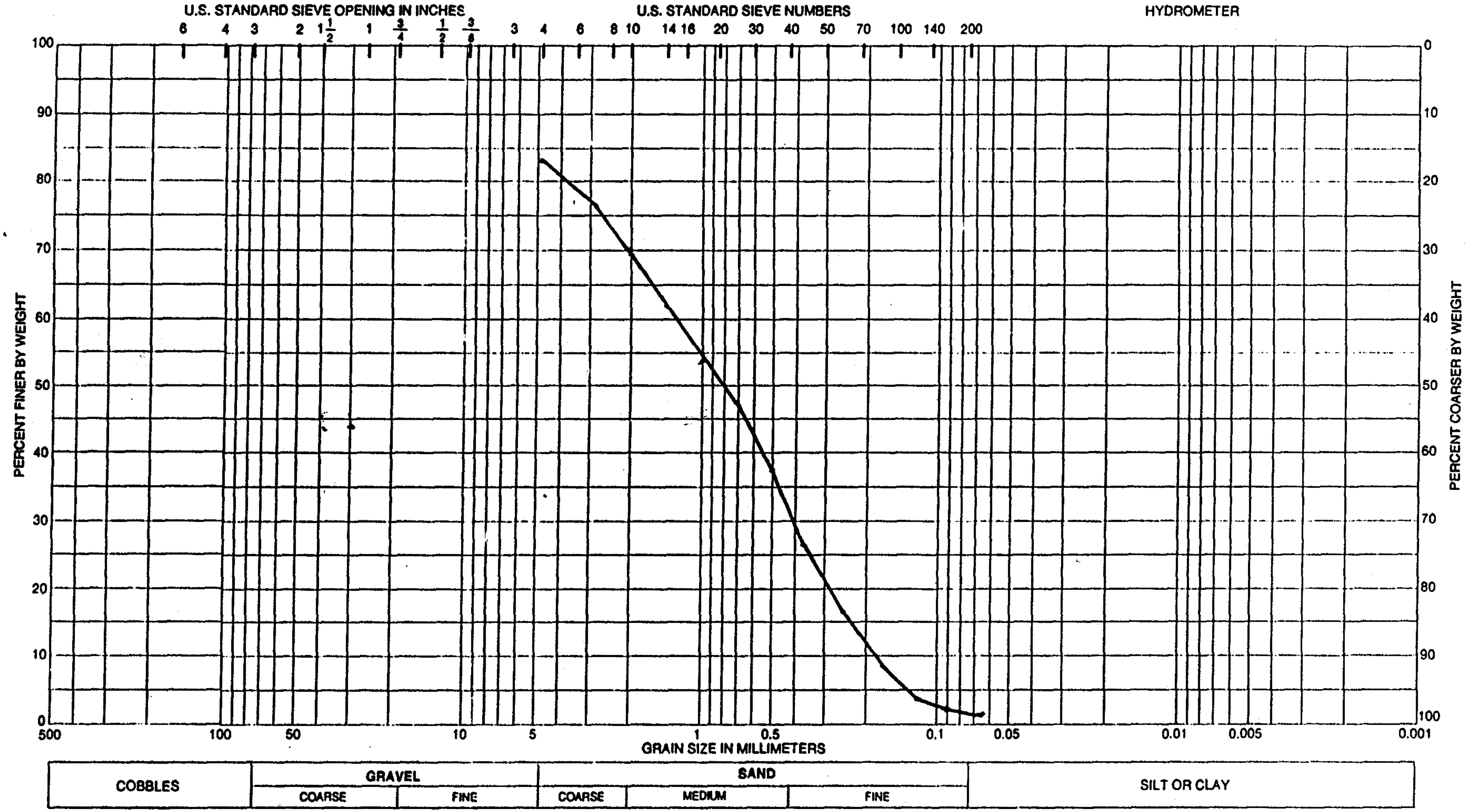
ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Mayport Little Jetties	CB-MLJ98-7

GEOTECHNICAL ATTACHMENT

Analytical Data from 1998

ATTACHMENT B



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
4	4.5-6.0	SP				

Project: Mayport Little Jetties
Duval County, Florida

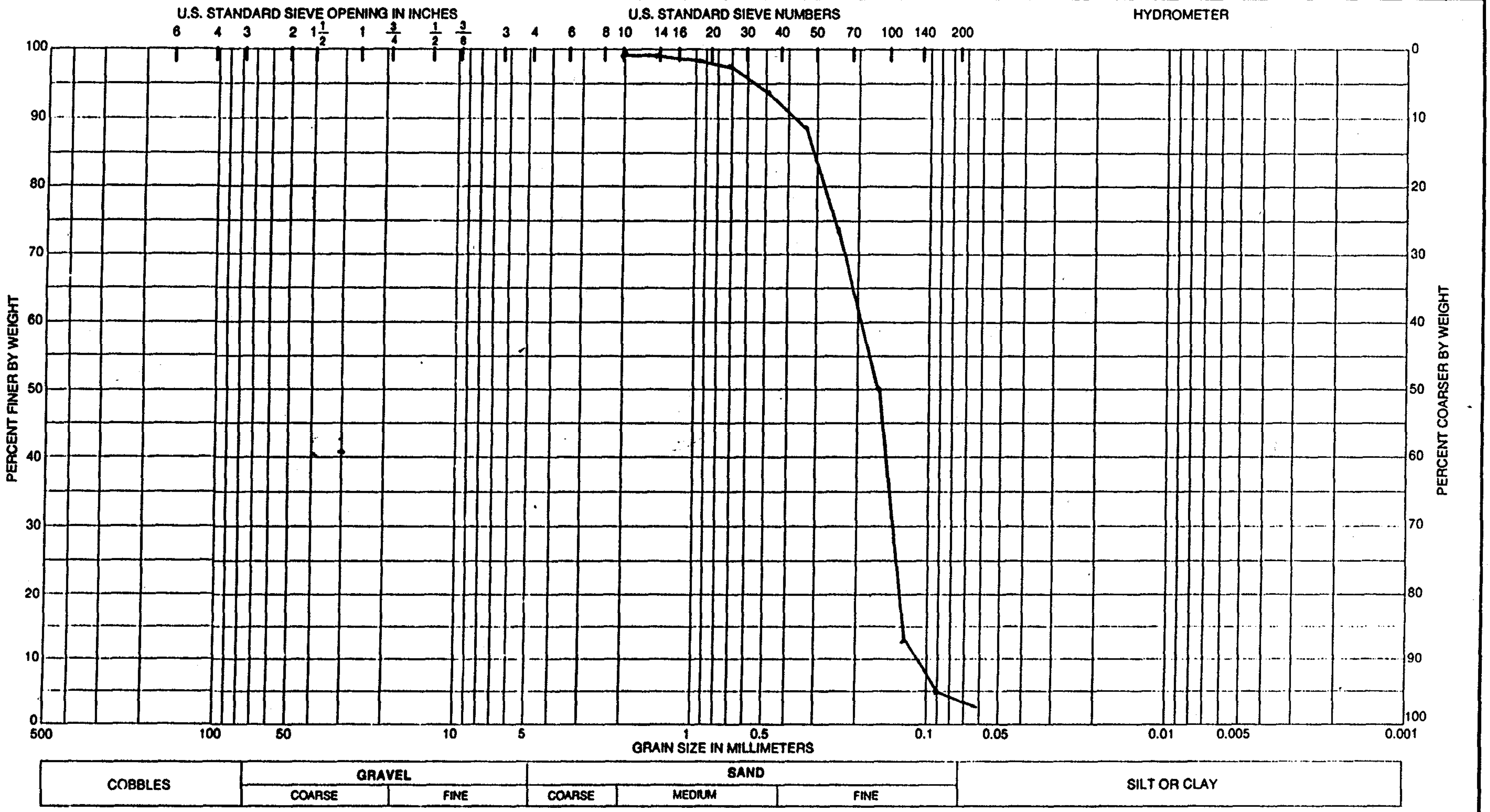
Area:

Boring No. CB-MLJ98-1

Date 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
5	6.0-7.5	SP				

Project: Mayport Little Jetties
Duval County, Florida

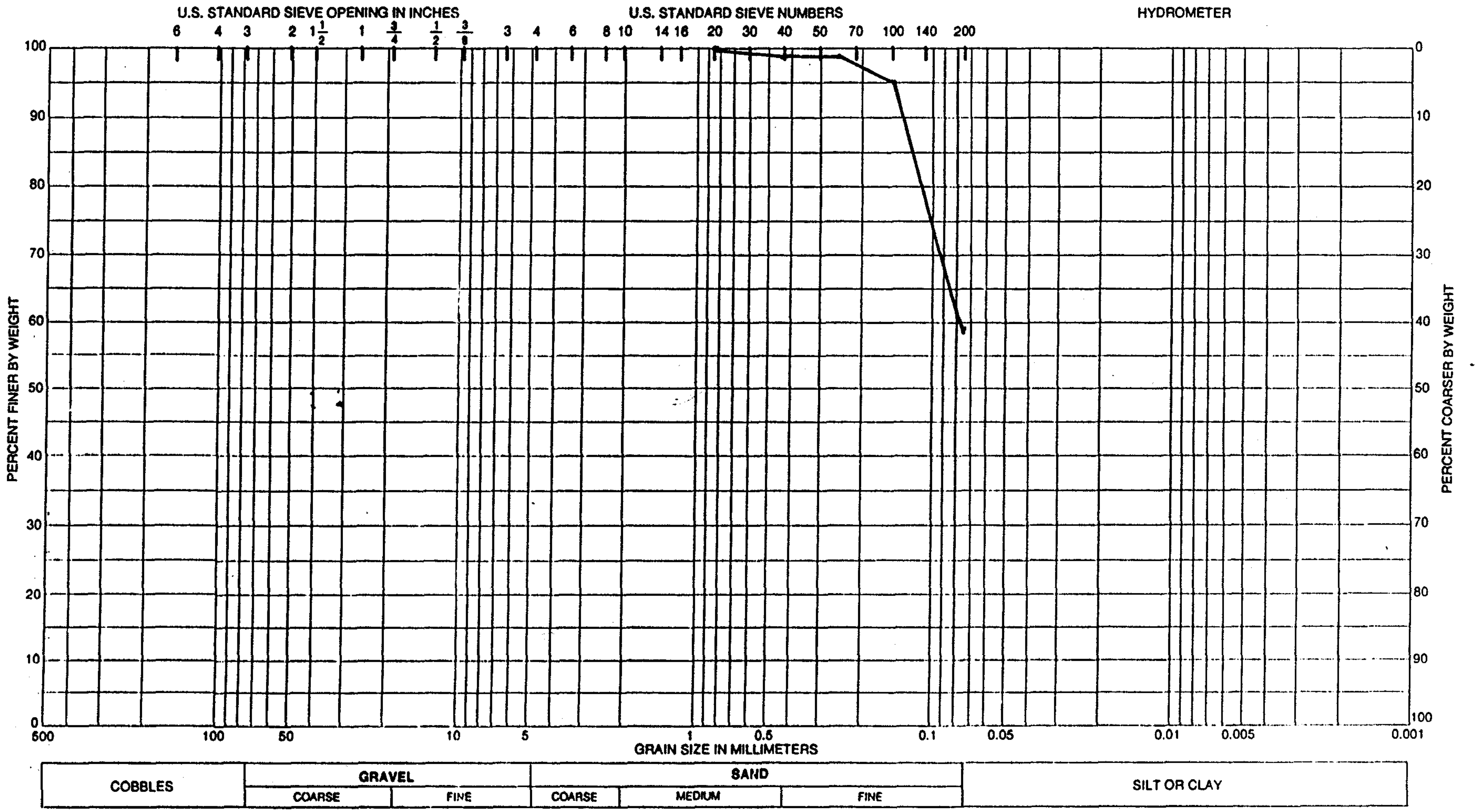
Area:

Boring No.: CB-MLJ98-2

Date: 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087

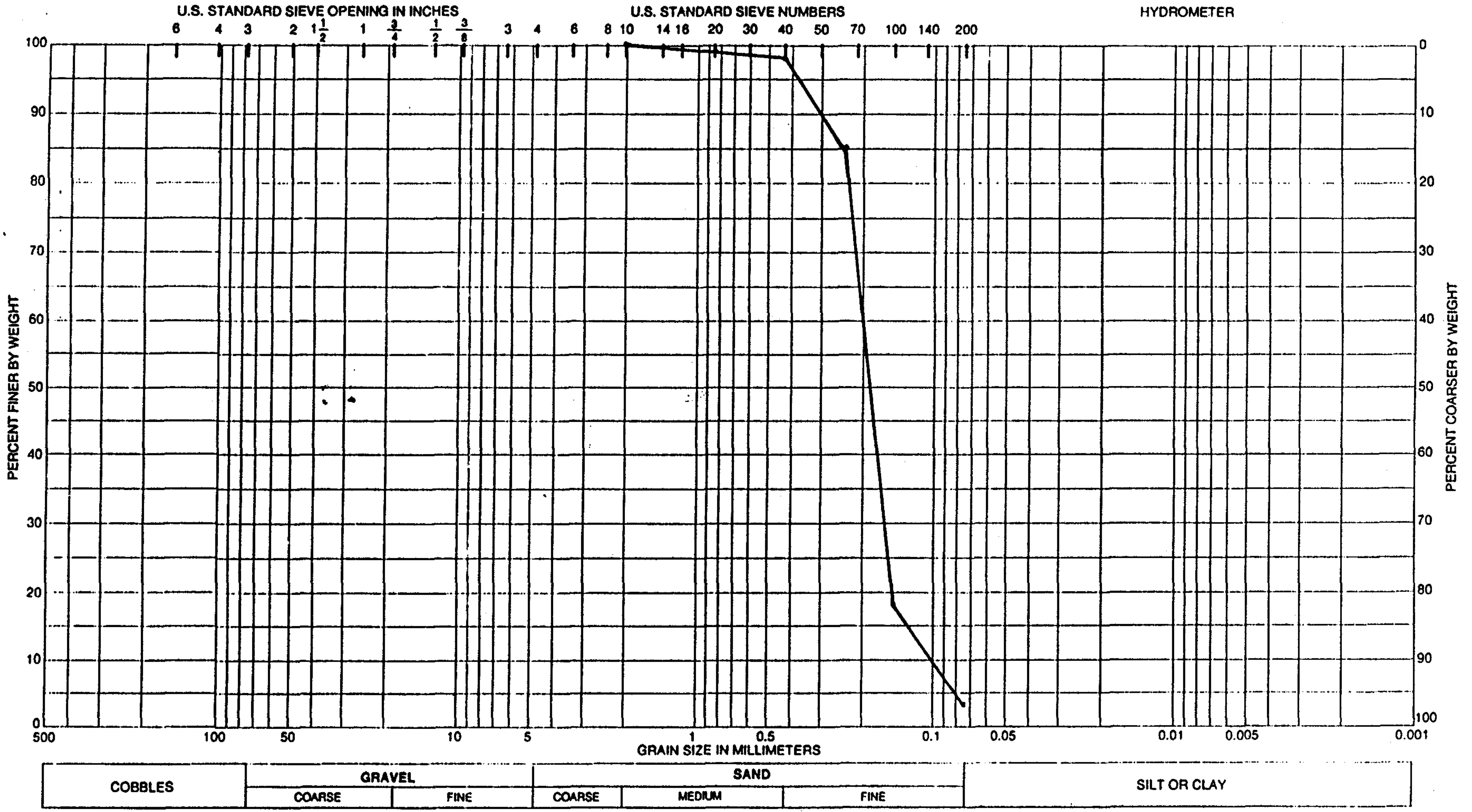


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
4	4.0 - 5.5	ML		96	33	63

Project	Mayport Little Jetties
	Duval County, Florida
Area	
Boring No.	CB-MLJ98-3
Date	2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
5	6.0 - 7.5	SP				

Project Mayport Little Jetties
Duval County, Florida

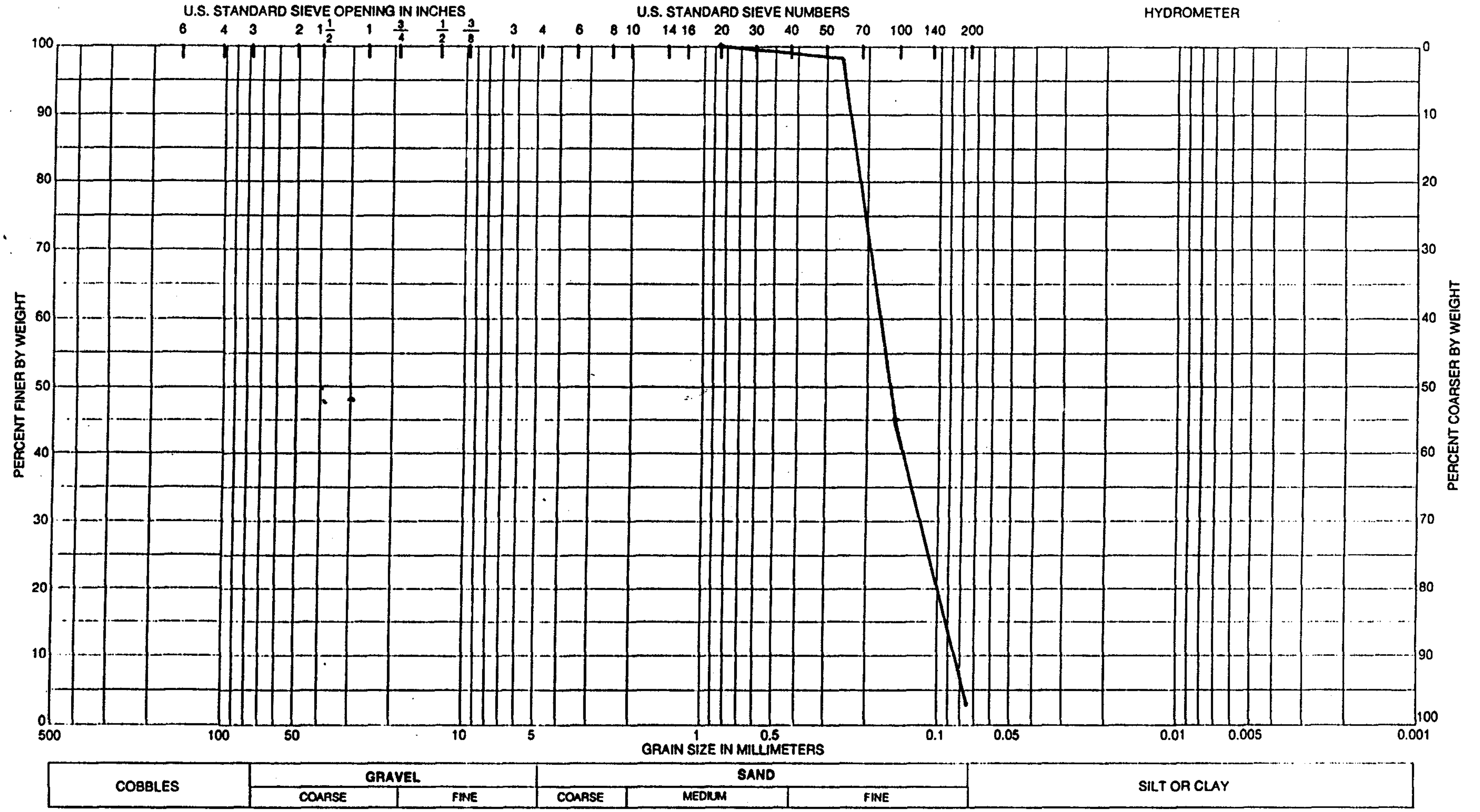
Area

Boring No. CB-MLJ98-3

Date 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
2	1.5 - 3.0	SP				

Project Mayport Little Jetties
Duval County, Florida

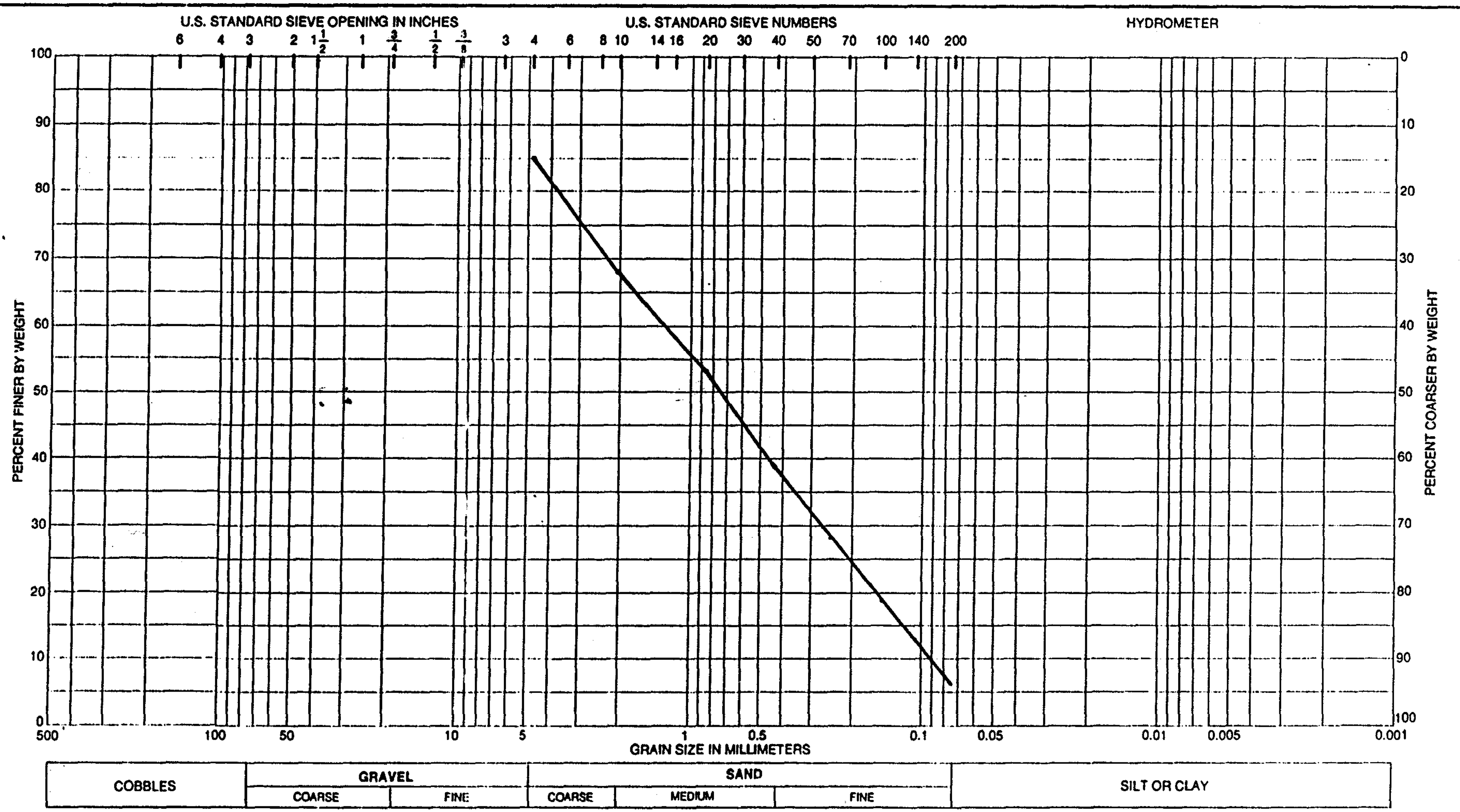
Area

Boring No. CB-MLJ98-4

Date 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
2	1.5 - 3.0	SP-SM				

Project: Mayport Little Jetties
Duval County, Florida

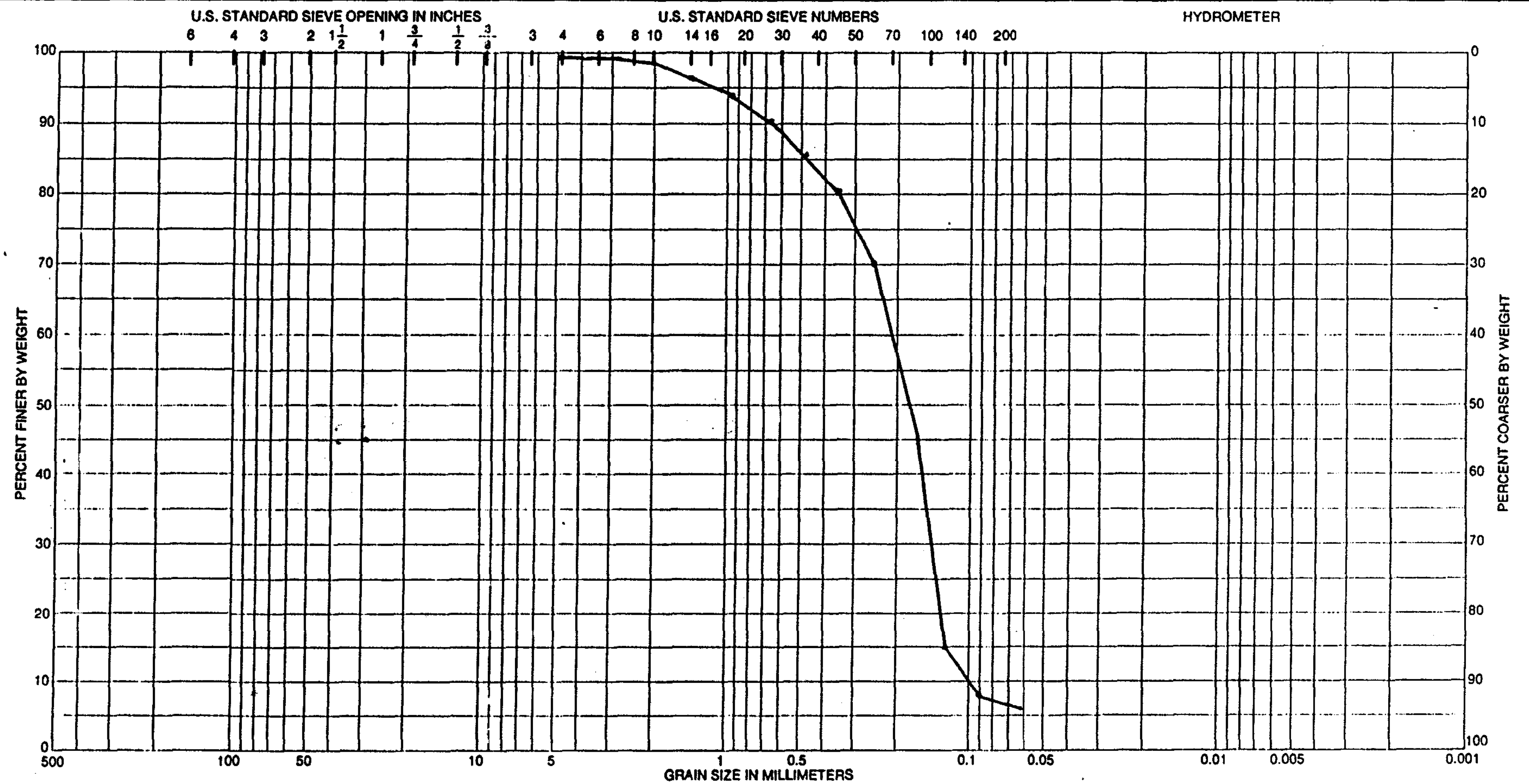
Area

Boring No. CB-MLJ98-6

Date 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
4	4.5-6.0	SP-SM				

Project: Mayport Little Jetties
Duval County, Florida

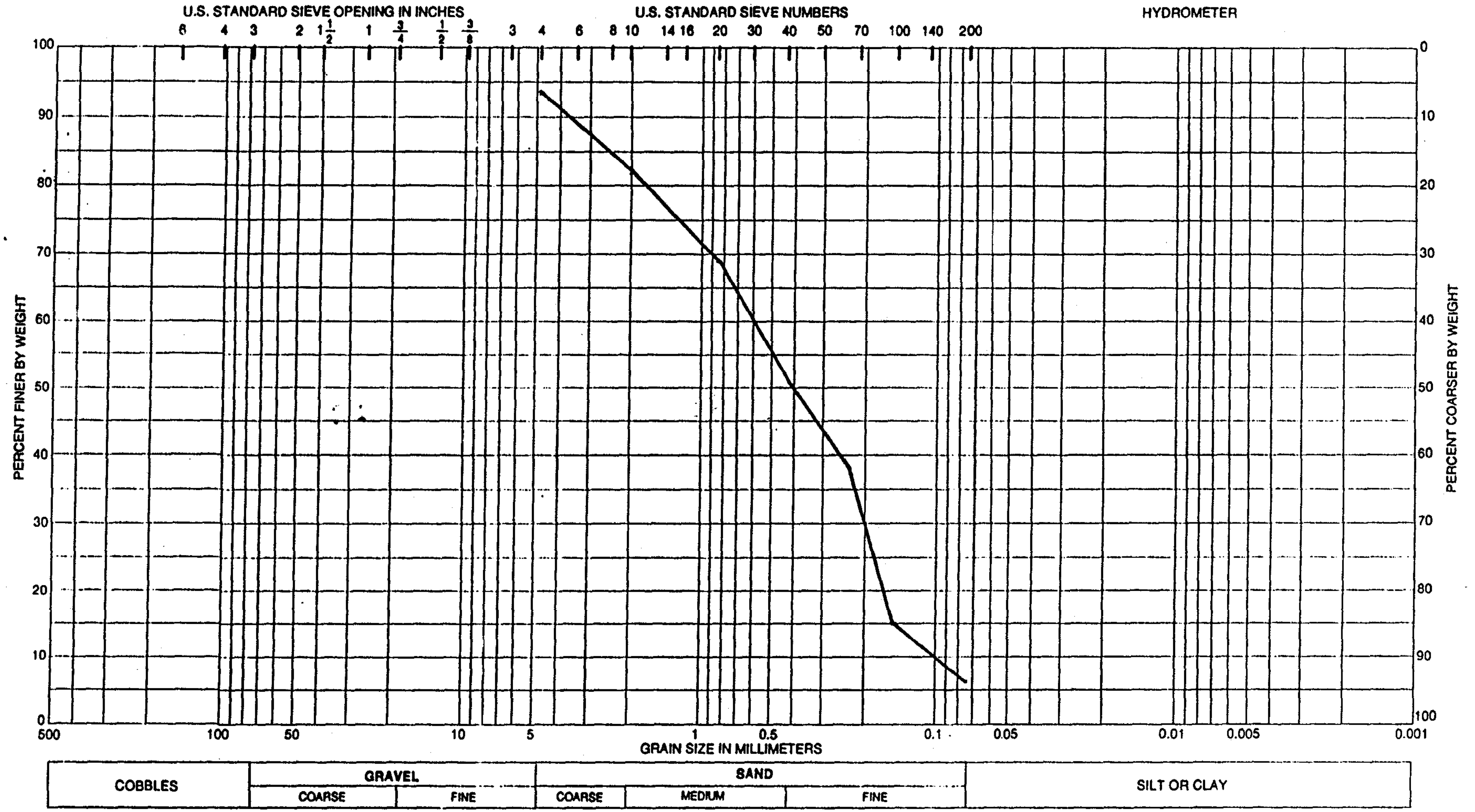
Area:

Boring No.: CB-MLJ98-6

Date: 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
4	4.5 - 6.0	SP-SM				

Project: Mayport Little Jetties
Duval County, Florida

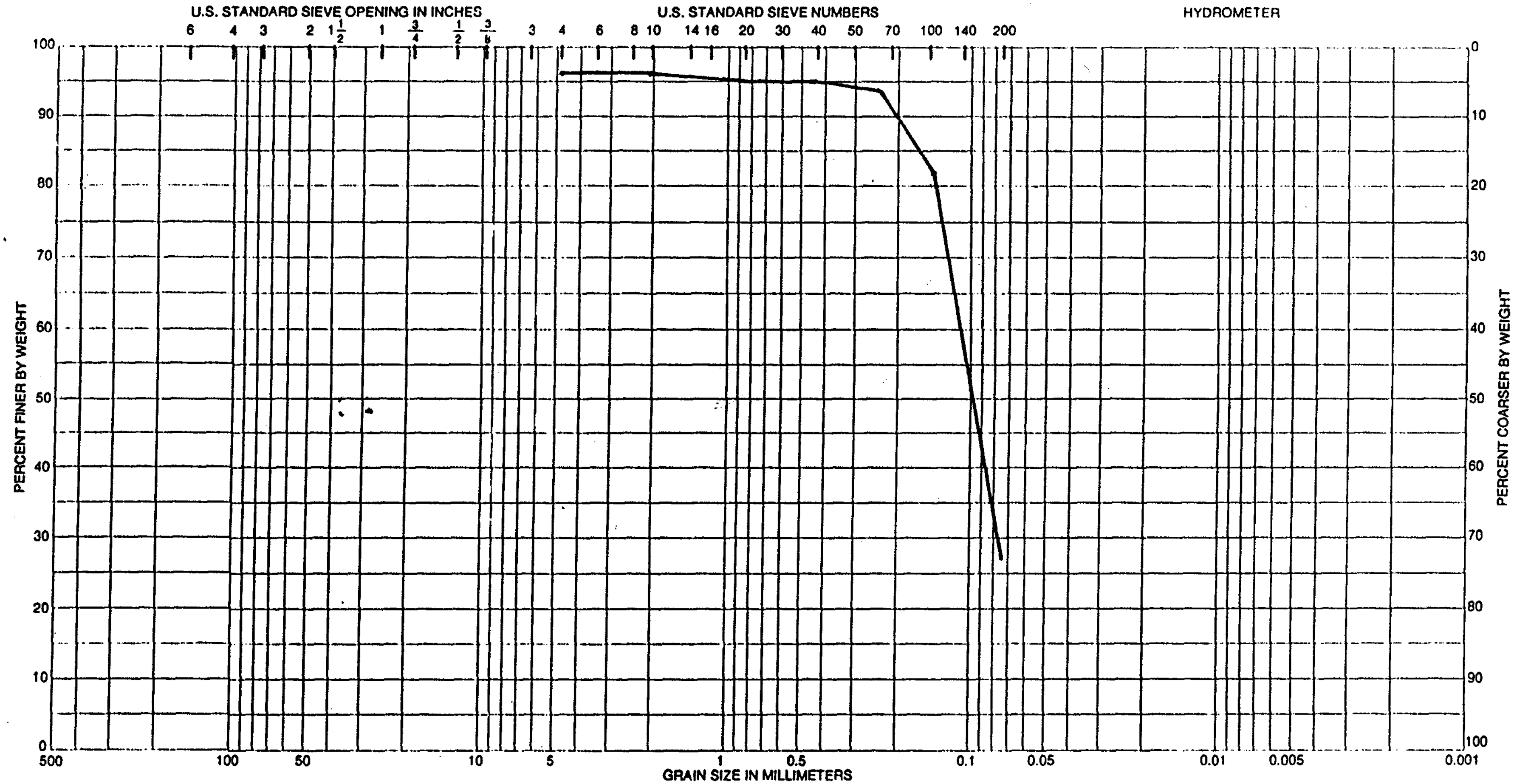
Area:

Boring No.: CB-MLJ98-7

Date: 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
10	13.5 - 15.0	SM				

Project Mayport Little Jetties
Duval County, Florida

Area

Boring No. CB-MLJ98-7

Date 2/18/98 98-027

GRADATION CURVES

ENG FORM 1 MAY 63 2087

GEOTECHNICAL ATTACHMENT

Boring Logs from 2005

ATTACHMENT B

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT: See Remarks
	10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.) — HORIZONTAL: NAD83 — VERTICAL: MLLW
2. BORING DESIGNATION: CB-JHMP-05-1 — LOCATION COORDINATES: X = 508,390 Y = 2,201,784	11. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500 — ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY: Corps of Engineers - CESAS — CONTRACTOR FILE NO.:	12. TOTAL SAMPLES — DISTURBED: 13 — UNDISTURBED (UD): 0
4. NAME OF DRILLER: Danny Hewett	13. TOTAL NUMBER CORE BOXES: 1
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG. FROM VERTICAL: — BEARING:	14. ELEVATION GROUND WATER: N/A
	15. DATE BORING — STARTED: 08-27-06 — COMPLETED: 08-27-06
6. THICKNESS OF OVERBURDEN: N/A	16. ELEVATION TOP OF BORING: -43.8 Ft.
7. DEPTH DRILLED INTO ROCK: N/A	17. TOTAL RECOVERY FOR BORING: 68 %
8. TOTAL DEPTH OF BORING: 16.2 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR: Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-43.8	0.0						-43.8		
-44.8	1.0		SAND, silty, mostly fine-grained sand-sized quartz, little silt, few shell up to 1/2", wet, dark brown (SM)	52	1		SPT Sampler	11 / 26 / 22	48
-47.5	3.7		SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace shell up to 1/2", trace fines, wet, tan/gray (SP)		2		-45.3		
							Overwashed		
							-47.5		
			CLAY, lean, low plasticity, very hard, few fine-grained sand-sized quartz, dry, tan (CL)	100	3		SPT Sampler -48.4	0 / 50/0.4'	
							-48.5 Advanced Boring		
				100	4		SPT Sampler -50.0	38 / 56 / 67	123
-51.2	7.4			45	5		SPT Sampler	19 / 28 / 38	66
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, some dark minerals, moist, gray (SP)		6		-51.5		
				80	7		SPT Sampler -53.0	18 / 36 / 54	90
-53.5	9.7		At El. -53.0 Ft.	80	8		-53.5 SPT Sampler	60	
			CLAY, lean, low plasticity, hard, trace fine-grained sand-sized quartz, dry, gray/green (CL)	67	9		-53.8 SPT Sampler	50/0.0'	
							-54.0 Advanced Boring		
			At El. -55.0 Ft., trace fine gravel-sized carbonate up to 1/4", moderate cementation	100	10		SPT Sampler -55.5	16 / 21 / 26	47
			At El. -56.5 Ft., no cementation	73	11		SPT Sampler -57.0	30 / 39 / 40	79
				87	12		SPT Sampler -58.5	18 / 26 / 31	57
				87	13		SPT Sampler	40	

(Continued)

Boring Designation CB-JHMP-05-1

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Jacksonville Harbor Mile Point	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL MLLW
LOCATION COORDINATES X = 508,390 Y = 2,201,784	ELEVATION TOP OF BORING -43.8 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-60.0	16.2			87	13		SPT Sampler -60.0	40 33	73
			NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. From El. -43.8 ft.to El. -44.8 ft. and El. -55.5 ft. to El. -57.0 ft.,. 4. Laboratory Testing Results				140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).		

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.0	SP-SC*
2	1.0/1.5	SC*
4	4.7/6.2	SC*
7	7.7/9.2	SC*
10	10.2/11.7	SC*

*Lab visual classification based on gradation curve. No Atterberg limits.

15 20 25 30 35

SAJ FORM 1836-A
JUN 02

DRILLING LOG

DRILLING LOG	**DIVISION** South Atlantic	**INSTALLATION** Jacksonville District	**SHEET** 1 **OF** 2 **SHEETS**
1. PROJECT Jacksonville Harbor Mile Point Erosion Investigation		**9. SIZE AND TYPE OF BIT** See Remarks	
		10. COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	**HORIZONTAL** NAD83 / **VERTICAL** MLLW
2. BORING DESIGNATION CB-JHMP-05-2	**LOCATION COORDINATES** X = 510,440 Y = 2,199,595	**11. MANUFACTURER'S DESIGNATION OF DRILL** Failing 1500	☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAS	**CONTRACTOR FILE NO.**	**12. TOTAL SAMPLES**	**DISTURBED** 16 / **UNDISTURBED (UD)** 0
4. NAME OF DRILLER Danny Hewett		**13. TOTAL NUMBER CORE BOXES** 1	
		14. ELEVATION GROUND WATER N/A	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	**DEG. FROM VERTICAL** / **BEARING**	**15. DATE BORING**	**STARTED** 08-28-06 / **COMPLETED** 08-28-06
6. THICKNESS OF OVERBURDEN N/A		**16. ELEVATION TOP OF BORING** -36.7 Ft.	
7. DEPTH DRILLED INTO ROCK N/A		**17. TOTAL RECOVERY FOR BORING** 75 %	
8. TOTAL DEPTH OF BORING 23.3 Ft.		**18. SIGNATURE AND TITLE OF INSPECTOR** Greg Taylor, Geologist	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-36.7	0.0						-36.7		
			CLAY, fat, high plasticity, soft, few shell up to 1/4", trace fine-grained sand-sized quartz, wet, green gray (CH)	87	1		SPT Sampler -38.2	0 / 1 / 3	4
			At El. -38.6 Ft., discontinue shell	87	2		SPT Sampler -39.7	5 / 7 / 8	15
				100	3		SPT Sampler -41.2	3 / 9 / 9	18
				100	4		SPT Sampler -42.7	5 / 9 / 11	20
			At El. -43.7 Ft., few fine-grained sand-sized quartz	100	5		SPT Sampler -44.2	8 / 8 / 8	16
			At El. -44.8 Ft., little fine-grained sand-sized quartz	100	6		SPT Sampler -45.7	5 / 6 / 8	14
				80	7		SPT Sampler -47.2	5 / 10 / 12	22
			At El. -47.6 Ft., stratified with poorly-graded sand up to 1/2", every 2 inches	93	8		SPT Sampler -48.7	5 / 8 / 11	19
			At El. -49.3 Ft., few shell up to 1/4"	73	9		SPT Sampler -50.2	9 / 16 / 23	39
-50.3	13.6		At El. -50.0 Ft., some shell, trace fine-grained sand-sized quartz		10				
			SAND, silty, mostly fine-grained sand-sized quartz, some fines, moist, gray/green (SM)	78	11		SPT Sampler -51.1	28 / 60/0.4'	
							-51.2 Advanced Boring		
				100	12		SPT Sampler	64	

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(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Jacksonville Harbor Mile Point	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL MLLW
LOCATION COORDINATES X = 510,440 Y = 2,199,595	ELEVATION TOP OF BORING -36.7 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
							-51.9	50/0.2'	
							Advanced Boring -52.7		
				85	13		SPT Sampler -54.0	30 62 50/0.3'	112+
							Advanced Boring -54.2		
			At El. -54.5 Ft., lenses of clay up to 1/4 in. thick	62	14		SPT Sampler -55.0	40 50/0.3'	
							Advanced Boring -55.7		
				33	15		SPT Sampler -57.2	50 45 37	82
				100	16		SPT Sampler -57.4	50/0.2'	
-57.7	21.0						Advanced Boring -57.7		
			SILT, inorganic-L, low plasticity, very soft, little fine-grained sand-sized sand, dry, gray (ML)	0			SPT Sampler -59.2	77 50 52	102
-60.0	23.3			0			SPT Sampler -60.0	30 50/0.3'	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Mud loss at El. 38.2 ft.

4. From El. -57.7 ft. to El. -60.0 ft., 4 x 5.5 " core barrel used to retrieve material after SPT had no recovery.

5. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
3	3.0/4.5	CH*
11	13.6/14.4	SC*

*Lab visual classification based on gradation curve. No Atterberg limits.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Depth scale: 15, 20, 25, 30, 35

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT: See Remarks
	10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.); HORIZONTAL: NAD83; VERTICAL: MLLW
2. BORING DESIGNATION: CB-JHMP-05-3; LOCATION COORDINATES: X = 510,417 Y = 2,198,831	11. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500; ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY: Corps of Engineers - CESAS; CONTRACTOR FILE NO.:	12. TOTAL SAMPLES: DISTURBED 12; UNDISTURBED (UD) 0
4. NAME OF DRILLER: Danny Hewett	13. TOTAL NUMBER CORE BOXES: 1
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG. FROM VERTICAL: ; BEARING:	14. ELEVATION GROUND WATER: N/A
	15. DATE BORING: STARTED 08-31-06; COMPLETED 08-31-06
6. THICKNESS OF OVERBURDEN: N/A	16. ELEVATION TOP OF BORING: -12.5 Ft.
7. DEPTH DRILLED INTO ROCK: N/A	17. TOTAL RECOVERY FOR BORING: 39 %
8. TOTAL DEPTH OF BORING: 18.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR: Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-12.5	0.0						-12.5		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace dark minerals, wet, tan/gray (SP)	67	1		SPT Sampler -14.0	6 12 14	26
			At El. -14.5 Ft., few shell up to 1/4" At El. -15.3 Ft., discontinue shell, dark gray	100	2		SPT Sampler -15.5	20 17 22	39
				20	3		SPT Sampler -17.0	7 9 10	19
				20	4		SPT Sampler -18.5	12 10 10	20
				20	5		SPT Sampler -20.0	8 11 8	19
				27	6		SPT Sampler -21.5	11 7 14	21
				33	7		SPT Sampler -23.0	16 14 12	26
				40	8		SPT Sampler -24.5	15 9 9	18
				33	9		SPT Sampler -26.0	14 11 15	26
				40	10		SPT Sampler -27.5	15 15 17	32

(Continued)

Boring Designation CB-JHMP-05-3

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Jacksonville Harbor Mile Point	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL MLLW
LOCATION COORDINATES X = 510,417 Y = 2,198,831	ELEVATION TOP OF BORING -12.5 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				27	11		SPT Sampler -29.0	12 11 7	18
-30.5	18.0			40	12		SPT Sampler -30.5	15 12 12	24
			NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System. 3. Mud loss at El. -45.7 ft. 4. Laboratory Testing Results				140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).		

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
2	1.5/3.0	SP-SC*

*Lab visual classification based on gradation curve. No Atterberg limits.

Depth scale: 15, 20, 25, 30, 35

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Boring Designation CB-JHMP-05-4

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT See Remarks
	10. COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.); HORIZONTAL NAD83; VERTICAL MLLW
2. BORING DESIGNATION CB-JHMP-05-4; LOCATION COORDINATES X = 514,358 Y = 2,199,652	11. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500; ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAS; CONTRACTOR FILE NO.	12. TOTAL SAMPLES DISTURBED 17; UNDISTURBED (UD) 0
4. NAME OF DRILLER Danny Hewett	13. TOTAL NUMBER CORE BOXES 1
	14. ELEVATION GROUND WATER N/A
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED; DEG. FROM VERTICAL; BEARING	15. DATE BORING STARTED 08-28-06; COMPLETED 08-28-06
6. THICKNESS OF OVERBURDEN N/A	16. ELEVATION TOP OF BORING -41.5 Ft.
7. DEPTH DRILLED INTO ROCK N/A	17. TOTAL RECOVERY FOR BORING 71 %
8. TOTAL DEPTH OF BORING 20.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-41.5	0.0						-41.5		
-43.0	1.5		SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace dark minerals, wet, tan (SP)	60	1		SPT Sampler -43.0	18 29 29	58
-44.0	2.5		GRAVEL, clayey, mostly fine to coarse gravel-sized limestone up to 1/2", some clay, few fine-grained sand-sized quartz, wet, weak cementation, tan/white (GC)	40	2		SPT Sampler	14 7	21
			SAND, poorly-graded, mostly quartz, trace fines, trace fine-grained sand-sized shell, wet, tan/gray (SP)		3		-44.5	14	
			At El. -45.1 Ft., few fines, few shell up to 1/2"	27	4		SPT Sampler -46.0	6 9 4	13
				27	5		SPT Sampler -47.5	0 2 7	9
			At El. -47.5 Ft., trace dark minerals	40	6		SPT Sampler -49.0	5 21 24	45
-50.5	9.0			60	7		SPT Sampler -50.5	12 25 20	45
			CLAY, lean, low plasticity, soft, few fine-grained sand-sized quartz, moist, green (CL)	87	8		SPT Sampler -52.0	4 5 8	13
-52.6	11.1			93	9		SPT Sampler	6 18	40
			SAND, clayey, mostly fine-grained sand-sized quartz, little clay, trace fine-grained sand-sized phosphate, moist, green (SC)		10		-53.5	22	
				100	11		SPT Sampler -55.0	12 7 9	16
				100	12		SPT Sampler -56.5	4 7 9	16

Scale: 0, 5, 10, 15

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(Continued)

Boring Designation CB-JHMP-05-4

DRILLING LOG (Cont. Sheet)

INSTALLATION	SHEET
Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Jacksonville Harbor Mile Point	State Plane, FLE (U.S. Ft.)	NAD83	MLLW

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 514,358 Y = 2,199,652	-41.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				100	13		SPT Sampler -58.0	5 / 8 / 9	17
-58.7	17.2			100	14 / 15		SPT Sampler -59.3	7 / 14 / 50/0.3'	64+
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, moist, tan (SM)				-59.5 Advanced Boring		
				100	16		-59.8 SPT Sampler	50/0.3'	
							-60.0 Advanced Boring		
-61.5	20.0			87	17		SPT Sampler -61.5	17 / 25 / 46	71
			BORING TERMINATED IN REFUSAL				140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.5	SC*
8	9.0/10.5	SC*
10	11.1/12.0	SP-SC*
15	17.2/17.8	SC*

*Lab visual classification based on gradation curve. No Atterberg limits.

Depth scale: 15, 20, 25, 30, 35

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JUN 02

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT See Remarks
	10. COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.); HORIZONTAL NAD83; VERTICAL MLLW
2. BORING DESIGNATION CB-JHMP-05-5; LOCATION COORDINATES X = 512,408 Y = 2,198,561	11. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500; ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAS; CONTRACTOR FILE NO.	12. TOTAL SAMPLES: DISTURBED 6; UNDISTURBED (UD) 0
4. NAME OF DRILLER Danny Hewett	13. TOTAL NUMBER CORE BOXES 2
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED; DEG. FROM VERTICAL; BEARING	14. ELEVATION GROUND WATER N/A
	15. DATE BORING: STARTED 08-30-06; COMPLETED 09-13-06
6. THICKNESS OF OVERBURDEN N/A	16. ELEVATION TOP OF BORING -38.2 Ft.
7. DEPTH DRILLED INTO ROCK N/A	17. TOTAL RECOVERY FOR BORING 57 %
8. TOTAL DEPTH OF BORING 15.9 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-38.2	0.0						-38.2		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little shell up to 1", wet, dark brown/black (SP)	80	1		SPT Sampler -39.7	8 / 23 / 14	37
-41.2	3.0			27	2		SPT Sampler -41.2	3 / 1 / 0	1
-42.0	3.8		CLAY, fat, high plasticity, few fine-grained sand-sized quartz, dry, gray (CH)	100	3		SPT Sampler -42.0	8 / 50/0.3'	
		Mod. Weathered	LIMESTONE, moderately hard, moderately weathered, pitted, gray	53	BOX 1		4 x 5-1/2" Diamond Set Bit -43.5		
-44.0	5.8			100			4 x 5-1/2" Diamond Set Bit -44.0		
-45.6	7.4		SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace shell up to 1/4", moist, gray (SP)	53	4		SPT Sampler -45.5	4 / 5 / 10	15
			At El. -45.5 Ft., 6 to 8 pieces of limestone shards up to 1 in.	NR	5		-45.6 SPT Sampler		
		Moderately Weathered	LIMESTONE, moderately hard, moderately weathered, pitted, gray	100			4 x 5-1/2" Diamond Set Bit -47.6		
-52.6	14.4			30	BOX 2		4 x 5-1/2" Diamond Set Bit -52.6		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, moist, gray (SP)	67	6		SPT Sampler	79	

Scale: 0, 5, 10, 15

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(Continued)

Boring Designation CB-JHMP-05-5

DRILLING LOG (Cont. Sheet)

INSTALLATION	SHEET 2 OF 2 SHEETS
Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Jacksonville Harbor Mile Point	State Plane, FLE (U.S. Ft.)	NAD83	MLLW

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 512,408 Y = 2,198,561	-38.2 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-54.1	15.9			67	6		SPT Sampler -54.1	90 44	134

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Below El. -45.6 ft., new location 51 ft. WNW of original location at coordinates X = 512408, Y=2198502. Sample 5 on the original hole penetrated to El. -46.7, however blow counts were not recorded.

4. Geologist also Tracey Tapley.

5. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.5	SP-SC*
3	3.0/3.8	SC*
4	5.8/7.3	SP*

*Lab visual classification based on gradation curve. No Atterberg limits.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
NR = Not Recorded.

15
20
25
30
35

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Boring Designation CB-JHMP-05-6

DRILLING LOG

DIVISION	South Atlantic
INSTALLATION	Jacksonville District
SHEET 1 OF 2 SHEETS	
1. PROJECT	Jacksonville Harbor Mile Point
2. BORING DESIGNATION	CB-JHMP-05-6
LOCATION COORDINATES	X = 511,898 Y = 2,197,452
3. DRILLING AGENCY	Corps of Engineers - CESAS
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Danny Hewett
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	12.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, FLE (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	MLLW
11. MANUFACTURER'S DESIGNATION OF DRILL	Failing 1500 ☐ AUTO HAMMER ☒ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 8, UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	1
14. ELEVATION GROUND WATER	N/A
15. DATE BORING	STARTED 08-31-06, COMPLETED 08-31-06
16. ELEVATION TOP OF BORING	-19.0 Ft.
17. TOTAL RECOVERY FOR BORING	35 %
18. SIGNATURE AND TITLE OF INSPECTOR	Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-19.0	0.0						-19.0		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace dark minerals, wet, gray (SP)	33	1		SPT Sampler -20.5	3 / 8 / 13	21
				20	2		SPT Sampler -22.0	22 / 19 / 9	28
				67	3		SPT Sampler -23.5	25 / 25 / 26	51
				47	4		SPT Sampler -25.0	9 / 9 / 4	13
				33	5		SPT Sampler -26.5	3 / 0 / 7	7
				27	6		SPT Sampler -28.0	5 / 7 / 6	13
				27	7		SPT Sampler -29.5	13 / 9 / 14	23
-31.0	12.0			27	8		SPT Sampler -31.0	7 / 8 / 8	16
			NOTES: 1. USACE Jacksonville is the custodian for these original files. 2. Soils are field visually classified in accordance with the Unified Soils Classification System.				140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).		

Depth scale: 0, 5, 10, 15

SAJ FORM 1836
JUN 02

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Jacksonville Harbor Mile Point	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL MLLW
LOCATION COORDINATES X = 511,898 Y = 2,197,452	ELEVATION TOP OF BORING -19.0 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			3. Laboratory Testing Results						

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
3	3.0/4.5	SP-SC*

*Lab visual classification based on gradation curve. No Atterberg limits.

15
20
25
30
35

Boring Designation CB-JHMP-05-7

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT See Remarks
	10. COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.); HORIZONTAL NAD83; VERTICAL MLLW
2. BORING DESIGNATION CB-JHMP-05-7; LOCATION COORDINATES X = 513,339 Y = 2,197,002	11. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500; ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAS; CONTRACTOR FILE NO.	12. TOTAL SAMPLES DISTURBED 14; UNDISTURBED (UD) 0
4. NAME OF DRILLER Danny Hewett	13. TOTAL NUMBER CORE BOXES 2
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED; DEG. FROM VERTICAL; BEARING	14. ELEVATION GROUND WATER N/A
	15. DATE BORING STARTED 09-01-06; COMPLETED 09-01-06
6. THICKNESS OF OVERBURDEN N/A	16. ELEVATION TOP OF BORING -9.5 Ft.
7. DEPTH DRILLED INTO ROCK N/A	17. TOTAL RECOVERY FOR BORING 40 %
8. TOTAL DEPTH OF BORING 21.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-9.5	0.0						-9.5		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace dark minerals, wet, green/gray (SP)	40	1		SPT Sampler -11.0	8, 8, 7	15
				60	2		SPT Sampler -12.5	20, 42, 40	82
				41	3		SPT Sampler -14.0	13, 13, 9	22
				33	4		SPT Sampler -15.5	9, 9, 11	20
				41	5		SPT Sampler -17.0	7, 7, 12	19
				33	6		SPT Sampler -18.5	8, 7, 12	19
				41	7		SPT Sampler -20.0	8, 15, 16	31
				33	8		SPT Sampler -21.5	18, 16, 14	30
				48	9		SPT Sampler -23.0	17, 17, 16	33
				33	10		SPT Sampler -24.5	15, 16, 14	30

Depth scale: 0, 5, 10, 15

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Jacksonville Harbor Mile Point	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL MLLW
LOCATION COORDINATES X = 513,339 Y = 2,197,002	ELEVATION TOP OF BORING -9.5 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				47	11		SPT Sampler -26.0	18 17 14	31
				27	12		SPT Sampler -27.5	19 14 12	26
				41	13		SPT Sampler -29.0	15 16 14	30
-30.5	21.0			34	14		SPT Sampler -30.5	11 15 20	35

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.5	SP*
8	10.5/12.0	SP-SC*

*Lab visual classification based on gradation curve. No Atterberg limits.

REMARKS: 140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Depth scale: 15, 20, 25, 30, 35

Boring Designation CB-JHMP-05-8

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT: Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT: See Remarks
	10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.) — HORIZONTAL: NAD83 — VERTICAL: MLLW
2. BORING DESIGNATION: CB-JHMP-05-8 — LOCATION COORDINATES: X = 517,056 Y = 2,198,878	11. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500 — ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY: Corps of Engineers - CESAS — CONTRACTOR FILE NO.:	12. TOTAL SAMPLES — DISTURBED: 2 — UNDISTURBED (UD): 0
4. NAME OF DRILLER: Danny Hewett	13. TOTAL NUMBER CORE BOXES: 1
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG. FROM VERTICAL: — BEARING:	14. ELEVATION GROUND WATER: N/A
	15. DATE BORING — STARTED: 09-01-06 — COMPLETED: 09-01-06
6. THICKNESS OF OVERBURDEN: N/A	16. ELEVATION TOP OF BORING: -22.5 Ft.
7. DEPTH DRILLED INTO ROCK: N/A	17. TOTAL RECOVERY FOR BORING: 19 %
8. TOTAL DEPTH OF BORING: 10.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR: Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-22.5	0.0						-22.5		
			SILT, inorganic-H, high plasticity, very soft, few shell up to 1/2", wet, gray (MH)						
			At El. -28.0 Ft., little fine-grained sand-sized quartz	15	1		Free Fall of Sampler		
-31.0	8.5						-31.0		
			SAND, clayey, mostly fine-grained sand-sized quartz, little clay, few shell up to 1/2", moist, gray/green (SC)	42	2		SPT Sampler	3 3 7	10
-32.5	10.0						-32.5		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/8.5	SP-SM*

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

SAJ FORM 1836
JUN 02

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Jacksonville Harbor Mile Point	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL MLLW
LOCATION COORDINATES X = 517,056 Y = 2,198,878	ELEVATION TOP OF BORING -22.5 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
	15		2 8.5/10.0 SP-SM*						
			*Lab visual classification based on gradation curve. No Atterberg limits.						
	20								
	25								
	30								
	35								

Boring Designation CB-JHMP-05-9

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1 SHEETS

1. PROJECT: Jacksonville Harbor Mile Point	9. SIZE AND TYPE OF BIT: See Remarks
	10. COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.); HORIZONTAL: NAD83; VERTICAL: MLLW
2. BORING DESIGNATION: CB-JHMP-05-9; LOCATION COORDINATES: X = 515,753 Y = 2,193,548	11. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500; ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY: Corps of Engineers - CESAS; CONTRACTOR FILE NO.:	12. TOTAL SAMPLES: DISTURBED 3; UNDISTURBED (UD) 0
4. NAME OF DRILLER: Danny Hewett	13. TOTAL NUMBER CORE BOXES: 1
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG. FROM VERTICAL: ; BEARING:	14. ELEVATION GROUND WATER: N/A
	15. DATE BORING: STARTED 09-01-06; COMPLETED 09-01-06
6. THICKNESS OF OVERBURDEN: N/A	16. ELEVATION TOP OF BORING: -25.0 Ft.
7. DEPTH DRILLED INTO ROCK: N/A	17. TOTAL RECOVERY FOR BORING: 45 %
8. TOTAL DEPTH OF BORING: 8.1 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR: Greg Taylor, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-25.0	0.0						-25.0		
			SILT, inorganic-H, high plasticity, very soft, wet, gray (MH)	58	1		Free Fall of Sampler		
							-27.6		
				40	2		Free Fall of Sampler		
-32.6	7.6						-32.6		
-33.1	8.1		SAND, silty, mostly fine-grained sand-sized sand, little silt, moist, gray (SM)	33	3		-33.1 SPT Sampler	3	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/2.6	CH*

*Lab visual classification based on gradation curve. No Atterberg limits.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
WOR = Weight of Rods.

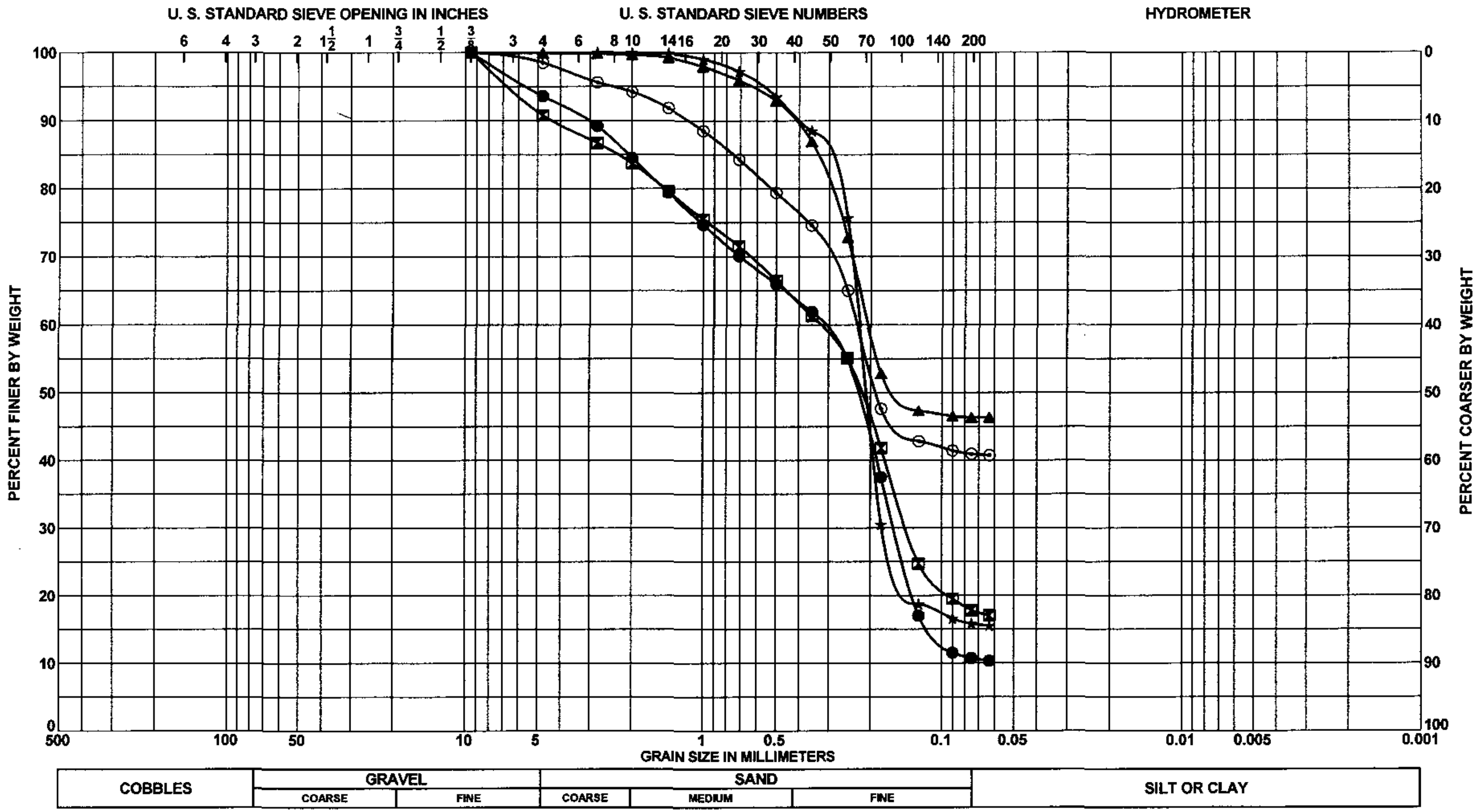
0 5 10 15

SAJ FORM 1836
JUN 02

GEOTECHNICAL ATTACHMENT

Analytical Data from 2005

ATTACHMENT B



Sample No.	Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.0 Ft.	(SP-SC)	5Y 4/1							
⊠ 2	1.0 to 1.5 Ft.	(SC)	10YR 6/6							
▲ 4	4.7 to 6.2 Ft.	(SC)	2.5Y 7/3							
★ 7	7.7 to 9.2 Ft.	(SC)	10YR 7/2							
⊙ 10	10.2 to 11.7 Ft.	(SC)	5Y 7/1							

GRADATION CURVES

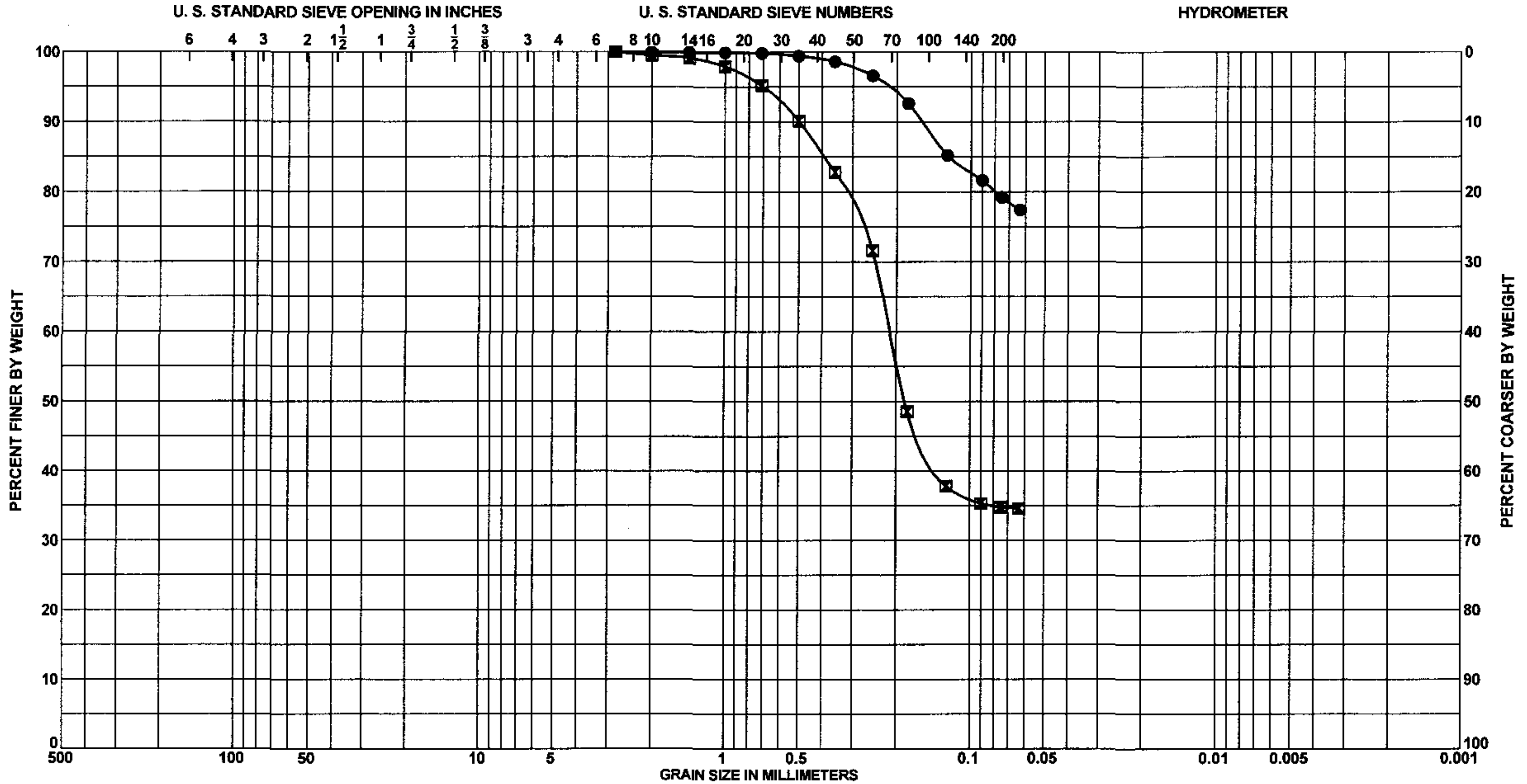
PROJECT Jacksonville Harbor Mile Point

BORING NO. CB-JHMP-05-1

BORING ELEV. -43.8 Ft., MLLW

DATE 7/19/2006

SAJ FORM 2087
JUN 02



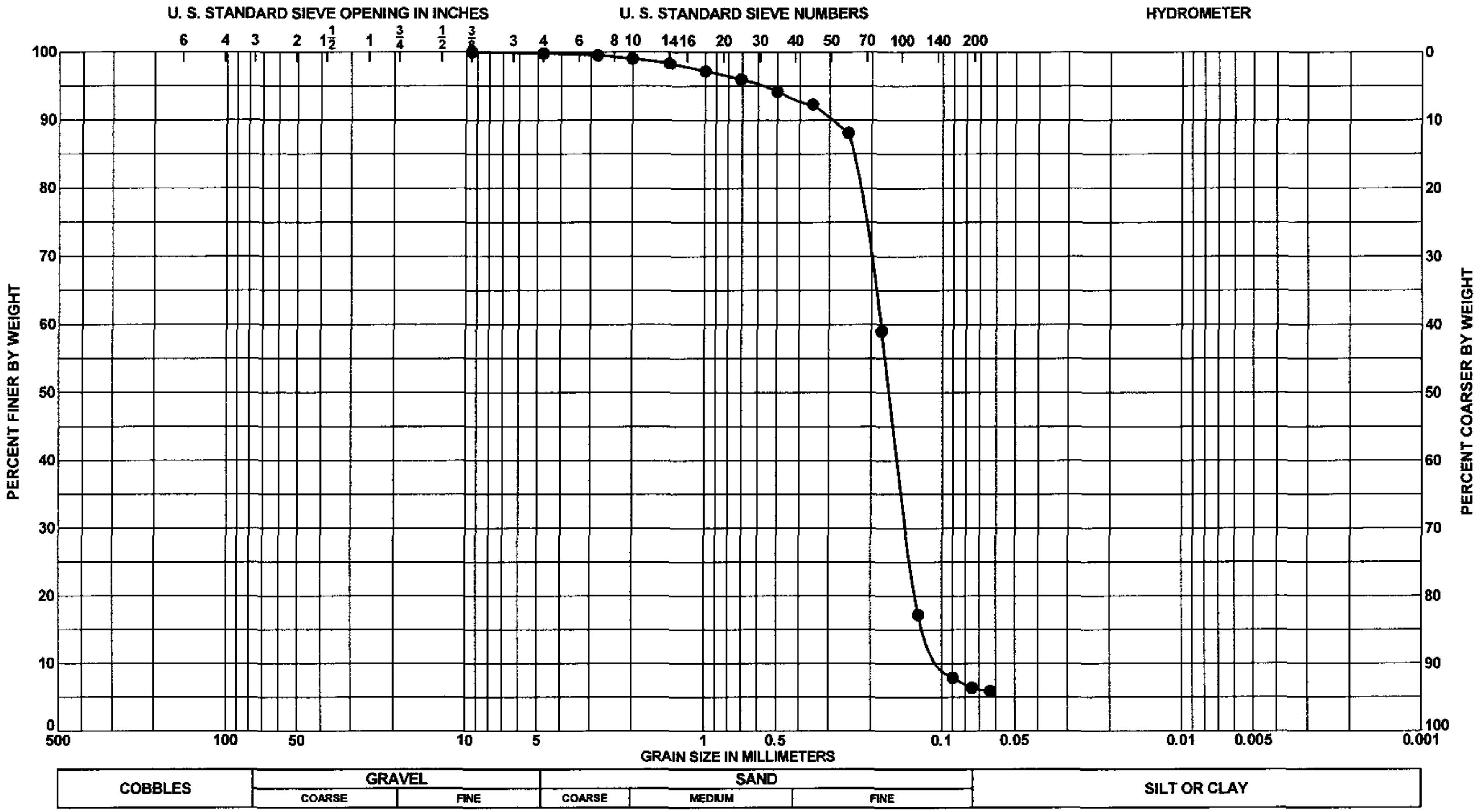
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.		Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
●	3	3.0 to 4.5 Ft.	(CH)	5Y 3/2							
⊠	11	13.6 to 14.4 Ft.	(SC)	5Y 6/1							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-2
BORING ELEV.	-36.7 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02

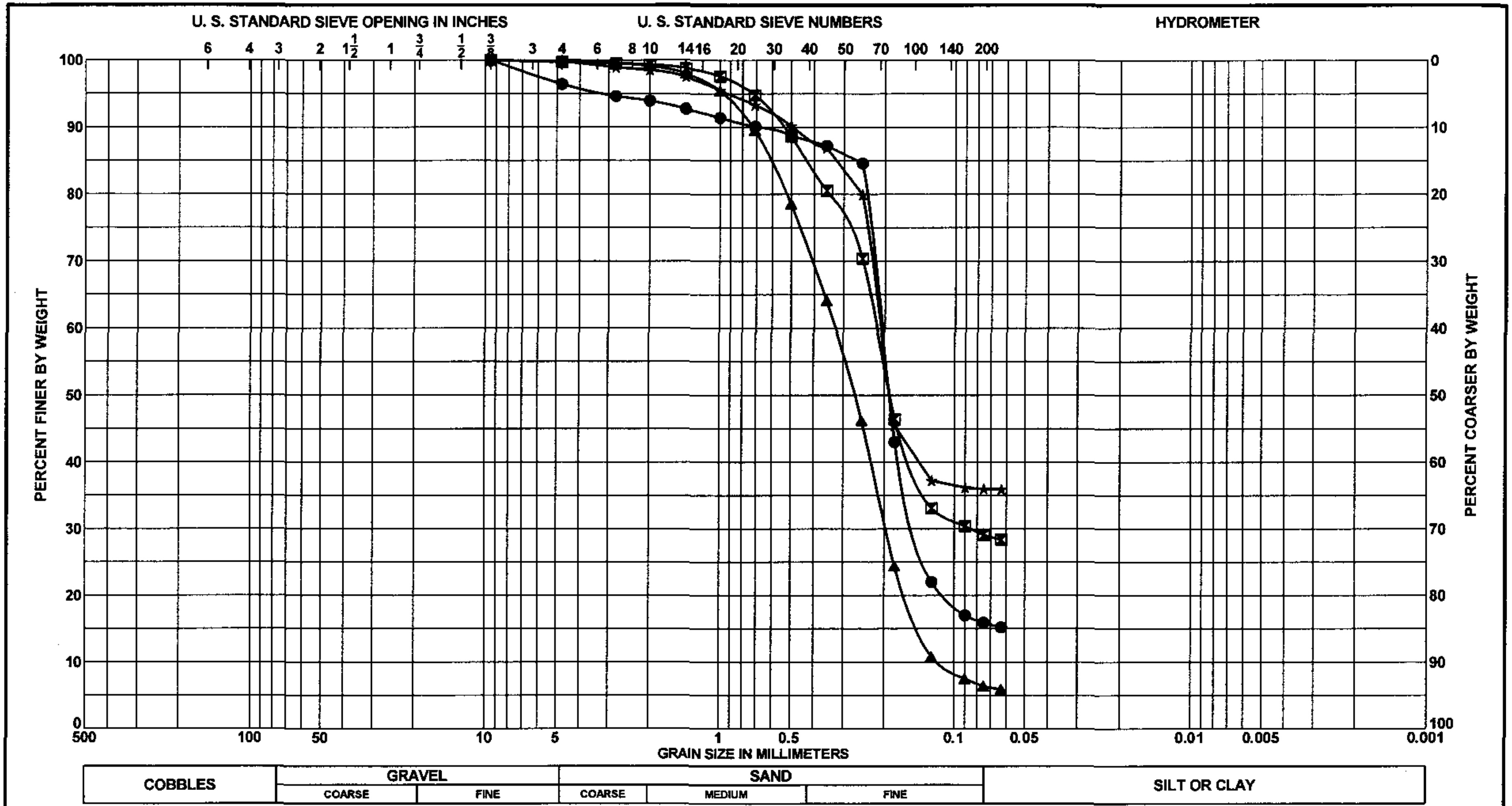


Sample No.	Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
● 2	1.5 to 3.0 Ft.	SAND, poorly-graded with clay, mostly fine-grained quartz sand, few shell fragments, few clay, gray (SP-SC)	10YR 5/1							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-3
BORING ELEV.	-12.5 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02

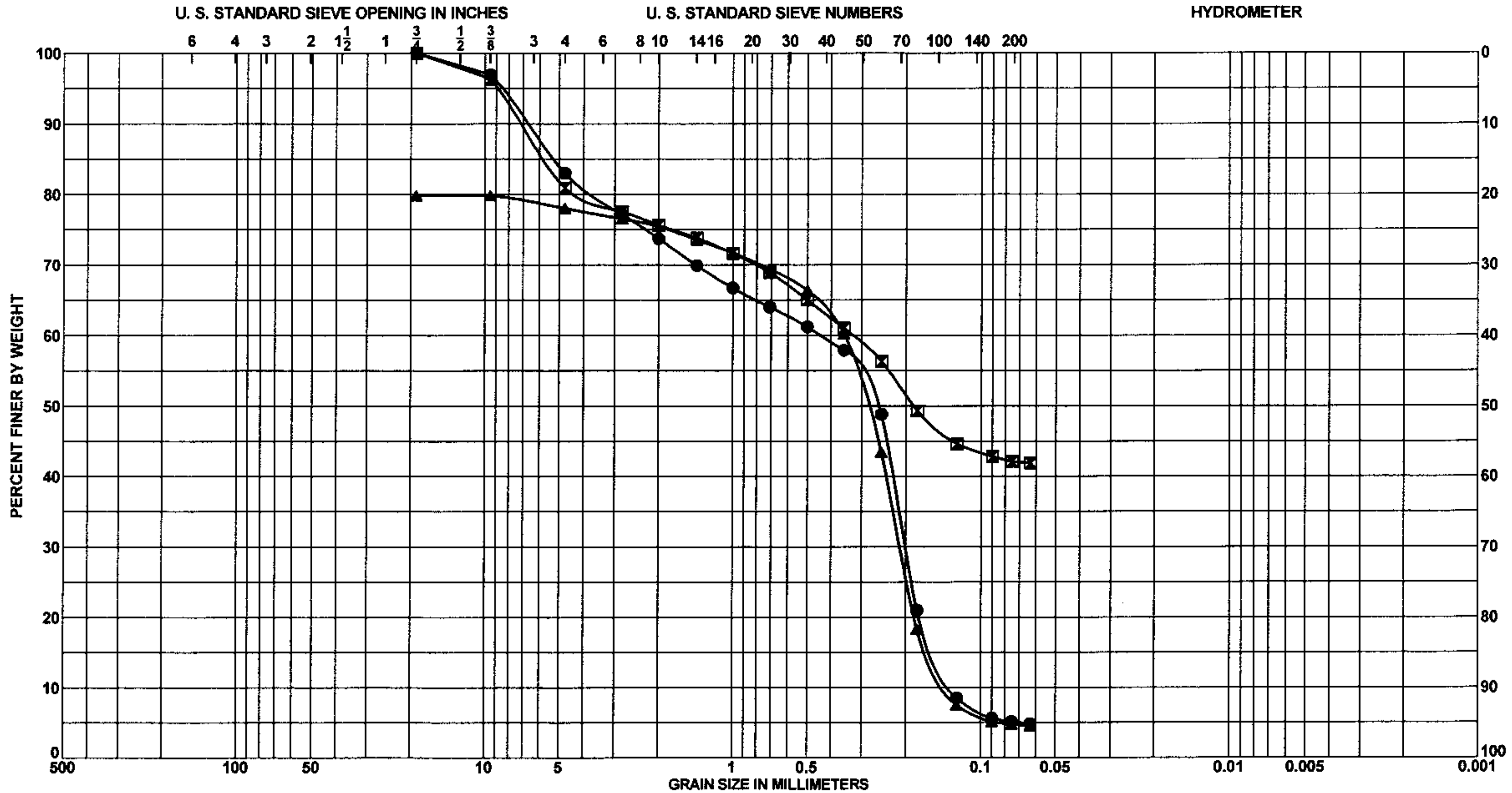


Sample No.		Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
●	1	0.0 to 1.5 Ft.	(SC)	10YR 7/3							
⊠	8	9.0 to 10.5 Ft.	(SC)	2.5Y 4/1							
▲	10	11.1 to 12.0 Ft.	(SP-SC)	10YR 4/1							
★	15	17.2 to 17.8 Ft.	(SC)	5Y 6/1							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-4
BORING ELEV.	-41.5 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02



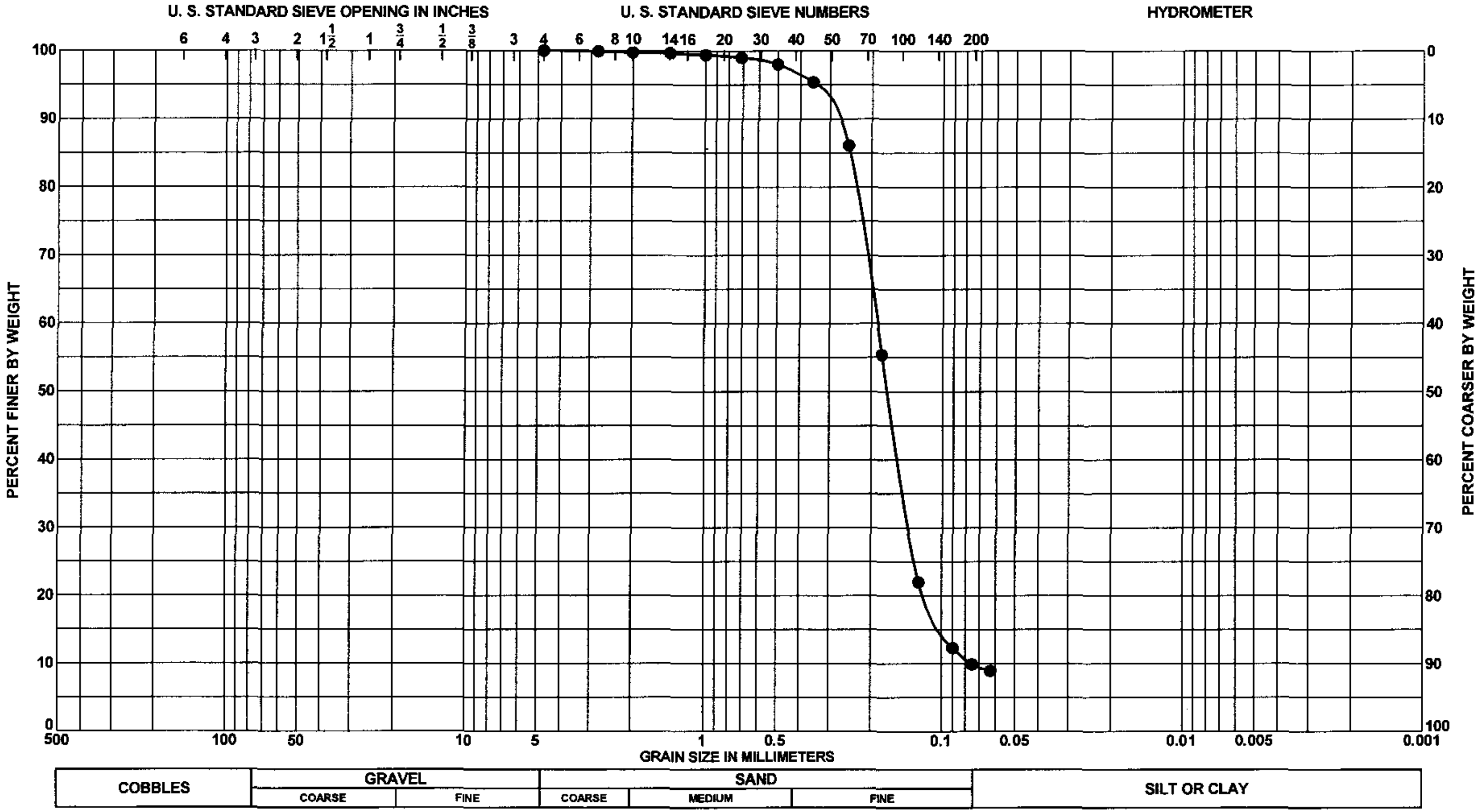
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.		Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
●	1	0.0 to 1.5 Ft.	(SP-SC)	10YR 5/1							
⊠	3	3.0 to 3.8 Ft.	(SC)	10YR 7/1							
▲	4	5.8 to 7.3 Ft.	(SP)	10YR 7/1							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-5
BORING ELEV.	-38.2 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02

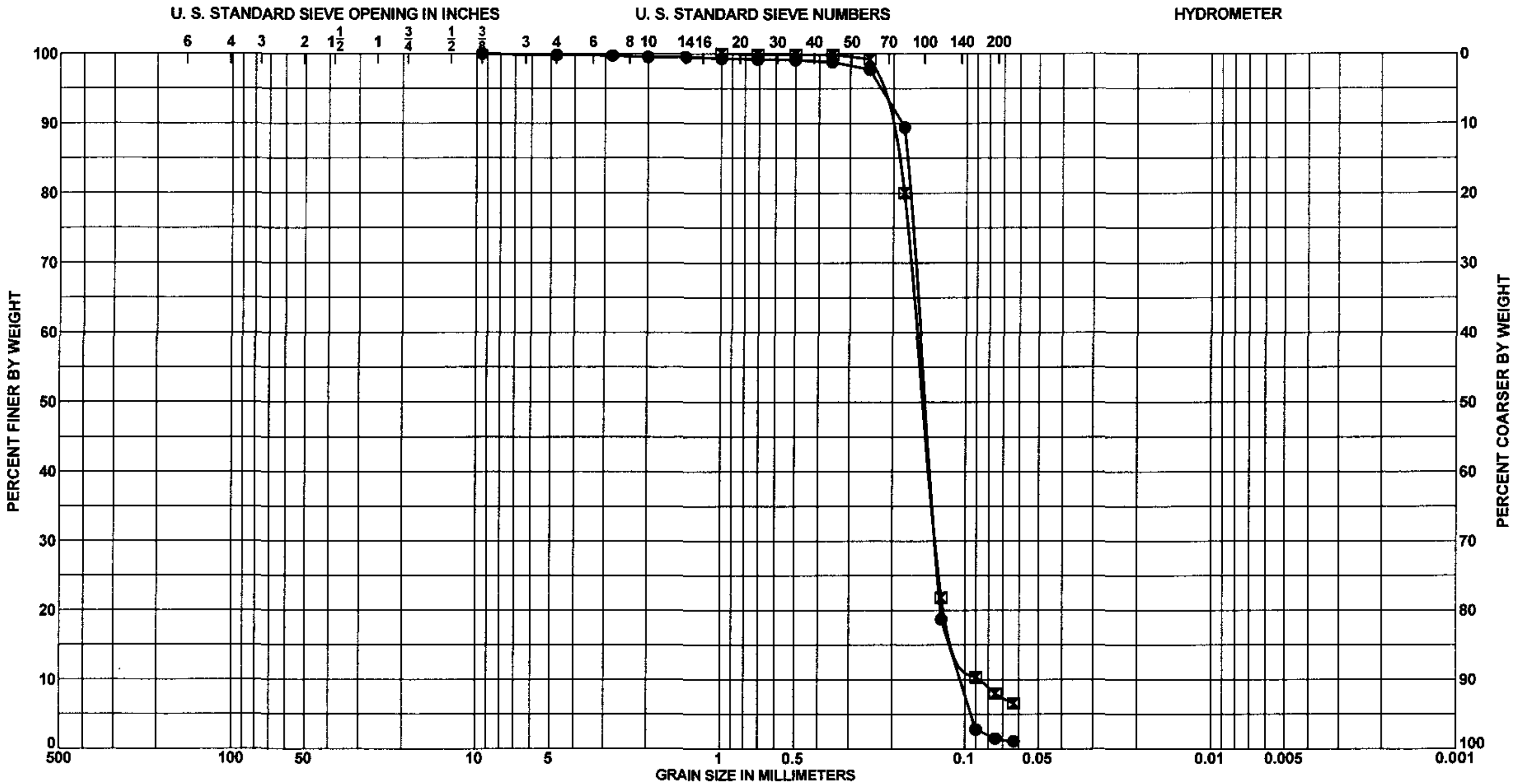


Sample No.	Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
● 3	3.0 to 4.5 Ft.	SAND, poorly-graded with clay, mostly fine-grained quartz sand, few clay, trace shell fragments, light brownish gray (SP-SC)	10YR 6/2							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-6
BORING ELEV.	-19.0 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02

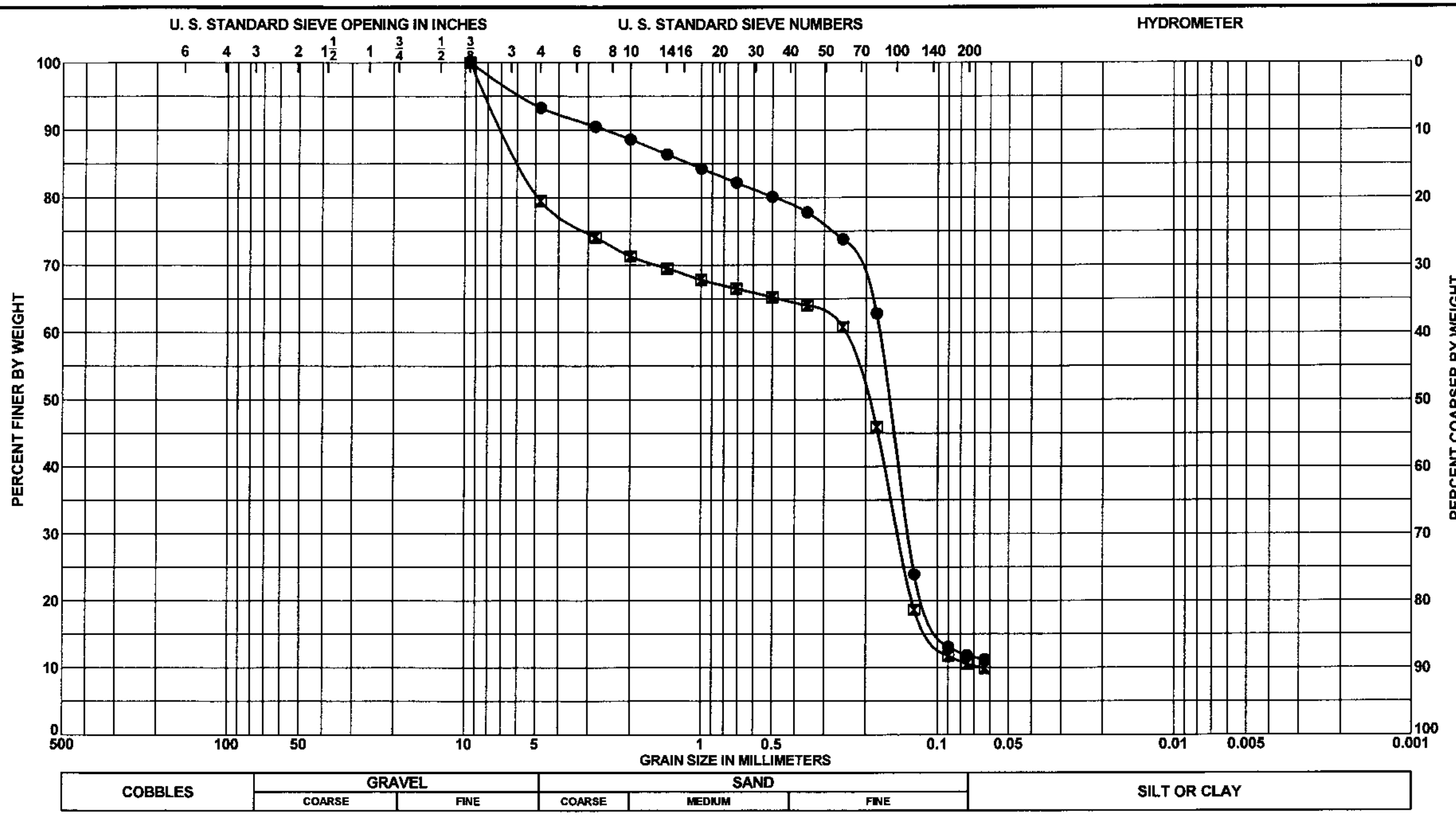


Sample No.		Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
●	1	0.0 to 1.5 Ft.	(SP)	10YR 6/2							
⊠	8	10.5 to 12.0 Ft.	(SP-SC)	10YR 6/1							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-7
BORING ELEV.	-9.5 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02

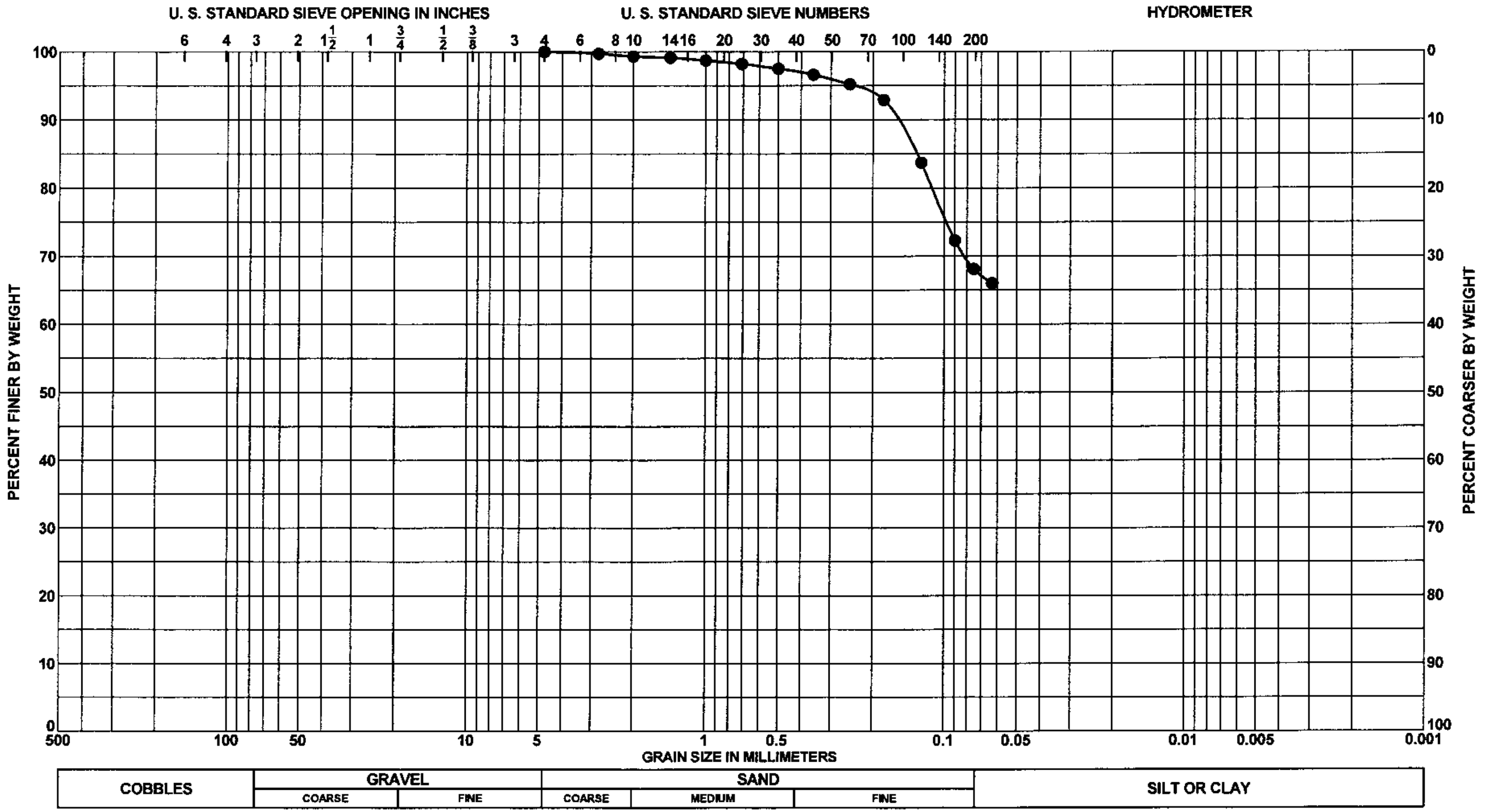


Sample No.		Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
●	1	0.0 to 8.5 Ft.	(SP-SM)	10YR 3/1							
⊠	2	8.5 to 10.0 Ft.	(SP-SM)	5Y 4/1							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-8
BORING ELEV.	-22.5 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	CO_3 %	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 2.6 Ft.	CLAY, inorganic-H, little fine-grained quartz sand, trace shell fragments, dark olive gray (CH)	5Y 3/2							

PROJECT	Jacksonville Harbor Mile Point
BORING NO.	CB-JHMP-05-9
BORING ELEV.	-25.0 Ft., MLLW
DATE	7/19/2006

GRADATION CURVES

SAJ FORM 2087
JUN 02

SHIP SIMULATION REPORT

ATTACHMENT C

NAVIGATION STUDY FOR MILE POINT CHANNEL IMPROVEMENTS

INTRODUCTION

Jacksonville, FL is located on the northeast corner of the state (Figure 1). The ships calling at the port of Jacksonville (JAXPORT) must transit St. Johns River, which links Jacksonville to the Atlantic Ocean. Presently, the St. Johns Bar Pilots Association restricts the movement of larger vessels during ebb tide due to strong crosscurrents at a section of St. Johns River known as Mile Point (Figure 2). Mile Point Lower Range and Turn and Training Wall Reach are crossed by the Atlantic IntraCoastal Waterway (IWW). The crosscurrents occur from Pablo Creek on the south and Sisters Creek on the north.

The US Army Corps of Engineers District, Jacksonville (SAJ) proposes to increase the cross-sectional area for flow into and out of Pablo Creek. The increase in cross-sectional area is designed to reduce the current magnitude and ease the angle at which the current enters the St. Johns River. This proposal is shown in Figure 3. SAJ also proposed widening Training Wall Reach by 100 ft on the southwest side to allow two-way traffic (Figure 4).

The U. S. Army Engineer Research and Development Center (ERDC) conducted a navigation study utilizing real-time ship simulation modeling to evaluate the proposed improvements to Mile Point. Model development and online testing occurred at the ERDC Waterways Experiment Station (WES) in Vicksburg, MS during the period from May 2005 to September 2006.

RECONAISSANCE TRIP

The Reconnaissance trip for the Mile Point study was conducted May 2 - 5, 2005. The purpose of the trip was to meet with representatives of SAJ and the St. Johns Bar Pilots Association. These meetings took place in the SAJ office and upon ships transiting the study area so navigation practices could be observed. In addition, ERDC representatives took photographs, which were later used for simulation model development. ERDC was represented by Dennis Webb and Don Wilson. Mr. Phil Sylvester and James McRae represented SAJ onboard some of the transits. Capt. Joe Heath of St. Johns Bar Pilots Association coordinated the vessel rides.

May 3. Mr. Webb and Mr. Wilson boarded the *Horizon Discovery* at Blount Island Berth 34 at approximately 1700 on May 3. The *Horizon Discovery* is a 700-ft length-over-all (LOA) containership. The *Horizon Discovery* has a beam of 90 ft and was loaded to a draft of approximately 30 ft. The ship got underway at approximately 1915. The pilot was Capt. Joe Heath. The transit began near the end of flood tide. The tide was ebbing by the time ship reached Mile Point. Figure 5 shows a view from the starboard wing of the *Horizon Discovery* on Training Wall Reach, approaching Mile Point Lower Range and Turn. Significant crosscurrents and eddies were clearly visible where Pablo Creek flowed into the St. Johns River. The ERDC team departed the ship between the jetties along with Capt. Heath at approximately 2015.

May 4. Mr. Webb and Mr. James McRae (CESAJ) boarded the *MSC Parana* at the sea buoy with the pilot at approximately 0800 on May 4, 2005. The pilot was Capt. Heath. The *MSC Parana* is 661-ft long (LOA) containership. The *MSC Parana's* beam is 93 ft and she was loaded to a draft of approximately 25 ft. The transit began during slack tide, which turned to ebb during the transit. The inbound *MSC Parana* met the outbound *Nicos Tomasas* in Training Wall Reach, just west of Mile Point Lower Range and Turn. The view from the *MSC Parana's* port wing while approaching the *Nicos Tomasas* is shown in Figure 6. The *MSC Parana* arrived at the Talleyrand Terminals, Berths 7 and 8 at approximately 1015.

Mr. Webb and Mr. Phil Sylvester (CESAJ) boarded the *Gypsum Centennial* at approximately 1600, on May 4, 2005, at the U. S. Gypsum dock. The pilot was Capt. James Winegeart. The *Gypsum Centennial* is a 646 ft LOA product carrier, with a beam of 93 ft. The *Gypsum Centennial* was empty, drafting approximately 18 ft. The vessel left the U. S. Gypsum dock at approximately 1620, during the last portion of ebb tide. The tide changed to flood during the transit. The team departed the ship at approximately 1800, with the pilot, at the sea buoy.

DATABASE DEVELOPMENT

Currents for both the existing and proposed channels were calculated by SAJ. Initially, a two-dimensional model was used. However, that model was converted to three-dimensional later in the study. Current data for the maximum strength of both the ebb and flood tides in St. Johns River and the maximum strength of ebb tide at Pablo Creek were extracted and converted into the format required by the ERDC Ship/Tow Simulator.

Two ship models were used for the Mile Point Navigation Study. The *Sibohelle* is a 797- x 106- x 38-ft tanker. The *Susan Maersk* is a 1140- x 140- x 47.5 ft containership. The Mile Point portion of St. Johns River is presently 40 ft deep, mean low water (MLW). The depth portion of the simulator database was overridden to a depth of 52 ft MLW to allow the *Susan Maersk* to transit. This is done to simulate a worst case scenario. Two two-way runs were also simulated. For those scenarios, the Sibohelle met the *SL Pride*. The *SL Pride* is a 865- x 106- 30-ft containership.

The visual scene was modified as per some of the photos taken during the reconnaissance trip. Figure 7 shows visual scene as one of the St. Johns River Pilots operates the simulator

The ERDC Ship/Tow Simulator provides an Electronic Chart Display and Information System (ECDIS) for the pilots (Figure 7). The ECDIS was modified to reflect proposed improvements.

VALIDATION

Validation for Mile Point was conducted September 27 – 30, 2005. Validation is a checkout of the existing condition simulation databases. An existing condition model must be successfully validated before it can be modified to reflect proposed conditions. Two St. Johns River pilots participated in validation. The visual scene, bank effects, ship models, radar and ECDIS were all successfully validated. However, the current database was not successfully validated. The initial model verification resulted in the conclusion that the simulated water current vector fields provided by the District did not accurately reflect conditions in the river near Mile Point and those simulated vector fields would not be adequate for conducting a testing program of project alternatives. Therefore, the remainder of validation time was used to develop a flow field based on pilot input. That flow field was furnished to SAJ to assist them in evaluating the current model results. That flow field is considered proprietary and is not included with this report.

The District developed revised water current vector fields from additional model studies. The revised currents were reviewed by the pilots in Jacksonville and determined to be suitable for validation on the simulator. The May 2006 simulation testing runs were preceded by a successful validation of the revised water current vector fields.

RESULTS

Testing with ship pilots was conducted May 15 – 18, July 11-13 and July 17 – , 2006. Two pilots participated in the May session. One pilot attended each of the July sessions. Simulation of towboat traffic was conducted Sept 18 – 20, 2006. At the end of each week of testing, the pilots were given a final questionnaire to complete. These questionnaires are included in Appendix A.

Results are presented in the form of composite track plots.

Inbound, Maximum Ebb from Pablo Creek.

Results of inbound simulations with the maximum ebb tide coming out of Pablo Creek are shown in Plates 1 – 3. Plate 1 shows the *Susan Maersk* transiting the reach in the existing channel. Although only one of the four ships left the channel, the pilots did not feel this was a safe condition or one they would try in real life. Plate 2 shows the same condition, but with the Alternative 1 conditions, i.e. the mouth of Pablo Creek widened. With the exception of one ship which went slightly out of the channel across from buoy R-24, the ships were tightly grouped through Mile Point Lower Range and Turn and Training Wall Reach. Plate 3 contains the track plots for the *Sibohelle* transiting the Alternative Channel. Five runs were completed under this condition because one pilot wanted to try it a second time. All runs were successful.

Outbound, Maximum Ebb from Pablo Creek.

Results of outbound simulations with the maximum ebb tide coming out of Pablo Creek are shown in Plates 4 – 6. Plate 2 shows the *Susan Maersk* transiting the reach in the existing channel. Although both runs were successful, the pilots did not feel this was a safe condition. Plate 5 shows the same condition, but with the Alternative 1 conditions. All three runs were successful. Plate 6 contains the track plots for the *Sibohelle* transiting the Alternative Channel. One ship lift the south side of the channel across from buoy R-22, but that was because the pilot started his turn late. Five runs were completed under this condition because one pilot wanted to try it a second time.

Inbound, Maximum Ebb in St. Johns River.

Results of inbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 7 – 9. Plate 7 shows the *Susan Maersk* transiting the reach in the existing channel. Although only one ship left the channel at the southern end of Training Wall Reach, the pilots reported it was a difficult situation. Plate 8 shows the same condition, but with the Alternative 1 conditions. All runs were successful. Plate 9 contains the track plots for the *Sibohelle* transiting the Alternative Channel. All runs were successful. Six runs were completed under this condition because one pilot wanted to try it three times.

Outbound, Maximum Ebb in St. Johns River.

Results of outbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 10 – 12. Plate 10 shows the *Susan Maersk* transiting the reach in the existing channel. Two of the ships left the channel by more than 100 ft on the south side of Mile Point Lower Rand and Turn. Plate 11 shows the same condition, but with the Alternative 1 conditions. One vessel went slightly outside of the channel near the north end of Training Wall Reach but the pilot did not feel it was significant. Plate 12 contains the track plots for the *Sibohelle* transiting the Alternative Channel. One vessel left the channel by about 50 ft while making the turn at Mile Point Lower Range and Turn.

Inbound, Maximum Flood in St. Johns River.

Results of inbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 13 – 15. Plate 13 shows the *Susan Maersk* transiting the reach in the existing channel. The ships were obviously being swept by the flood tide as they passed through Mile Point Lower Range and Turn and the southern end of Training Wall Reach. Two of the ships were nearly 200 ft out of the channel. Plate 14 shows the same condition, but with the Alternative 1 conditions. These ships were swept by the flood tide also and left the channel at the same places as in the existing condition run. However, they did not go out of the channel as far. Plate 15 contains the track plots for the *Sibohelle* transiting the Alternative Channel. The ships tended to go out of the channel in the same location as the *Susan Maersk* runs.

Outbound, Maximum Flood in St. Johns River.

Results of outbound simulations with the maximum flood tide in St. Johns River are shown in Plates 16 – 18. Plate 16 shows the *Susan Maersk* transiting the reach in the existing channel. One ship's stern swung out of the channel at the southern end of Training Wall Reach. All ships left the channel near buoy R-22. Plate 17 shows the same condition, but with the Alternative 1 conditions. The ship slightly left the channel near buoy R-22.

These ships were swept by the flood tide also and left the channel at the same places as in the existing condition run. However, they did not go out of the channel as far. Plate 18 contains the track plots for the *Sibohelle* transiting the Alternative Channel. The ships tended to go out of the channel in the same location as the *Susan Maersk* runs. One ship's stern swung out of the channel at the southern end of Training Wall Reach. One ship slightly left the channel near buoy R-22.

Two-way traffic scenarios.

Two two-way traffic scenarios were simulated to test the 100 ft widening. Results for the outbound *SL Pride* and inbound Sibohelle in maximum ebb tide are shown on Plate 19. The inbound ship remained near the center of the channel. Vessel interaction pushed the outbound ship's bow out of the channel. The second run of the same scenario is shown in Plate 20. The outbound Sibohelle left the channel while making room for inbound tanker.

Two-barge tow simulations.

Simulation of a two-barge tow was conducted for IWW traffic. Simulations were conducted for maximum ebb tide, maximum ebb from Pablo Creek, and maximum flood tide. Simulations were conducted for both northbound and southbound tows. This was done to assure that the improvements for deep-draft traffic would not adversely affect tow traffic. Two towboat captains participated in the study, each making three runs for each condition.

Results are shown in Plates 21 – 26. All runs were successful. The towboat captains felt that opening up Pablo Creek made the run easier.

Final Questionnaire

At the end of their simulator testing session, the pilots completed a final questionnaire. The final questionnaires are included as Appendix A. Three of the four ship pilots felt that Alternative 1 would reduce or eliminate tidal delays. One pilot felt that delays might be reduced after trying the proposal in real life. The two pilots that tried the widened

Training Wall Reach (Alternative 2) did not feel it would provide more two-way traffic than they already have. The towboat captains felt the plan improved navigation. One pilot recommended removing some of the buoys.

CONCLUSIONS

Based upon the simulator results and the pilot's final questionnaires, the following conclusions are made for the Mile Point improvements.

1. Alternative 1 improved navigation for the maximum ebb, maximum ebb from Pablo Creek, and maximum flood.
2. Three of the four ship pilots felt that tidal restriction would be lifted or greatly reduced.
3. The pilots felt that widening Training Wall Reach would not improve two-way traffic beyond what they are already doing.
4. Alternative improved navigation for tow traffic on the IWW.

RECOMMENDATIONS

1. Based upon the simulation results and pilot comments, we recommend that Alternative 1 be constructed to reduce or eliminate tidal restrictions.
2. If Alternative 1 is too costly to construct, we recommend that examining alternatives that widen the mouth of Pablo's Creek by less amounts, thus making them less expensive. These alternatives should be modeled by SAJ using their 3D current model. Those currents should be furnished to ERDC so additional simulations can be undertaken with the pilots.

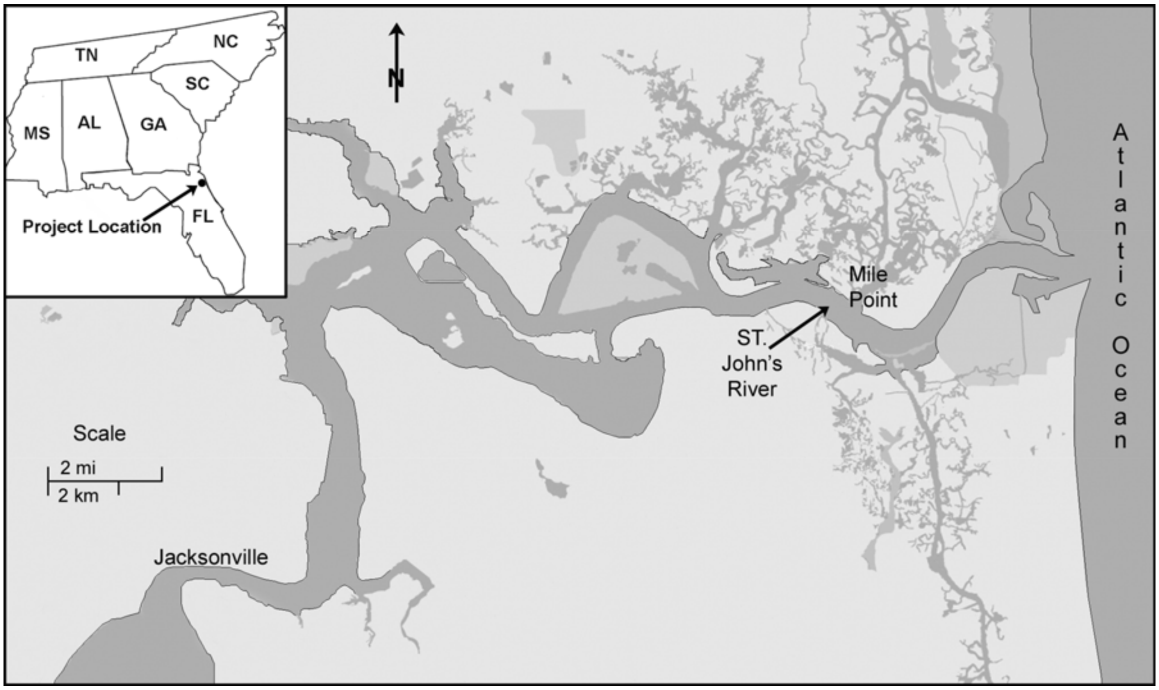
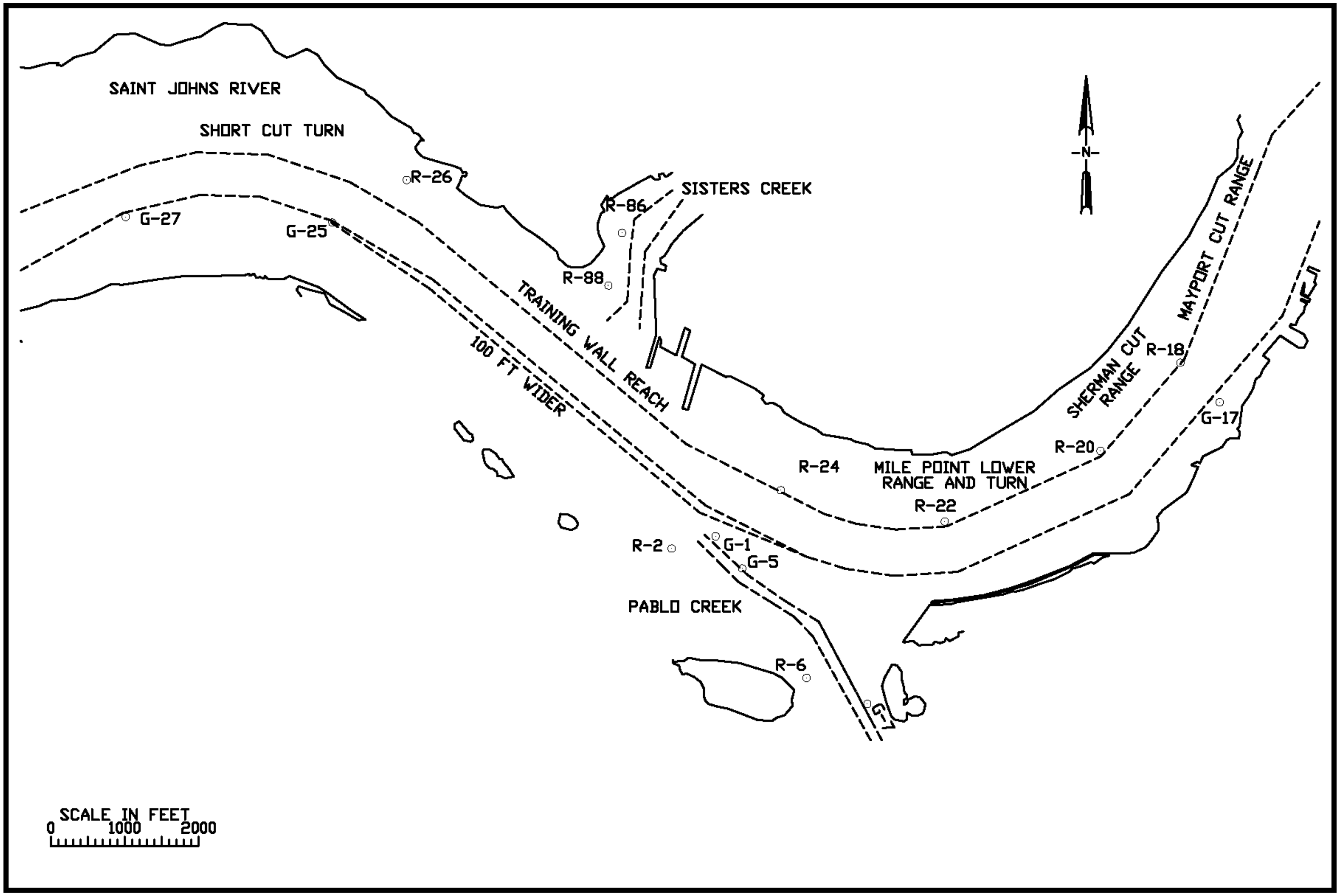


Figure 1. Project Location Map

Figure 2. Mile Point, St. Johns River



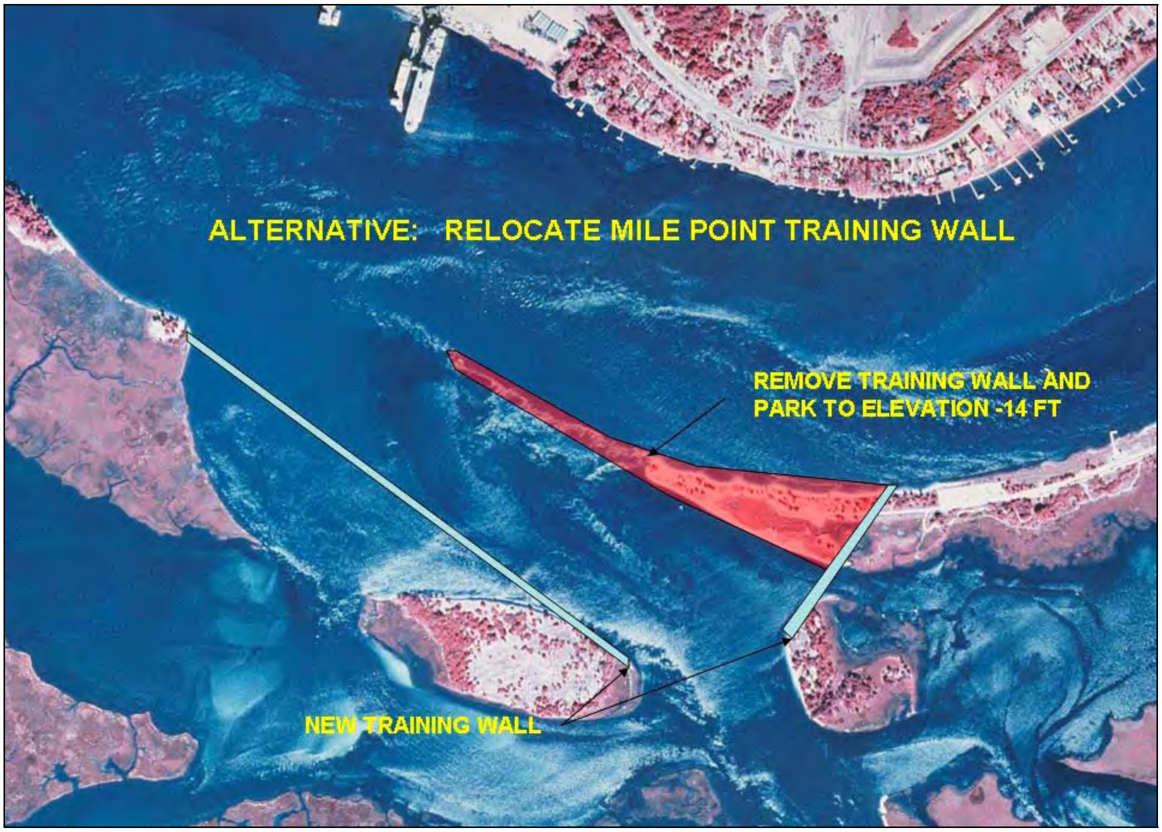


Figure 3. Proposed widening at mouth of Pablo Creek

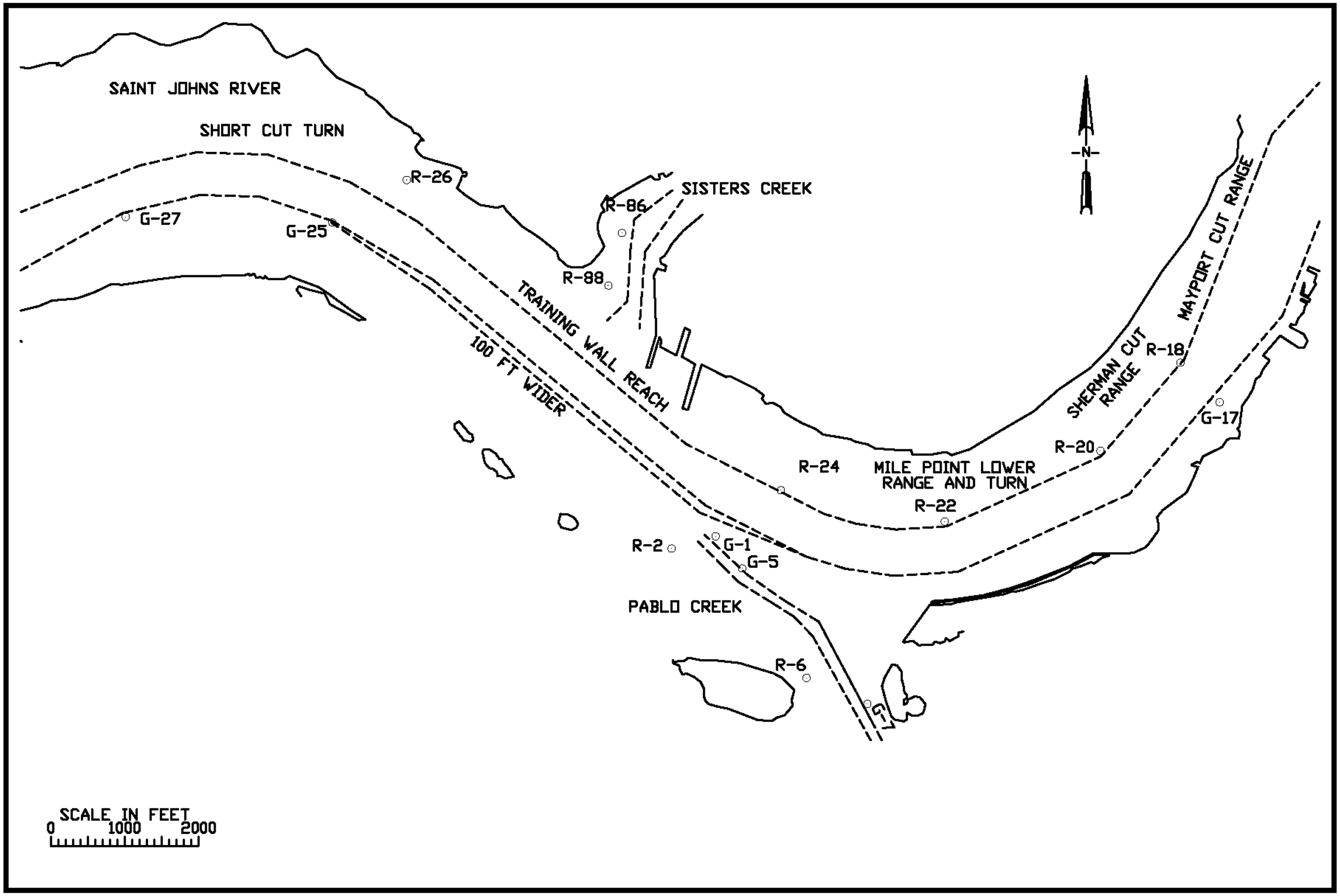


Figure 4. Alternative 2

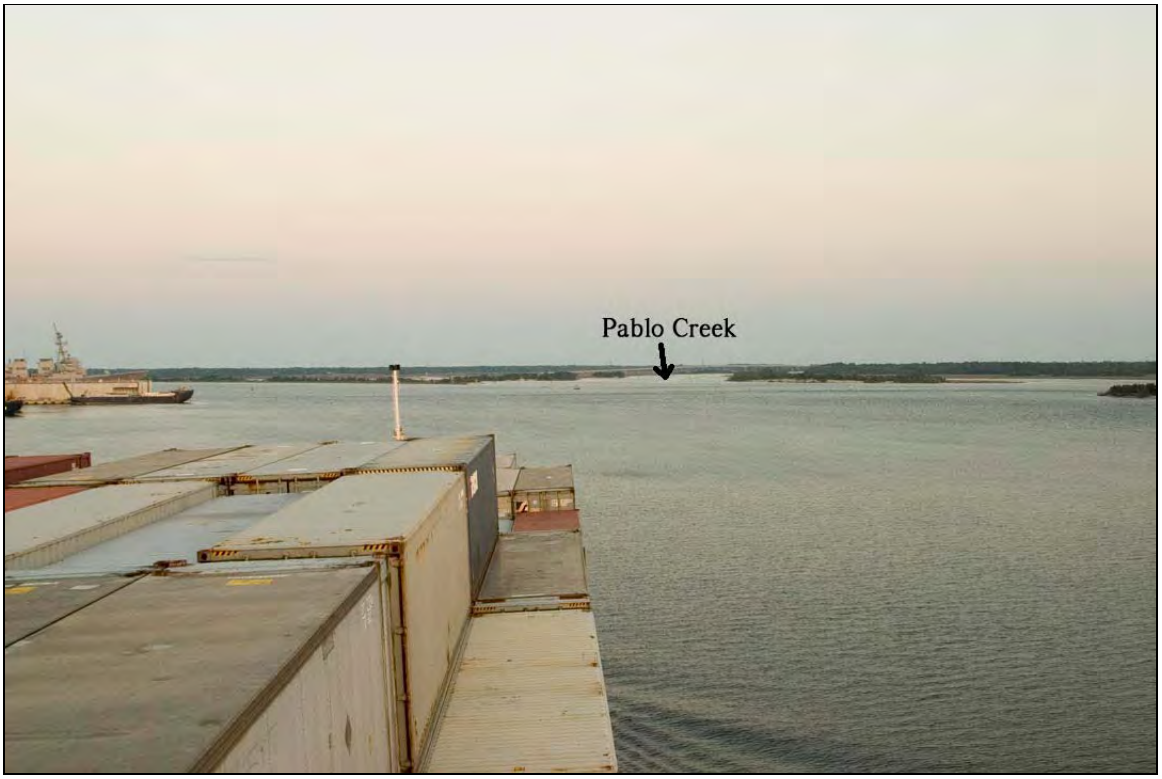


Figure 5. *Horizon Discovery* heading outbound on Training Wall Reach

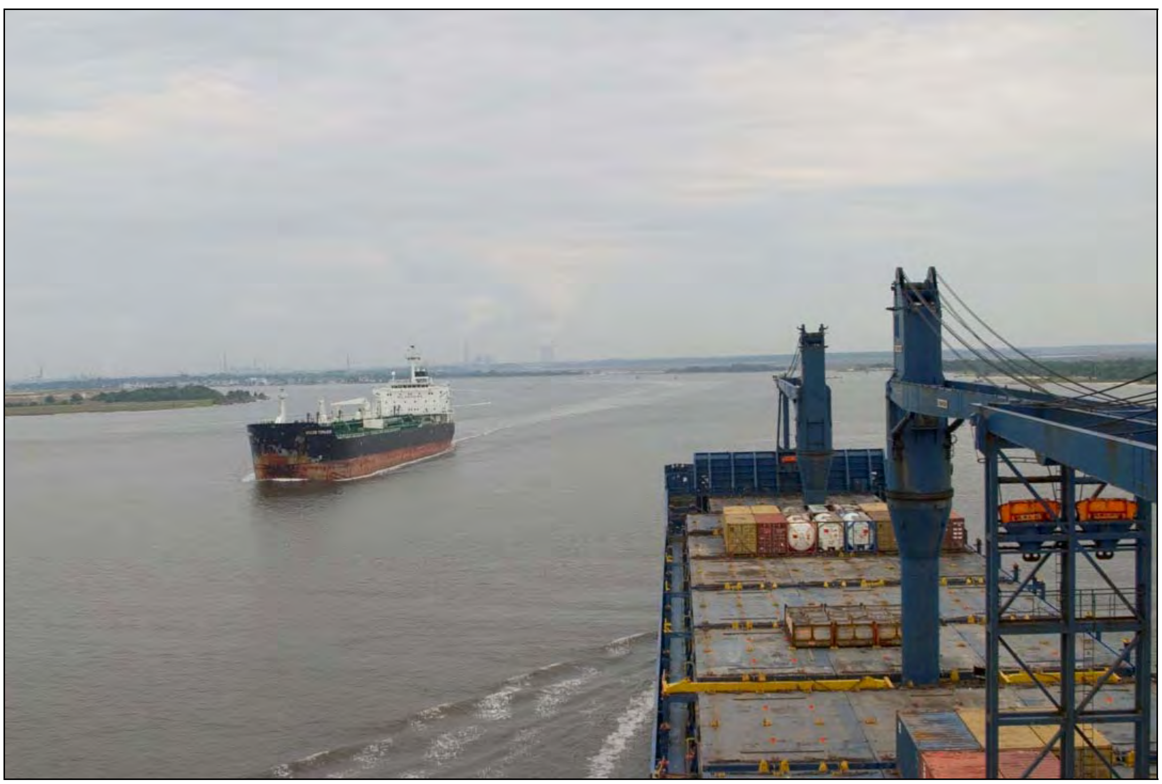


Figure 6. . The *MSC Parana* meeting the *Nicos Tomasas* in Training Wall Reach

Figure 7. St. Johns Pilot operating simulation of Mile Point

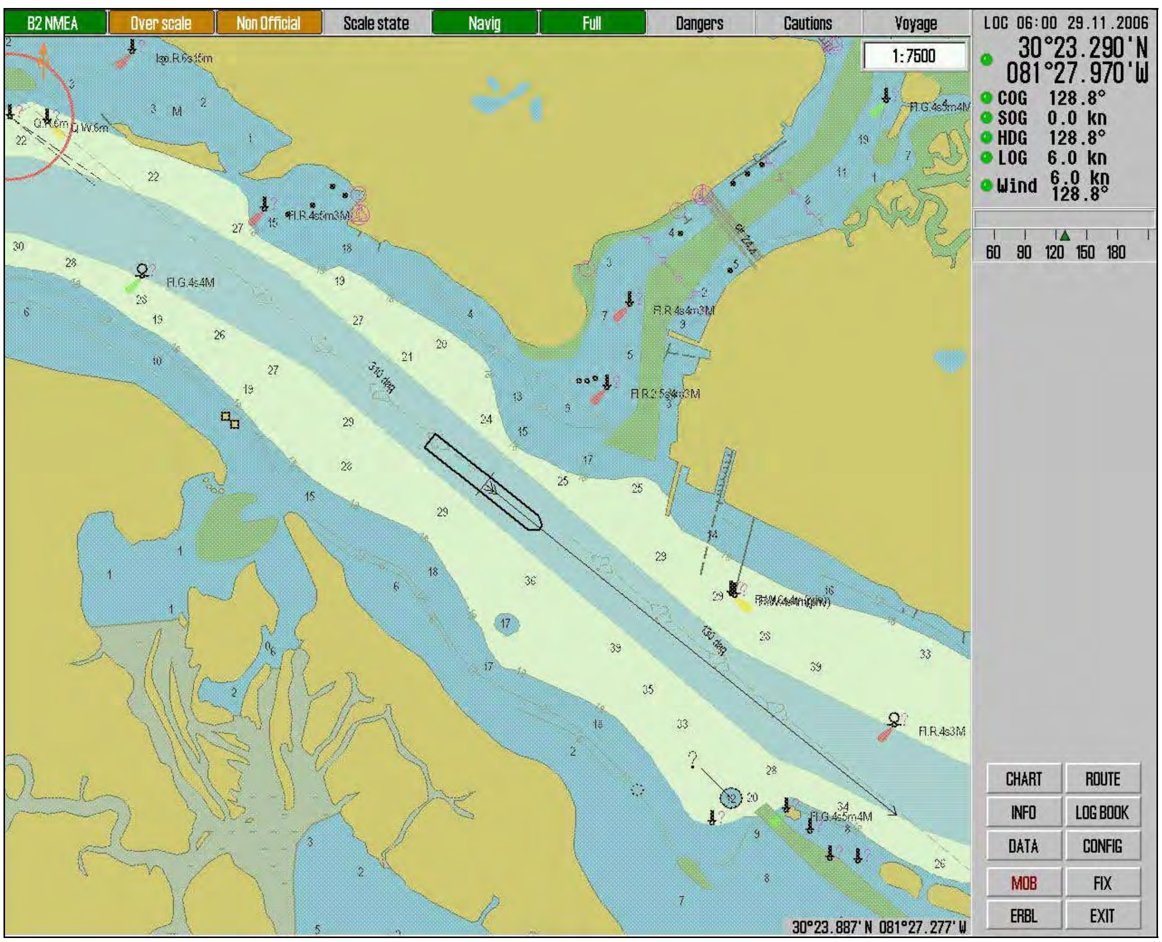


Figure 8. ECDIS display for Mile Point

ADDITIONAL SHIP SIMULATION REPORT

ATTACHMENT D

PROOF OF CONCEPT STUDY FOR MILE POINT CHANNEL WIDENERS

INTRODUCTION

Jacksonville, FL is located on the northeast corner of the state (Figure 1). The ships calling at the port of Jacksonville (JAXPORT) must transit St. Johns River, which links Jacksonville to the Atlantic Ocean. Presently, the St. Johns Bar Pilots Association restricts the movement of larger vessels during ebb tide due to strong crosscurrents at a section of St. Johns River known as Mile Point (Figure 2). Mile Point Lower Range and Turn and Training Wall Reach are crossed by the Atlantic IntraCoastal Waterway (ICW). The crosscurrents occur from Pablo Creek on the south and Sisters Creek on the north. JAXPORT considers it imperative that the tidal restriction be removed or significantly reduced.

The US Army Corps of Engineers District, Jacksonville (SAJ) proposed to increase the cross-sectional area for flow into and out of Pablo Creek. The increase in cross-sectional area is designed to reduce the current magnitude and ease the angle at which the current enters the St. Johns River. This proposal is shown in Figure 3. This proposal was studied by the U. S. Army Engineer Research and Development Center (ERDC) with a ship simulation model in 2004. That study concluded that the widening the mouth of Pablo Creek could reduce or eliminate the tidal restrictions. The proposed widening is referred to as Alternative 1.

SAJ now wishes to determine if widening on the west side of Training Wall Reach would be effective in reducing or eliminating the tidal restrictions. Three wideners of 300 ft, 400 ft, and 525 ft width were proposed (Figure 4). The wideners are referred to as Plan 1, Plan 2, and Plan 3, respectively. To assist SAJ in this determination, the ERDC conducted a "proof of concept" navigation study utilizing real-time ship simulation modeling to evaluate the proposed Mile Point wideners. Model development and online testing occurred at the ERDC in Vicksburg, MS during the period from June 2009 to September 2009.

STUDY ASSUMPTIONS

To quickly provide SAJ with input as to the effectiveness of the wideners, a "proof of concept" study was undertaken. If the wideners appear to be effective, a more robust study could be conducted.

Several assumptions were made to meet the time requirements of this effort. The existing condition currents from the 2004 study were used for all three plans. The same current directions and magnitudes from the 2004 were used for Plans 1, 2, and 3. The depths in within the wideners were deepened. The water in the area proposed to be widened is fairly deep, so this seemed a reasonable assumption. Subsequent analysis SAJ's three-dimensional hydrodynamic modeling effort indicate that this is true. Results from this model were not available to get them converted in the simulator database format and checked out prior to real time testing.

Three pilots participated in the real-time simulation study. All three are members of the St. Johns River Pilots Association. There were Captains Jay Winegeart, Tim McGill, and Bill Brauer. Captains McGill and Brauer conducted simulations from the afternoon of September 14 through the morning of September 16. Captain Winegeart conducted simulations from the afternoon of September 16 all day September 17. Mr. Phil Sylvester represented SAJ at the simulations September 14 – 15. For many full navigation studies, six pilots participate for one week each. However, for this "proof of concept" study, an adequate amount of exercises were undertaken to evaluate the wideners.

RESULTS

Results are presented in the form of composite track plots.

Plan 1 – 300 ft widener

<u>Inbound, Maximum Ebb in Saint Johns River.</u>

Results of inbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 1 – 2. Plate 1 shows two runs of the *Sibohelle* transiting the reach in the Plan 1 channel. Both pilots took their vessels into the 300 ft widener. However, they only used about 100 ft of the widener. Both pilots felt that going further into the widener forced their ships into an unsafe alignment with Training Wall Reach. Plate 2 shows two runs of the *Susan Maersk* transiting the reach in the Plan 1 channel. One run left the north side of the channel twice. Only one pilot took his vessels into the 300 ft widener. Both pilots felt that going further into the widener forced their ships into an unsafe alignment with Training Wall Reach.

<u>Inbound, Maximum Ebb from Pablo Creek.</u>

Results of inbound simulations with the maximum ebb tide from Pablo Creek are shown in Plates 3 – 5. Plate 3 shows two runs of the *Sibohelle* transiting the reach in the Plan 1 channel. The pilots used the southern portion of the widener, but were not comfortable bringing the ship into that position. Plate 4 shows two runs of the *Susan Maersk* transiting the reach. They also used the southern portion of the widener. One ship was set so severely by the flow from Pablo Creek that it left the north side of the channel. The track plot of one run of the *Sabrina* is shown in Plate 5. The ebb tide coming out of Pablo Creek forced the ship out of the channel on the north side.

Plan 2 – 400 ft widener

<u>Inbound, Maximum Ebb in Saint Johns River.</u>

Results of inbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 6 – 8. Plate 8 shows two runs of the *Sibohelle* transiting the reach in the Plan 2 channel. Neither pilot brought their vessel into the widener. Plate 7 shows two runs of the *Susan Maersk* transiting the reach in the Plan 2 channel. Only one pilot took his vessels into the widener. Both ships ended up on the north side of the channel near Atlantic Marine. The track plot of one run of the *Sabrina* is shown in Plate 8. The pilot used the widener to make the turn.

<u>Inbound, Maximum Ebb from Pablo Creek.</u>

Results of inbound simulations with the maximum ebb tide from Pablo Creek are shown in Plates 9 – 11. Plate 9 shows one run of the *Sibohelle* transiting the reach in the Plan 2 channel. The pilot did not bring his ship into the widener, but did come to the edge of the existing channel. Plate 10 shows the *Susan Maersk* transiting the reach. The pilot did not bring his ship into the widener. The track plot of one run of the *Sabrina* is shown in Plate 11. The pilot brought the ship into the widener to make the turn.

Plan 3 – 525 ft widener

<u>Inbound, Maximum Ebb in Saint Johns River.</u>

Results of inbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 12 – 14. Plate 12 shows two runs of the *Sibohelle* transiting the reach in the Plan 3 channel. On pilot took his ship deep into the widener, the other just crossed into it. Plate 13 shows two runs of the *Susan Maersk* transiting the reach in the Plan 3 channel. Both pilots used a small portion of the widener. One ship was severely set towards Atlantic Marine. The track plot of one run of the *Sabrina* is shown in Plate 14. The pilot did not use the widener.

Alternate 1 from 2004 study

<u>Inbound, Maximum Ebb in Saint Johns River.</u>

Results of inbound simulations with the maximum ebb tide in St. Johns River are shown in Plates 15 – 16. Plate 15 shows two runs of the *Sibohelle* transiting the reach in the existing channel with the mouth of Pablo Creek widened. The pilot was able to make the turn. Plate 16 shows two runs of the *Susan Maersk* transiting the reach in the existing channel with the mouth of Pablo Creek widened. Both pilots were able to make the turn.

<u>Inbound, Maximum Ebb from Pablo Creek.</u>

Results of inbound simulations with the maximum ebb tide from Pablo Creek are shown in Plates 17 – 18. Plate 17shows three runs of the *Sibohelle* transiting the reach in the existing channel with the mouth of Pablo Creek widened. All three runs were successful.

Plate 18 shows two runs the *Susan Maersk* transiting the reach. Both runs were successful.

Pilot Comments

The three pilots furnished the ERDC with an e-mail, as a record of their final comments.

This will be added later.

CONCLUSIONS

Based upon the simulator results and the pilot's final questionnaires, the following conclusions are made for the Mile Point improvements.

1. The pilots, as observed by ERDC and SAJ personnel, attempted to use the wideners to make the turn and avoid getting set toward Atlantic Marine.
2. The pilots felt that using the wideners put their vessels in harms way and would not use them unless they were 100% certain about currents.
3. The pilots, after using the wideners in the simulation, stated that they felt the wideners would not reduce tidal restrictions for Mile Point.
4. Based upon the simulator runs, the pilots felt that Alternative 1, widening the mouth of Pablo Creek, could reduce or eliminate tidal restrictions for Mile Point

U.S. ARMY CORPS OF ENGINEERS,
JACKSONVILLE DISTRICT

U.S. ARMY CORPS OF ENGINEERS

ATTACHMENT E - VE STUDY FY'08

VALUE ENGINEERING STUDY REPORT

FINAL REPORT COPY

Mile Point Feasibility Report Study

(Jacksonville Harbor Navigation Study)

Duval County, Florida

Sponsored By: Jacksonville Port Authority and U.S. Army Engineering District, Jacksonville

SEPTEMBER 2008

VALUE ENGINEERING TEAM STUDY

DOD SERVICE: USACE **VALUE ENGINEERING OFFICER:** Fred McAuley
CONTROL NO: CESAJ-VE-08-009C

Final Value Engineering Report on the

Mile Point Feasibility Report Study

(Jacksonville Harbor Navigation Study)

DUVAL COUNTY, FLORIDA

September 2008

STUDY SPONSOR: Jacksonville Port Authority & USACE, Jacksonville District

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VALUE ENGINEERING TEAM STUDY

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VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: Mile Point Improvements Project
PROJECT LOCATION: Duval County, Florida

Mile Point is located in Duval County, Florida. It consists of about 5,000 feet of shoreline located along the north shore of the St. Johns River and east of the Intracoastal Waterway (IWW). The Mile Point study is intended to assess Federal interest in navigation improvements to include an evaluation of benefits, costs, and environmental impacts. The feasibility study was authorized by a resolution of the House Committee on Transportation and Infrastructure, March 24, 1998. The study will determine plans to evaluate the Mile Point erosion problem and to provide recommendation for reducing the difficult crosscurrents during the ebb flow at the confluence of the St. Johns River with the IWW.

Benefits of the proposed action would minimize the impacts of the flows out of the IWW during the ebb tide to slow the velocities on the north bank and slow the progression of erosion. Due to the difficult crosscurrents in the channel the St. Johns Bar Pilots have restricted navigation for vessels transiting on a draft of 33 feet or deeper. Reducing the difficult crosscurrents in the harbor would allow the pilots to reduce or eliminate these navigation restrictions. Adverse impacts would include loss of salt marsh that would be mitigated. Measures taken to avoid, minimize, and compensate for adverse impacts include beneficial use of dredged material, creation of habitat units beyond the required mitigation, and providing flow improvement measures to mitigate for erosion caused by the project.

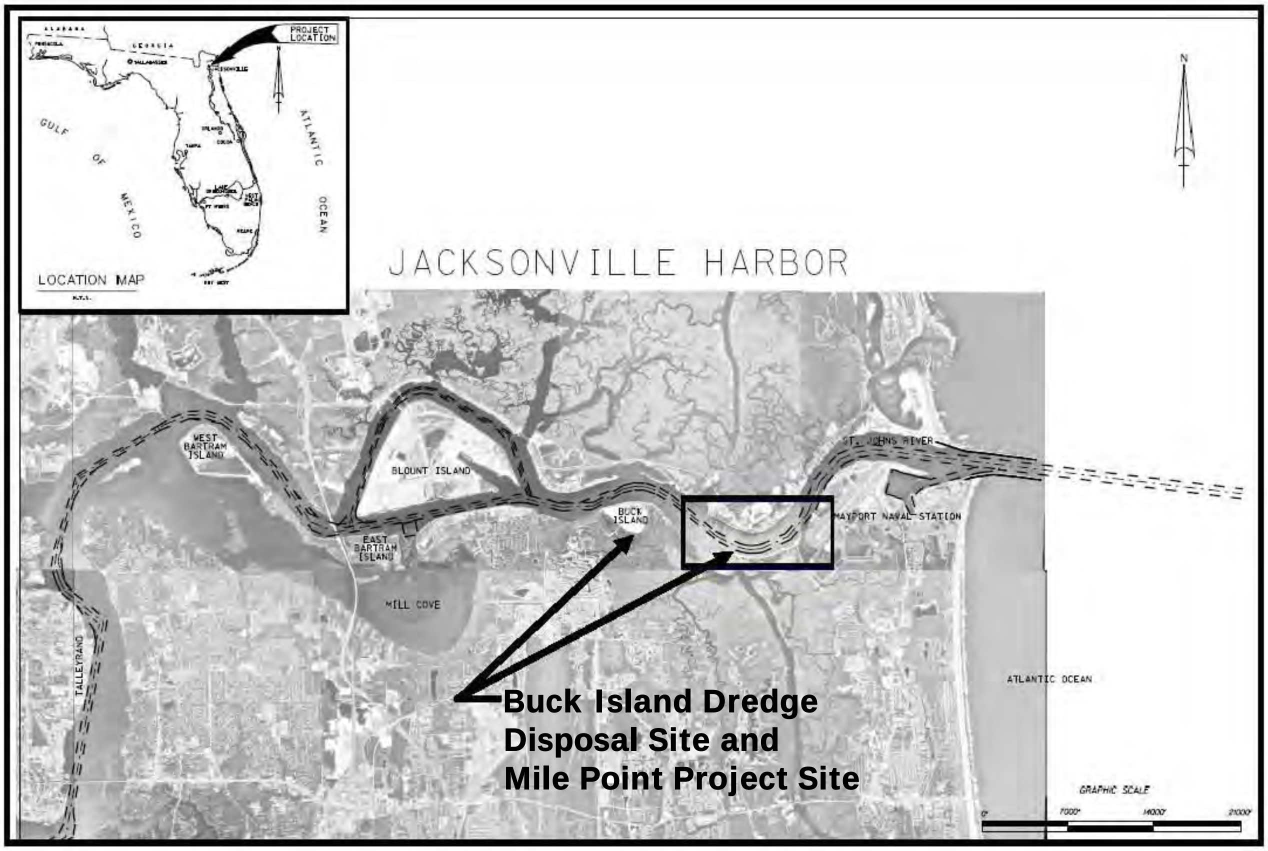
<u>Alternatives</u>: Alternatives that were evaluated include Non-structural alternatives include operational measures and a no action alternative. Structural alternatives include a North shoreline groin field, San Pablo Creek IWW Submerged Weir, Rebuild Mile Point Training Wall, 150 Foot Training Wall Reach Widening, Eastern Chicopit Bay Diversion, Relocate Mile Point Training Wall, and a Short Cut Widener. Combinations of these alternatives were also evaluated.

The emerging alternative identified at the time of the Value Engineering study was Alternative 3B -- Relocate Mile Point Training Wall. This alternative relocated and constructed new east and west training walls, using armor and bedding stone for erosion control, and placed approximately 0.9 MCY of dredge material by pipeline upland into the Buck Island dredge disposal site located approximately 2 to 3 miles west of the project site. The estimated cost for the refined initial plan, Final Alternative 3B, design is $76.388 million. Defining and developing salt marsh mitigation requirements for the project resulted in further refinement to the plan. A salt marsh restoration plan was identified and incorporated into the Alternative 3B – Great Marsh Island Required Mitigation (18.2 Acre) plan estimated as $55.945 million. These two plans were used as baseline for the VE study alternatives.

See the Supporting Documents for the Value Engineering Team Members, the Speculation List, Cost Models, FAST Diagram (identifying project functions), and Supporting Information for Proposals and comments including detailed cost estimates.

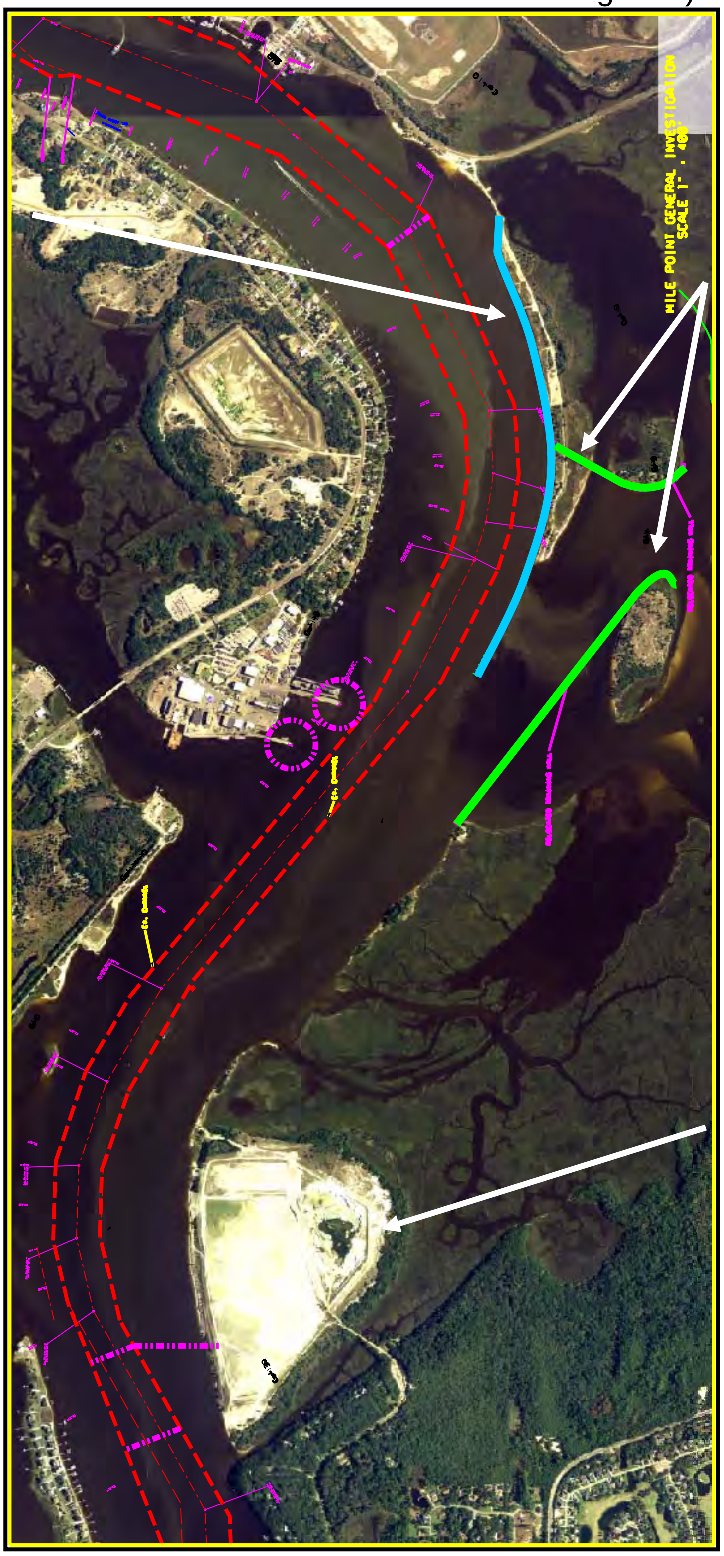
PROJECT TITLE: Mile Point Improvements Project
PROJECT LOCATION: Duval County, Florida

JACKSONVILLE HARBOR AND MILE POINT PROJECT AREA MAP



PROJECT TITLE: Mile Point Improvements Project
PROJECT LOCATION: Duval County, Florida

MILE POINT PROJECT AREA SITE MAP
(Alternative 3B – Relocate Mile Point Training Wall)



The initial Alternative 3B was limited in development and quantities for features were early plan formulation level of detail with rough order of magnitude cost estimate. The formal VE study process was initiated May 1, 2008, and continued with alternative plan development though June, July and August 2008. Revisions resulted in the revised Final Alternative 3B Plan (Relocate Retaining Walls with Upland Disposal), Alternative 3B – Great Marsh Island Required Mitigation (18.2 Acre), and the Tentatively Selected Plan (TSP), VE Alternative 3B, which were developed using VE ideas for equal comparison and best plan selection. These two Alternative 3B plans were considered to represent the Mile Point base condition plan and the potential VE plan, and are incorporated into the Final Value Engineering Study Report dated September 2008. The participants included District project design team (PDT) members listed in Appendix A.

Value Engineering (VE) is a process used to study the functions a project is to accomplish. As a result, the VE team takes a critical look at how these functions are being met, and it identifies alternative ways to achieve the equivalent function while increasing the value, and the cost ratio of the project. The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology:

Information Phase: The Team was presented figures, descriptions of project work, and cost estimates to fully understand the work to be performed and the functions to be achieved. Cost Models (see Appendix C) were compared to determine areas of relative high cost to ensure that the team focused on those parts of the project that offered the most potential for cost savings.

Speculation Phase: The Team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged (see Appendix B).

Analysis Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development. Ideas that did not survive critical analysis were deleted.

Development Phase: VE team members developed the selected priority ideas identified during analysis into written proposals. Proposal descriptions and possible impacts to schedule and funding were identified for each item discussed. Savings were estimated where realized.

Presentation Phase: Presentation Phase includes publication of the VE Study Report for distribution, review and coordination. Notation reflecting “Recommended Action” for each proposal is shown on Summary of Proposals / Recommended Action. Further formal coordination of VE action items will be through the project PDT and VEO. Savings realized from the VE study are reported to Division and HQ, and are credited to the District assigned Value Engineering goals.

VALUE ENGINEERING TEAM STUDY

SUMMARY OF PROPOSALS / RECOMMENDED ACTION

PROPOSAL NUMBER	DESCRIPTION	POTENTIAL SAVINGS	RECOMMENED ACTION
C-1	Develop Improved Training Wall Sections and Delete Scour Stone	$12,234,000	Accepted in NED/TSP
C-2	Develop a Composite Plan for Mile Point Navigation Improvements and Dredge Disposal Supporting Salt Marsh Mitigation and Restoration of Great Marsh Island	$9,056,000	Accepted in NED/TSP
	Estimated Total First Cost Savings	**$21,290,000**	

DESCRIPTION: Develop Improved Training Wall Sections and Delete Scour Stone

ORIGINAL DESIGN: Alternative 3B-Relocation of the Training Wall, initially included removal of the 3,110 feet of an existing Mile Point training wall and reconstruction of a relocated eastern training wall (approximately 2,050 feet), and construction of a new western training wall (approximately 4,250 feet). New channel armoring was to be provided for the improved confluence opening and between training walls by jetty stone (revised to use bedding stone at a 2 foot thickness). Total quantities of stone included the following: bedding stone scour protection using 100,000 CY; and training walls used 32,800 CY of armor stone and 11,700 CY of filter stone. Dredging to reshape confluence was designated to -16 MLW as influenced by the depth of stone and a 2 foot authorized paid over depth. Dredged material was to be placed by pipe-line into the upland disposal site at Buck Island located approximately 2 to 3 miles west of the Mile Point project site.

The initial plan was renamed "Final Alternative 3B - Relocation of the Training Wall", with a reduced dredge by pipeline to Buck Island material quantity of 889,000 CY. This quantity is adjusted by adding 150,000 CY for the required depth for bedding stone and paid overdepth to justify proposed savings. The Mile Point Dredge Area Plan with notes on dredging depths and bedding stone scour protection is shown on Figure 1. Modified East and West Training Wall Structures Sectional Views are shown in Figure 2. This alternative is considered the baseline plan for comparison of the VE alternative plan.

PROPOSED DESIGN: Improved Mile Point IWW channel widening and deepening will reduce currents and cross-currents at the confluence of the main channel. Erosion potential is greatly reduced with improvement in place. Scour toe sections would be added to protect the structural integrity of the training walls. Optimization to the training wall sections as recommended has potential to reduce the needs for vast quantities of scour stone armoring. Elimination of the scour mat and refinement to the paid overdepth reduces dredge material quantities. The new dredging depth for Mile Point changes from -16' MLW to -13' MLW (-14'+2' overdepth to -12'+1' overdepth). See notes shown on Figures 1 and 2.

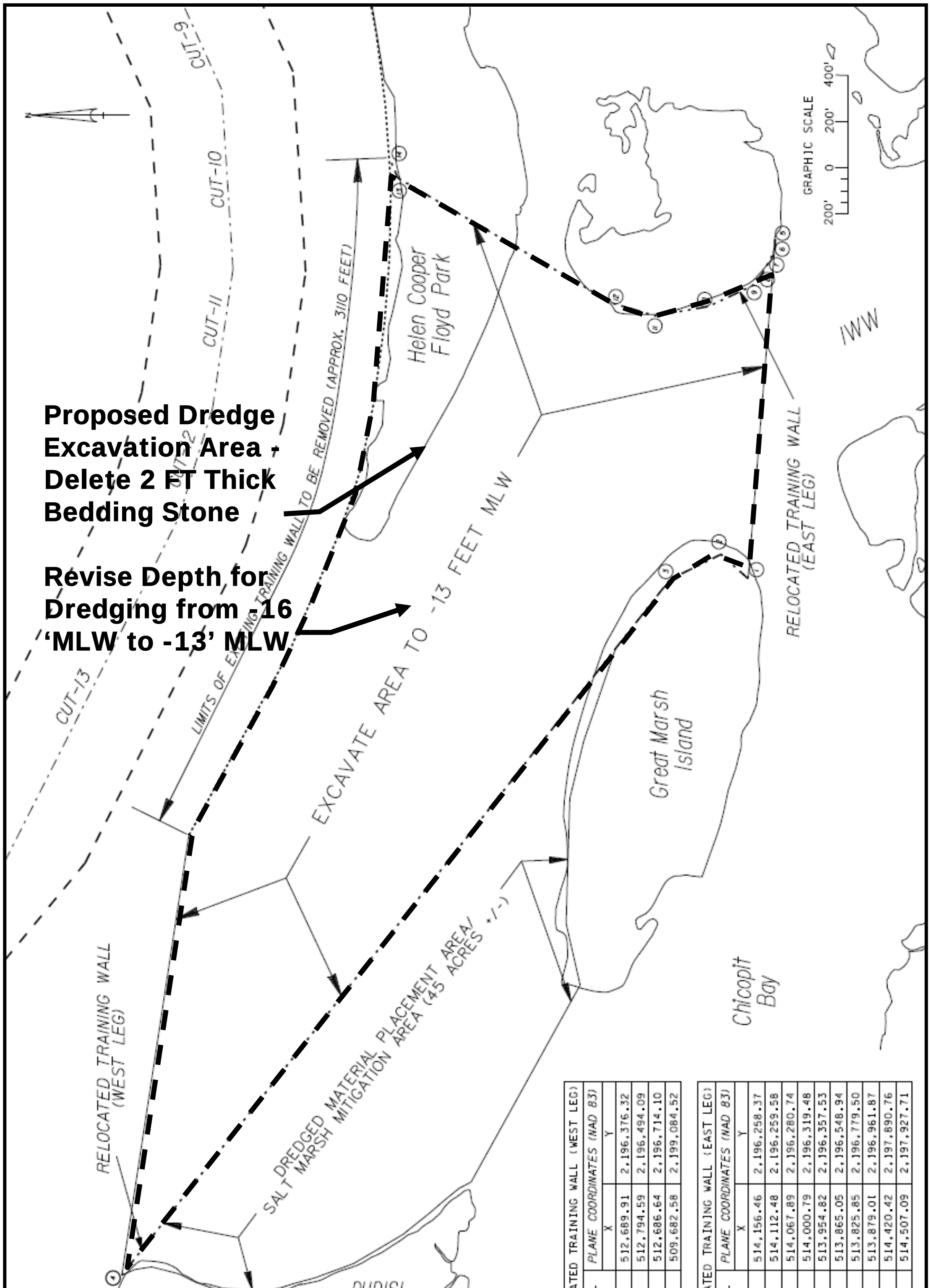
ADVANTAGES:
- Training wall structures incorporates larger scour aprons designed for optimal service life and minimal maintenance, repair and replacement - part of savings from scour blanket are reinvested in scour aprons.
- Elimination of the 2 foot thick scour mat and refinement to the paid overdepth to 1 foot would reduce dredge material quantities.
- New surveys and coordination of Mile Point navigation and flowway requirements indicates potential for reduced excavation quantities to develop the navigation improvements – nets total reduced dredge quantities.
- Recommended changes are provided early in the plan formulation process to permit modification of the alternative plan under study.

JUSTIFICATION: The recommended VE plan includes removal of the western 3,110 feet of existing Mile Point training wall and the construction of a new Western Leg and a relocated Eastern Leg training wall of approximately 4,250 feet and 2,050 feet as generally described in the initial plan. Total stone class and weights are increased, and the new section incorporates larger scour aprons. The original planned mass bedding stone is eliminated and part of the total savings is used to pay for increases in stone quantities. Incorporation of the improved training wall structures are assumed to provide 85 to 100 years service and are designed for optimal service life, and minimal maintenance, repair and replacement.

Total quantities of stone included the following: training walls used 48,800 CY of armor stone and 52,900 CY of filter stone. Dredging to reshape confluence was reduced by 150,000 CY.

Savings will be reported under the SAJ Value Engineering program based on estimates for the initial Alternative 3B and modified Alternative VE-3B+FIC. Savings are estimated as $12,234,000.

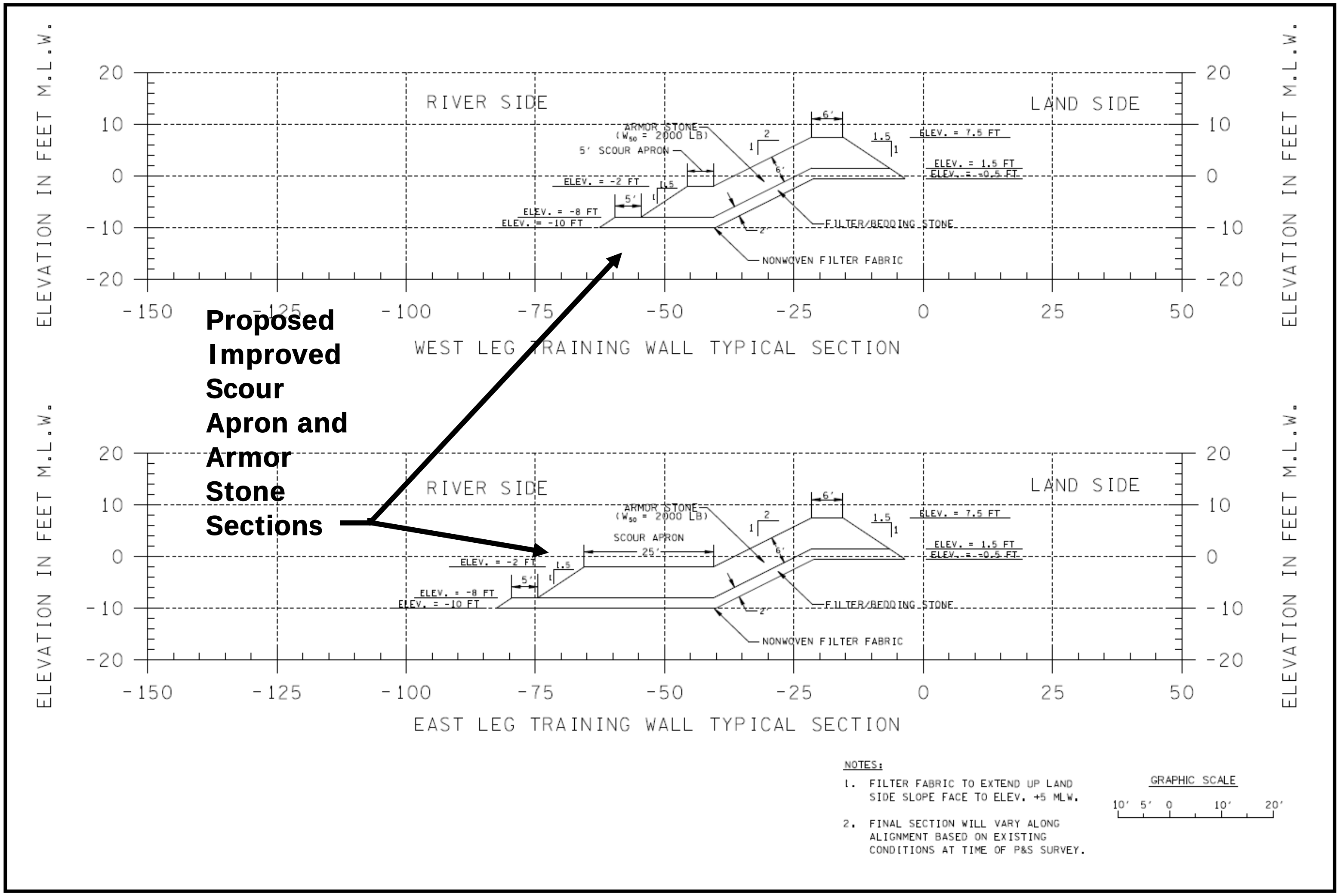
FIGURE 1: ALTERNATIVE 3B MILE POINT DREDGE AREA PLAN



RELOCATED TRAINING WALL (WEST LEG)		
POINT	PLANE COORDINATES (NAD 83)	
	X	Y
1	512,689.91	2,196,376.32
2	512,794.59	2,196,494.09
3	512,686.64	2,196,714.10
4	509,682.58	2,199,084.52

RELOCATED TRAINING WALL (EAST LEG)		
POINT	PLANE COORDINATES (NAD 83)	
	X	Y
5	514,156.46	2,196,258.37
6	514,112.48	2,196,259.58
7	514,067.89	2,196,280.74
8	514,000.79	2,196,319.48
9	513,954.82	2,196,357.53
10	513,865.05	2,196,548.94
11	513,825.85	2,196,779.50
12	513,879.01	2,196,961.87
13	514,420.42	2,197,890.76
14	514,507.09	2,197,927.71

FIGURE 5: MODIFIED ALTERNATIVE 3B TRAINING WALL SECTIONS
(East and West Training Wall Structures Sectional Views)



COST ESTIMATE WORKSHEET

PROPOSAL DESCRIPTION: Develop Improved Training Wall Sections, Delete Bedding Stone

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
S-1 Filter Stone	CY	7,900	$182.57	$1,442,303
S-1 Armor Stone	CY	22,100	$436.29	$9,642,009
S-2 Filter Stone	CY	3,800	$178.65	$678,870
S-2 Armor Stone	CY	10,700	$437.22	$4,678,254
Bedding Stone (2' Thick)	CY	100,000	$197.87	$19,787,000
Dredging to Buck Island (+3' for Stone/POD)	CY	150,000	$21.24	$3,186,000
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$39,414,436

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
S-1 Improved Section - Filter Stone	CY	18,400	$182.57	$3,359,288
S-1 Improved Section - Armor Stone	CY	36,900	$436.29	$16,099,101
S-1 Improved Section - Filter Fabric	SY	34,556	$3.82	$132,004
S-2 Improved Section - Filter Stone	CY	11,900	$178.65	$2,125,935
S-2 Improved Section - Armor Stone	CY	12,300	$437.22	$5,377,806
S-1 Improved Section - Filter Fabric	SY	22,500	$3.82	$85,950
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$27,180,084
	Net Cost Decrease/Increase			$12,234,352
*	Mark-ups	0.00%		$0
	Total Cost Decrease/Increase			$12,234,352

* Mark-ups: Gen. Contractor Mark-up (Field Office/Home Office/Profit/Bond); Construction Mgt; & Contingencies included in Unit Prices.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-2

DESCRIPTION: Develop a Composite Plan for Mile Point Navigation Improvements and Dredge Disposal Supporting Salt Marsh Mitigation and Restoration of Great Marsh Island

ORIGINAL DESIGN: The initial plan, Alternative 3B-Relocation of the Training Wall, includes removal of the 3,110 feet of an existing Mile Point training wall and reconstruction of a relocated eastern training wall (approximately 2,050 feet), and construction of a new western training wall (approximately 4,250 feet). Refinements were made to the structures for reduced quantities of bedding and armor stone. Dredging to reshape confluence to -16 MLW was refined to -13 MLW. Dredged material quantities were reduced from ~1.3 MCY to 889,000 CY (by updated survey and elimination of scour stone), and material would then be placed by pipeline into the upland disposal site at Buck Island located approximately 2 to 3 miles west of the Mile Point project site. The mitigation feature was a known project requirement at the time of the initial VE sessions, though the estimated quantities and costs were not developed at the start of the VE study.

Reconstruction of the new eastern training wall would result in the removal of the western portion of Helen Cooper Floyd Park. This portion of the park consists of jurisdictional wetlands, specifically salt marsh, as well as disturbed uplands. The salt marsh boundaries had been previously delineated by the landowner (US Navy), and it was calculated that the proposed relocation of the training wall would impact 8.15 acres of marsh. Two conceptual alternatives being considered for the mitigation site were: 1. Required Marsh Restoration Area - 18.2 Acres (Low Marsh - 16.4 acres and High Marsh - 1.8 acres); and 2. Optimal Marsh Restoration Area - 45 Acres (Low Marsh - 43 acres and High Marsh - 2 acres). Material to create the restoration area would come from the authorized project.

The initial plan was further modified to incorporate the required salt marsh mitigation feature, and it was renamed “Alternative 3B – Great Marsh Island Required Mitigation (18.2 Acres)”. This plan retains the removal of 889,000 CY of dredge material with quantities for the 18.2 acre mitigation site by 16-inch pipeline and the remaining dredge material by 30-inch pipeline to Buck Island. Dredge by Pipeline to Buck Island and Relocate Training Walls is shown on Figure 1. Great Marsh Island salt marsh and high marsh mitigation alternatives are shown as Figure 2 and 3. This alternative is considered the baseline plan for comparison of the VE alternative plan.

PROPOSED DESIGN: As a result of the number of closely related, dependent and sequentially supporting ideas for project features identified during the VE study brainstorming and analysis sessions, a composite plan has been developed incorporating four specific Speculation ideas:

- Fully develop Great Marsh Island as a material placement location and salt marsh mitigation feature with available project dredge material quantities (~45 acres +/-).
- Evaluate dredging depths and navigation performance, and balance dredge excavation quantities to salt marsh mitigation feature fill requirements.

- Develop stone training wall structures for optimal service life and minimal maintenance, repair and replacement – incorporate larger scour aprons and eliminate mass bedding stone.
- Add Chicopit Bay flowway to allow for improved water quality and environmental stability of the project area by increasing flushing capacities and channel flow dynamics, and place dredge material into Great Marsh Island mitigation improvements (~8 acres +/-).

Plan views of the modified composite Alternative VE-3B Plan with removal of 889,000 CY of dredge material by pipeline to Great Marsh Island, relocation of Training Walls, Great Marsh Island salt marsh mitigation areas and modified stone training wall structures are shown on Figures 4 and 5.

ADVANTAGES:

- Per the U.S. Clean Water Act and Florida state statute, mitigation for the loss of salt marsh at Helen Cooper Floyd Park would be required. The eroded breakthrough at Great Marsh Island would provide an appropriate mitigation site.
- New surveys and coordination of Mile Point navigation and flowway requirements indicates potential for balanced excavation to develop the Great Marsh Island mitigation feature – nets total reduced dredge quantities ~410,000 CY.
- Training wall structures designed for optimal service life and minimal maintenance, repair and replacement incorporates larger scour aprons. The mass bedding stone is eliminated; however, the size of stone increases and net cost savings are reinvested in scour aprons.
- There is both a reduction in quantities to be dredged and the proposed mitigation site is closer than Buck Island, thereby reducing pipeline pumping distance and cost.
- The size and capacity of dredge equipment needed to excavate and move material changes significantly, i.e. a 30-inch cutter-suction pipeline operation could be reduced to a 16-inch cutter-suction pipeline.
- Recommended changes are provided early in the plan formulation process to permit modification of the alternative plan under study.

DISADVANTAGES:

- Achieving the correct elevation for salt marsh mitigation will likely require a phased approach. See Comment 1 for additional details.
- The restoration area would need to be monitored for at least five years.
- Potential cultural resources will have to be determined within the proposed restoration area.

JUSTIFICATION: The recommended VE plan includes removal of the existing western Mile Point training wall and the construction of a new Western Leg and a relocated Eastern Leg training wall of approximately 4,250 feet and 2,050 feet as generally described in the initial plan.

The recommended plan is modified to realize beneficial use of approximately 889,000 CY of dredged material by creating a combination of salt marsh and high marsh mitigation areas that restores wetlands lost on Great Marsh Island and Helen Cooper Floyd Park. Restoring Great Marsh Island is both the least cost alternative for dredged material and also provides additional acres of salt marsh restoration above the 18.2 required acres.

This plan incorporates the beneficial use of dredged material by creating a salt marsh mitigation area that restores wetlands lost on Great Marsh Island. Environmental Restoration benefits (National Environmental Restoration) were realized with this alternative. Restoration in excess of the required mitigation (18.2 acres) could be used as credits (26.8 acres) for a future project. The mitigation site at Great Marsh Island is closer than Buck Island, which would result in a substantial cost savings by reducing pumping distance of dredged material and allow a smaller dredge and less pipeline.

As presented in Proposal C-1, improved training wall structures are assumed to provide 85 to 100 years service and are designed for optimal service life and minimal maintenance, repair and replacement incorporates larger scour aprons.

The Chicopit Bay flow improvement channel (FIC) was added to the design of this alternative to allow for improved water quality and environmental stability of the project area by increasing flushing capacities and channel flow dynamics. Dredged material potentially contributes an additional ~8 acres of salt marsh.

The preferred alternative is Relocation of the Mile Point Training Wall and is referred to as Alternative VE-3B+FIC in the report. This alternative was the only alternative that provides for a reduction in erosion on the Mile Point shoreline and allows for the St. Johns Bar Pilots to lift the restrictions to navigation.

Savings will be reported under the SAJ Value Engineering program based on estimates for the modified initial alternative plan, “Alternative 3B – Great Marsh Island Required Mitigation (18.2 Acres)”, and modified Alternative VE-3B+FIC. Savings are estimated as $9.056 million.

FIGURE 1: ORIGINAL ALTERNATIVE 3B PLAN
(Dredge by Pipeline to Buck Island and Relocate Training Walls)

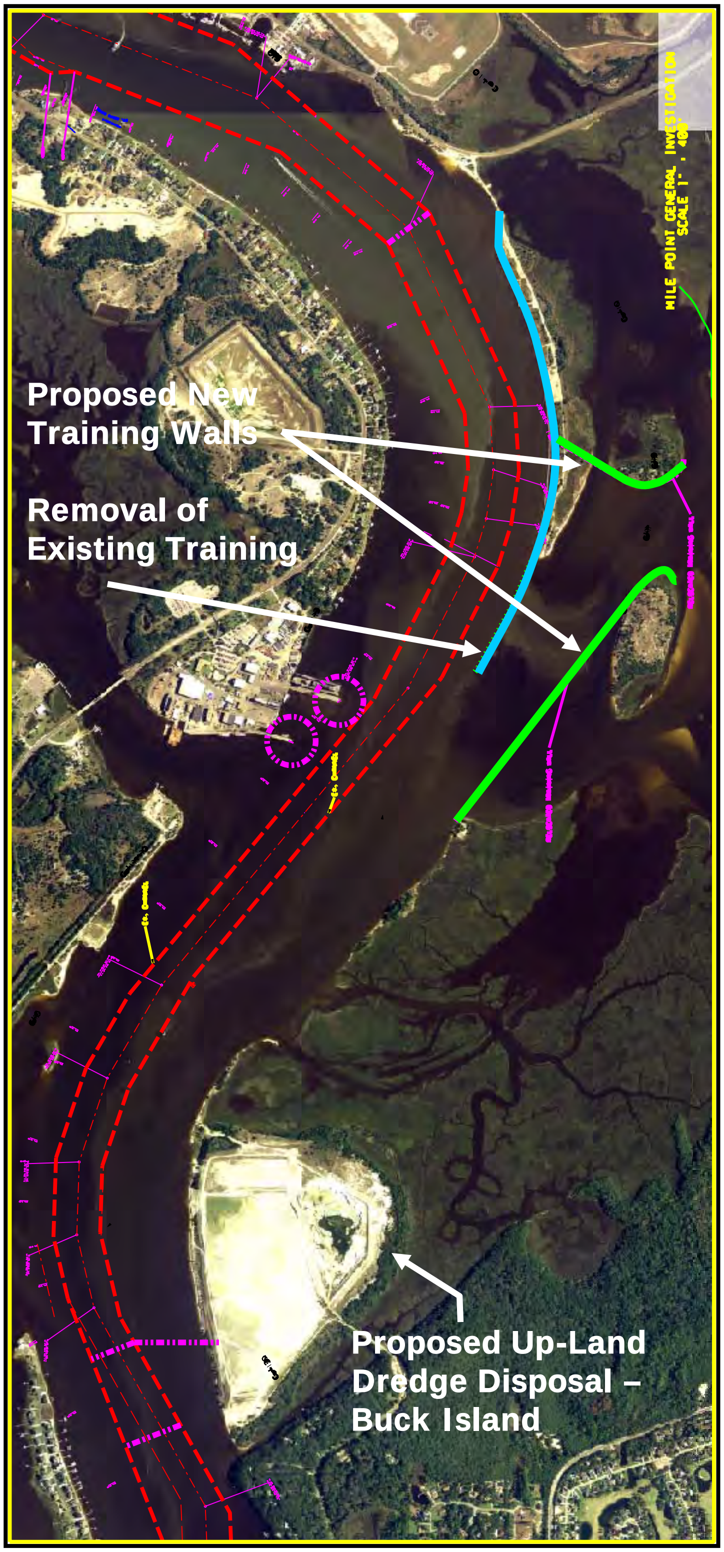


FIGURE 2 AND 3: ALTERNATIVE 3B MITIGATION PLANS

(Great Marsh Island Minimal 18 Acre Required and Expanded 45 Acre Mitigation Plans)

CONCEPTUAL MITIGATION PLAN FOR MILE POINT STUDY

NOTES

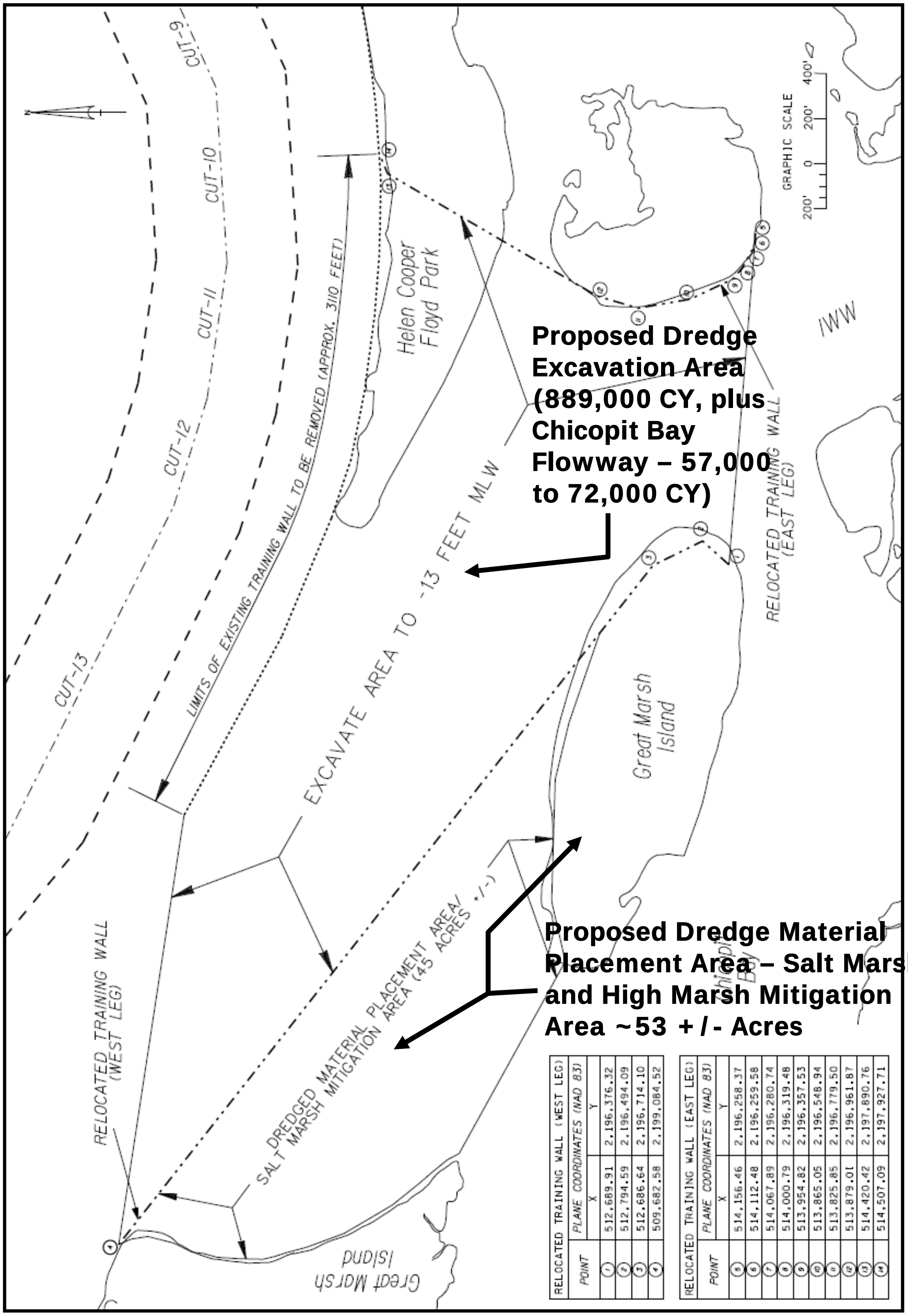
1. AREA A CONSISTS OF 16.38 ACRES OF LOW MARSH AT ESTIMATED ELEVATION + 2.0 FEET (MUST BE CONFIRMED BY SURVEY).
2. AREA B CONSISTS OF 1.82 ACRES OF HIGH MARSH AT ESTIMATED ELEVATION + 3.0 FEET (MUST BE CONFIRMED BY SURVEY).
3. TOTAL MITIGATION (AREA A PLUS AREA B) EQUALS 18.2 ACRES.

ALTERNATIVE CONCEPTUAL MITIGATION PLAN FOR MILE POINT STUDY

NOTES

1. AREA A CONSISTS OF 43 ACRES OF LOW MARSH AT ESTIMATED ELEVATION + 2.0 FEET (MUST BE CONFIRMED BY SURVEY).
2. AREA B CONSISTS OF 2 ACRES OF HIGH MARSH AT ESTIMATED ELEVATION + 3.0 FEET (MUST BE CONFIRMED BY SURVEY).
3. TOTAL MITIGATION (AREA A PLUS AREA B) EQUALS 45 ACRES.

FIGURE 4: PROPOSED MODIFIED ALTERNATIVE 3B MILE POINT PLAN



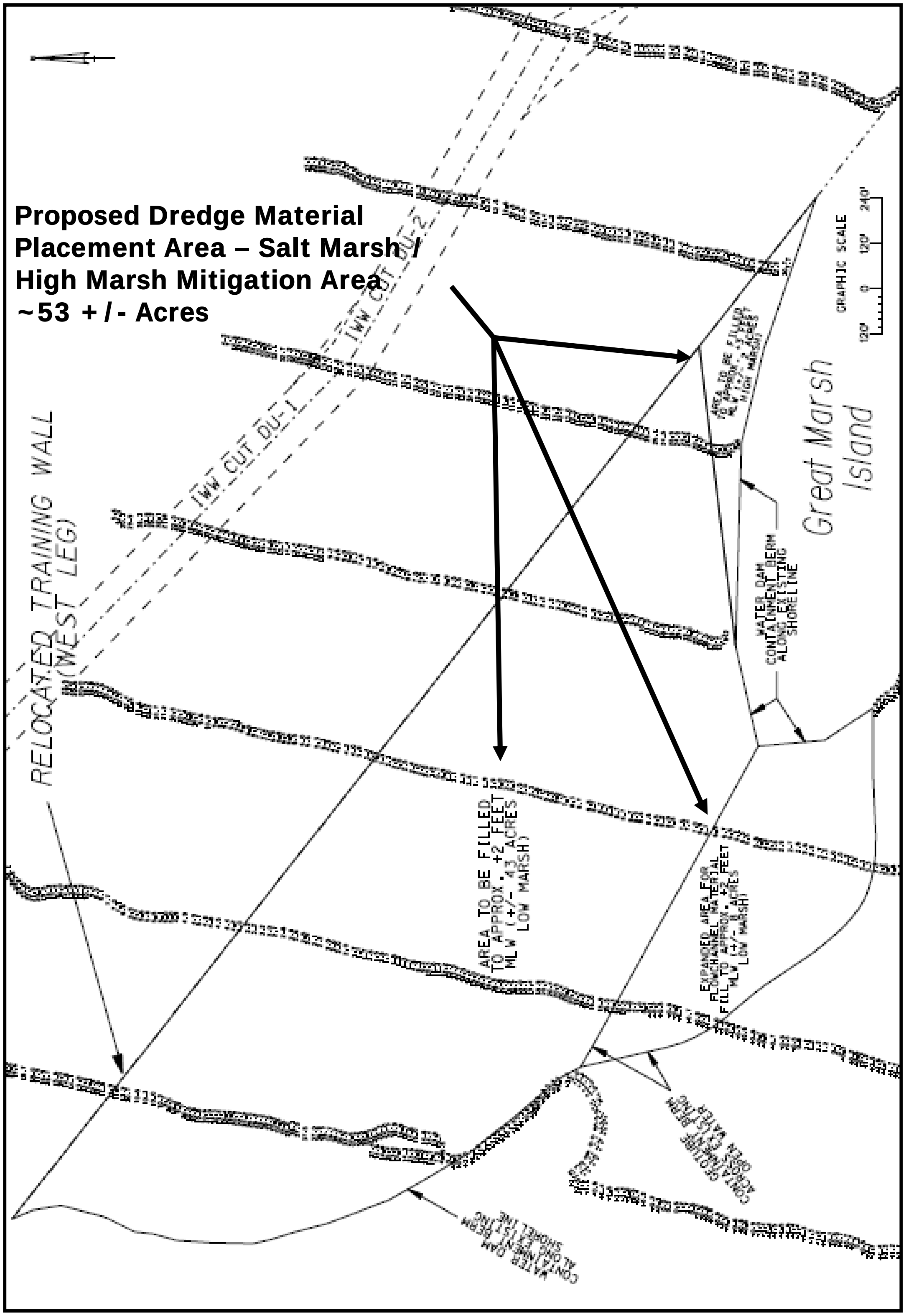
RELOCATED TRAINING WALL (WEST LEG)

POINT	PLANE COORDINATES (NAD 83) X	Y
1	512,689.91	2,196,376.32
2	512,794.59	2,196,494.09
3	512,686.64	2,196,714.10
4	509,682.58	2,199,084.52

RELOCATED TRAINING WALL (EAST LEG)

POINT	PLANE COORDINATES (NAD 83) X	Y
5	514,156.46	2,196,258.37
6	514,112.48	2,196,259.58
7	514,067.89	2,196,280.74
8	514,000.79	2,196,319.48
9	513,954.82	2,196,357.53
10	513,865.05	2,196,548.94
11	513,825.85	2,196,779.50
12	513,879.01	2,196,961.87
13	514,420.42	2,197,890.76
14	514,507.09	2,197,927.71

FIGURE 5: PROPOSED MODIFIED ALTERNATIVE 3B MITIGATION PLAN
(Detail Great Marsh Island – 53 +/- Acre Mitigation Plan)



COST ESTIMATE WORKSHEET

PROPOSAL DESCRIPTION: Composite Plan for Mile Point Navigation Improvements

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Alternative 3B Great Marsh Island	LS	1	$55,945,078.00	$55,945,078
Required Mitigation (18.2 Acre)				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$55,945,078

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Proposed Modified Alternative VE-3B	LS	1	$46,888,664.00	$46,888,664
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$46,888,664

	Net Cost Decrease/Increase		$9,056,414
*	Mark-ups	0.00%	$0
	Total Cost Decrease/Increase		$9,056,414

* Mark-ups: Gen. Contractor Mark-up (Field Office/Home Office/Profit/Bond); Construction Mgt; PED and Contingency included in Unit Prices. See Appendix E for supporting cost details

COMMENTS ON VALUE ENGINEERING SESSION IDEAS

The following comments are provided on ideas that were considered by the VE team and are documented to varying levels of detail. Comments may be integrated with selected modified plan, or may stand alone.

COMMENT 1: Subsequent to the formation of Alternative 3B, it was determined that the western portion of Helen Cooper Floyd Park consists of jurisdictional wetlands, specifically salt marsh, as well as disturbed uplands. The salt marsh boundaries had been previously delineated by the landowner (US Navy), and with this information it was calculated that the proposed relocation of the training wall would impact 8.15 acres of marsh. Instead of placing the dredged material at Buck Island, the recommended alternative is to use the material to mitigate for project related impacts. This could be accomplished by restoring salt marsh which historically occurred within the eroded breakthrough at nearby Great Marsh Island.

The mitigation plan could be implemented in phases as follows:

Phase 1: Construction of the project would include: surveys to determine existing elevations or depths of the proposed salt marsh restoration area as well as elevations of low and high salt marsh of adjacent marsh areas; relocation of the training wall; placement of berm type structures on the south, east and west sides of the restoration area; and placement of dredged material into the contained restoration area. The target elevation of the restoration area should be comparable to adjacent marsh, with settling taken into consideration. This work would be accomplished under the initial construction contract.

Phase 2: After the dredged material within the restoration area has settled, the following tasks would be performed: elevations within the restoration area would be determined; if necessary, material would be added or removed in order to achieve elevations that match adjacent existing low and high marsh; biological site survey of the upland area of Great Marsh Island prior to use as potential borrow area; construction of tidal channels within the restoration area; and transplanting low and high marsh species of plants from adjacent donor marshes to the restoration area. This work would be accomplished under a second construction contract; however, the planting could be performed by a separate contract administered by SAJ-PD-EC.

Phase 3: The restoration site would be monitored for a minimum of five years.

ADVANTAGES:

- Per the U.S. Clean Water Act and Florida state statute, mitigation for the loss of salt marsh at Helen Cooper Floyd Park would be required. The eroded breakthrough at Great Marsh Island would provide an appropriate mitigation site.

- The project will attempt to restore the entire eroded breakthrough, which would result in the restoration of ~53 +/- acres of marsh area. This beneficial use of dredged material would exceed the required 18.2 acres of mitigation, and would provide a higher net increase of salt marsh functions and values.
- The proposed mitigation site is closer than Buck Island, thereby reducing pumping distance and cost.
- Equipment needed to excavate and move material would change significantly, i.e. a smaller dredge could be used, due to the proximity of the mitigation site. This would also result in a cost savings.
- Recommended changes are provided early in the plan formulation process to permit modification of the alternative plan under study.

DISADVANTAGES:
- Achieving the correct elevation for salt marsh mitigation will likely require a phased approach. Dredged material would be placed in the mitigation site during the first phase of the mitigation plan, and then an amount of time would have to be allocated for settling of the material to take place. During the second phase of the plan, the elevation of the mitigation site would be assessed and, if necessary, material would be added or removed in order to achieve the correct elevation for low and high marsh Construction of tidal channels and planting of salt marsh vegetation would be performed once the correct elevation is achieved. The restoration area would need to be monitored for at least five years.
- Potential cultural resources will have to be determined within the proposed restoration area.

JUSTIFICATION: This opportunity incorporates the beneficial use of dredged material on Great Marsh Island by creating a salt marsh mitigation area that restores wetlands lost by improvement in the Mile Point project area. The initial plan can be modified to realize beneficial use of approximately 889,000 CY of dredged material by creating a salt marsh mitigation area. The Chicopit Bay flow improvement channel (FIC) provides an additional 50,000 to 70,000 CY, or potentially 8 +/- acres. The total acreage may range to 53 acres.

The Uniform Mitigation Assessment Method was used to determine that 18.2 acres of mitigation would be required to offset the loss of 8.15 acres of salt marsh at Helen Cooper Floyd Park. As a beneficial use of dredged material, the project will attempt to restore the entire eroded breakthrough at Great Marsh Island. This would result in the restoration of ~53 acres of marsh, and would provide a higher net increase of salt marsh functions and values. Environmental benefits of this magnitude could help justify the proposed project in addition to the economic benefits.

The District could also request that any restoration in excess of the required mitigation (18.2 acres) could be used as credits (34.8 acres) for a future project. Restoring Great Marsh Island is both the least cost alternative for dredged material and also provides additional acres of salt marsh restoration above the required minimum acres. Environmental Restoration benefits (National Environmental Restoration NER) will be realized with this option.

It should be noted that identifying appropriate mitigation sites can be problematic; however, in this case, the proposed site is ideal due its close proximity to the project and the fact that salt marsh historically occurred at this location. The proposed west training wall would protect the mitigation site from future erosion while supporting tidal exchange. In addition to the wall, containment of material within the mitigation site would require some type of berm along the southern side and possibly the east and west sides of the site. These containment structures would have openings to also allow for tidal exchange and provide water quality control required by permitting for dredged material placement. With proper containment and a phased, planned approach, the use of the proposed site should result in a highly successful mitigation effort. The proximity of the mitigation site would also allow for smaller, less expensive equipment to be used, i.e. a smaller dredge and less pipeline. Finally, the mitigation site at Great Marsh Island is closer than Buck Island, which would result in a substantial cost savings by reducing pumping distance of dredged material.

COMMENTS ON VALUE ENGINEERING SESSION IDEAS

COMMENT 2: A reconstructed marsh mitigation area is being considered south of Structure 1. Two conceptual alternatives are being considered for the mitigation site: 1. - Minimal Marsh Restoration Area –18.2 Acres (Low Marsh - 16.38 acres and High Marsh - 1.82 acres); and 2. - Optimal Marsh Restoration Area, 41.4 Acres (Low Marsh – 39.58 acres and High Marsh 1.82 acres).

PROPOSED DESIGN: It is recommended that the following containment systems be evaluated for the south mitigation containment wall. The four systems are Geotubes, a water dam (Aqua-Dam), stone revetment or sand. The two mitigation alternatives will require different lengths of wall. The Minimal Marsh plan requires an approximately 1,200 LF wall. The Optimal Marsh plan requires approximately a 1,000 LF wall.

ADVANTAGES:

- Containment using a south dike structure would assure water quality compliance during dredge material placement.
- Geotubes are flexible offering an 8 to 10 year service life for erosion protection.
- Both Geotubes and water dam provides initial containment for water decanting.
- Stone containment dike offers the longest service life.
- Stone work is currently in contract scope.
- Sand/earth work is also in contract scope.

DISADVANTAGES:

- Geotubes will have a limited service life – likely 8-10 years, but should not require replacement one the marsh is established.
- Temporary water dam requires both placement and removal – one year service.
- Damage repair to Geotube and water dam systems are sometimes required from vandalism.
- Stone systems are costly for long distance transportation and on-site equipment placement.
- Higher superiority may be needed for sand berm and service length is unknown.

JUSTIFICATION: The west training wall will serve as one containment structure for either dredge material placement mitigation alternative. The mitigation site will require some type of southern containment berm feature for placement of dredge material and decanting of water from dredging fill process. It will also provide water quality control likely required by permitting for hydraulic dredging operations.

Additional functions of the containment berm may consider long term protection from erosion attack and wash out (as is the current condition) and protection of marsh plantings from storm surge. The new structure may be considered for construction using Geotubes, a water dam, stone or sand. Evaluation of flexibility should consider that the new south mitigation wall may be only an initial “one-time use” containment wall for initial dredge placement. All plans are initially placed below water surface approximately -3 feet to a final height of +5 feet.

Geotubes are frequently used for dredge material placement for both water decanting and extended protection of developing marsh plantings. Geotubes can have drain pipes and soil cover with planting integrated into their use. Geotubes can also be developed with low weir sections to complement the planed marsh drainage patterns shown in both mitigation plans.

The water dam alternative is considered a "one-time use" application and should be removed following dredge placement. The water dam system work well for water containment and decanting, but will require some off-set to prevent material from building up against it thereby complicating removal. Drain pipes can be placed with water dam systems. The water dam could remain in place for a full year for protection of the developing marsh plants. It would likely be a temporary dam purchase system with contractor placement with some technical support from the manufacturer. Purchase pricing for an 8 foot height is $100 per LF and for a 10 height is $250 per LF plus installation. See Aqua-Dam at the following web site:
http://www.waterstructures.com/

The stone containment berm is very traditional for marsh restoration containment features and offers tidal delivery of water to the new marsh area through the open rock structures including both north training wall and south wall. Stone is prone to be expensive for transportation and placement. The level of service may be more than is required for the south side of the medication site.

A sand berm could be used for initial dredge placement and it could be incorporated into the final native planting scheme. Drain pipes can be placed with the berm. A sand berm is likely a lower service life for Geotube and stone alternatives.

The south wall is a far less critical structure than the training wall, primarily serving during dredge placement and for early establishment of marsh grasses. The lower cost alternative may be fully satisfactory, but the longer service life for storm may be desired.

Dredge material and water decanting is considered a contractor option to achieve work within permit limitations using methods he is familiar with. Estimated cost per 1,000 LF is provided for each system:

1. Geotube - $85,000
2. Water Dam (Aqua-Dam) - $135,000
3. Stone - $433,000 (Not a best buy)
4. Sand Berm - $35,000 - $50,000

PROPOSED MITIGATION CONTAINMENT ALTERNATIVES
(Alternative Dredge Containment Systems – Geotubes)

Island and Marsh Recreation with Geotube Containment

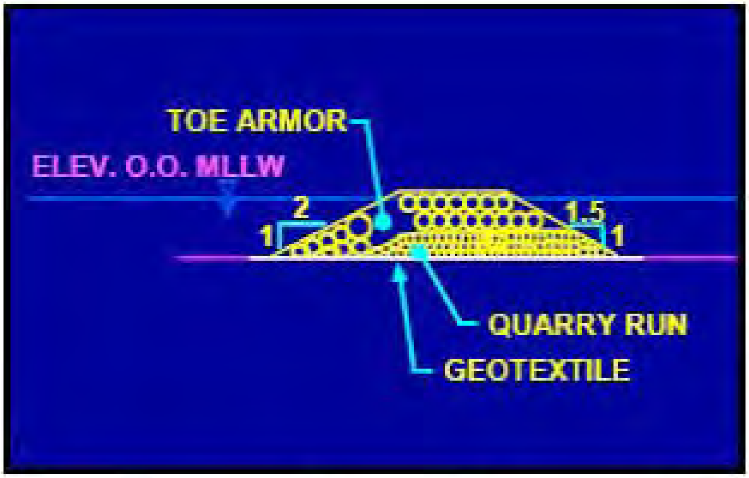
Typical Covered and Planted Section and Geotube Filling Operation

Geotube Dredge Containment Applications

PROPOSED MITIGATION CONTAINMENT ALTERNATIVES
(Alternative Dredge Containment Systems – Aqua-Dam)

Aqua-Dam Water Containment Applications

PROPOSED MITIGATION CONTAINMENT ALTERNATIVES
(Alternative Dredge Containment Systems – Stone)



Typical Stone Containment Dike Section and Photos
(May be Fully Constructed from Barges or Supported by Land Equipment)

COMMENT 3: Alternative 3B provides relocations of reconfigured stone training walls for the west and east side of the southern IWW connection to the St. Johns River. The west training wall (Structure 1 – 4,250 LF) extends westward from Great Marsh Island and will be new filter and armor stone. The east wall (Structure 2 – 2,050 LF) will be constructed using relocated existing training wall filter and armor stone materials with new stone as needed. A reconstructed marsh mitigation area is being considered south of Structure 1.

PROPOSED DESIGN: The new S-1 west training wall is recommended to be studied for construction with Geotubes covered with geotextile and bedding stone layer, and topped with concrete armor units such as A-Jacks. The combinations of systems will be backed with overlapping geotextile filter material. The wall will serve as both the revetment and containment structure for the planned salt marsh mitigation area. The armor units will rise to EL 7.5-FT. Sufficient permeability on the upper wall will allow for tide inflow into the proposed mitigation areas south of the wall. This is recommended for analysis during PED design phase where more detailed analysis can be applied.

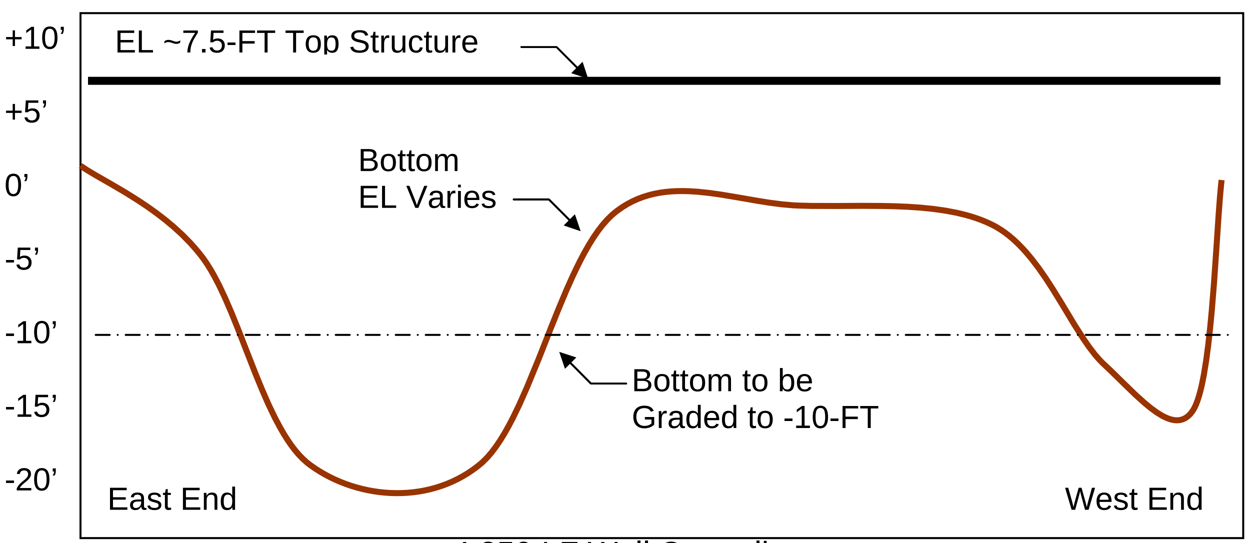
ADVANTAGES:
- Eliminates the need to transport heavy stone over long distance from the quarry source out of state.
- Interlocking nature of A-jacks will reduce instability due to scour at the toe.
- Efficient shipping on pallets would be available from close proximity to project.
- Two sets of Geotubes and 6 foot stone provide vertical height for containment for dredge material.
- The geotextiles provides dredge material containment and bedding stone provided protection of the Geotubes for placement of armor units (A-Jacks).

DISADVANTAGES:
- Construction of interlocking A-jacks below water level may be difficult.
- Bedding stone is needed for protection of geotextiles and Geotubes.

JUSTIFICATION: New filter, bedding and jetty stone will likely come from a middle or north Georgia source and likely will be shipped by rail. Total new stone quantities for Structure 1 are estimated as 18,400 CY for filter stone and 36,900 CY for armor stone. The armor unit wall will can be constructed of factory manufactured units that are shipped on pallets that minimizes shipping volume and distance. Each layered system supports another – A-Jacks stabilize wall, bedding stone protects Geotubes, Geotubes support stone and fill, and geotextile scour and filter materials contains fill material. The proposed wall will have inherent permeability that should allow tidal exchange from the mitigation marsh area, but prevent pulling of marsh area soils out through the rock wall. The concept was developed to a limited stage for material quantity take-off and pricing for the VE study. A limited service life was applied for 50 years with full replacement. It is not recommended as the feature cost basis for initial plan authorization. It is however recommended for analysis during PED design phase where more detailed analysis can be applied.

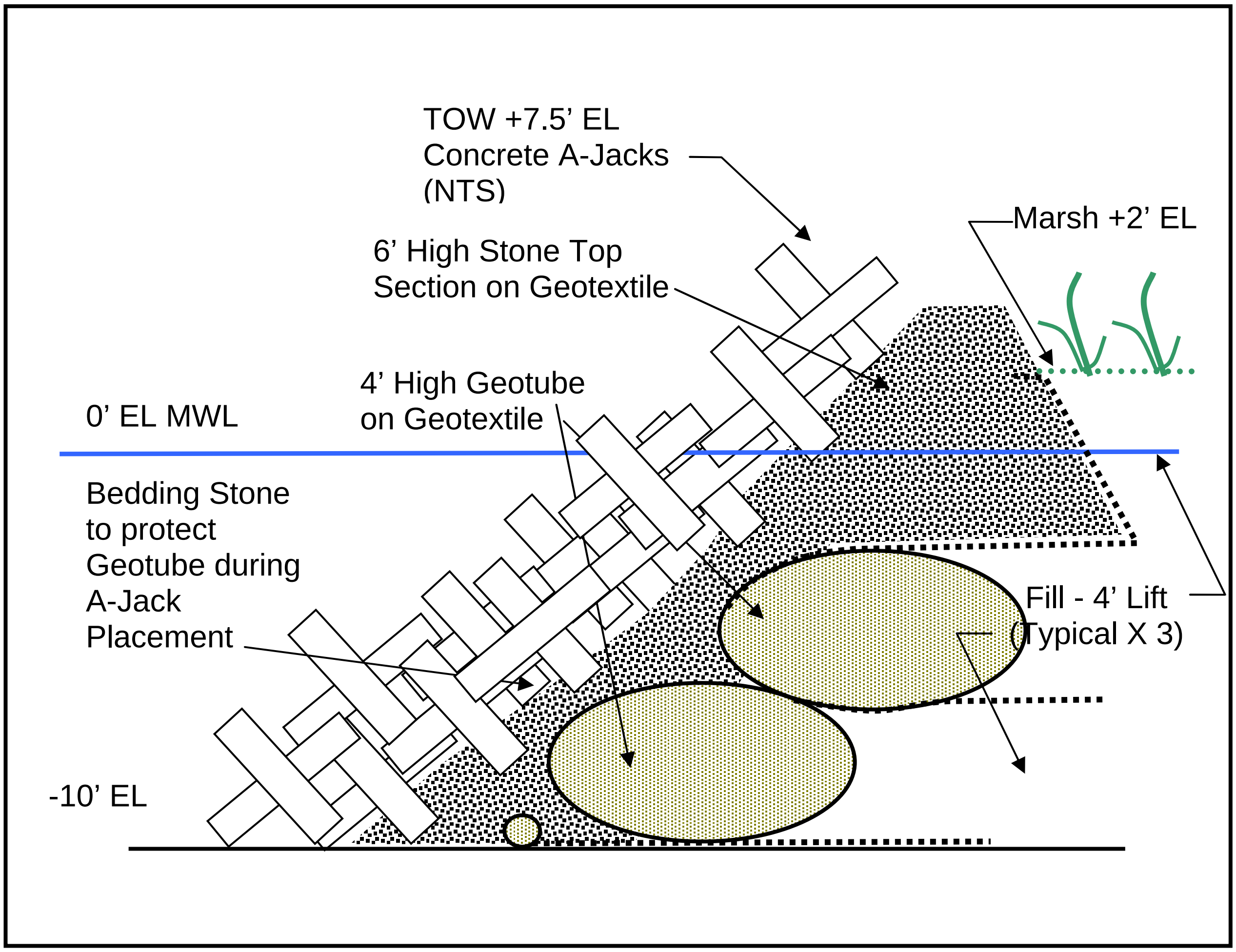
PROPOSED TRAINING WALL PLAN AND PROFILE

S-1 Training Wall and Mitigation Area Plan



4,250 LF Wall Centerline
S-1 Profile

CONCEPTUAL CROSS SECTION OF NEW S-1 WALL



COST ESTIMATE WORKSHEET

COMMENT 2 DESCRIPTION: Develop A-Jacks, Geotube and Stone Training Wall System

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
S-1 Filter Stone	CY	18,400	$183	$3,359,288
S-1 Armor Stone	CY	36,900	$436	$16,099,101
FIlter Fabric	SY	34,556	$3.82	$132,004
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$19,590,393

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Armor Unit	EA	188,160	$31.24	$5,877,366
Armor Unit Transportation	EA	188,160	$1.82	$342,846
Geotube embankments	LF	8,500	$65.21	$554,285
Geotextile	SF	310,500	$3.82	$1,186,110
Bedding/Filter Stone	CY	26,000	$182.57	$4,746,820
Replaced Year 50 - Present Worth 4.7/8%	LS	1	$1,176,000	$1,176,000
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$13,883,427

	Net Cost Decrease/Increase		$5,706,966
*	Mark-ups	0.00%	$0
	Total Cost Decrease/Increase		$5,706,966

* Mark-ups: Gen. Contractor Mark-up - (Field Office/Home Office/Profit/Bond); PED, Con Mgt; Contingencies included in unit prices

COMMENT 4: The current plan for Alternative 3B provides relocations of reconfigured stone training walls for the west and east side of the southern IWW connection to the St. Johns River. The west training wall (Structure 1 – 4,250 LF) will be new filter and armor stone. The east wall (Structure 2 – 2,050 LF) will be constructed using the relocated existing training wall filter and armor stone materials. A reconstructed marsh mitigation area is being considered south of Structure 1.

PROPOSED DESIGN: The new S-1 west training wall is recommended to be developed to be constructed with a steel sheet pile wall with inflow windows and augmented with a filter stone. The wall will serve as both the training wall and containment structure for the planned salt marsh mitigation area. The sheet pile will be driven to grade (~EL +6.5-FT) for placement of a concrete cap (TOW EL 7.5-FT) and every other sheet will be driven lower to approximately EL -1-FT for tide inflow into the proposed mitigation areas south of the wall.

ADVANTAGES:

- Reduces the class and amount of stone required and related transportation from remote stone sources
- Provides a faster construction method using a core sheet pile wall modified for water delivery into redeveloped marsh area.
- Sheet pile wall may be full depth cantilevered or be shortened using a tie-back system.

DISADVANTAGES:

- Steel sheet pile may be limited to approximately a 50-year service life for the Mile Point application.
- If a wall tie-back system is required, the fill placement may require phasing before full fill placement is made.

JUSTIFICATION: New filter, bedding and jetty stone will likely come form a middle or north Georgia source and will likely be shipped by rail. Total new stone quantities for Structure 1 are estimated as 18,400 CY for filter stone and 36,900 CY for armor stone. Structure 2 will approximately use all 14,600 CY of stone from the existing training wall structure. If a shortfall is identified the sheet pile concept can be developed and integrated with stone to complete Structure 2. The proposed sheet pile wall will be developed with alternating full height sheet and lowered sheets to allow tidal inflow into the mitigation marsh area. Modeling can optimize the number of windows needed. A concrete cap and toe stone is assumed for further stability of the wall. The lower gaps will be filled with a filter stone to permit incoming water, but prevent pulling of marsh areas soils back through the windows. The windows are assumed to be set at elevation -1- to +4-FT or 5-FT height by 2-FT in width. Windows can be analyzed for desired elevations and widths. Epoxy coating is assumed to provide 4 coats on both sides. A PZC-18 (24.2 #/SF replaces the old PZ-27 section) sheet size is assumed.

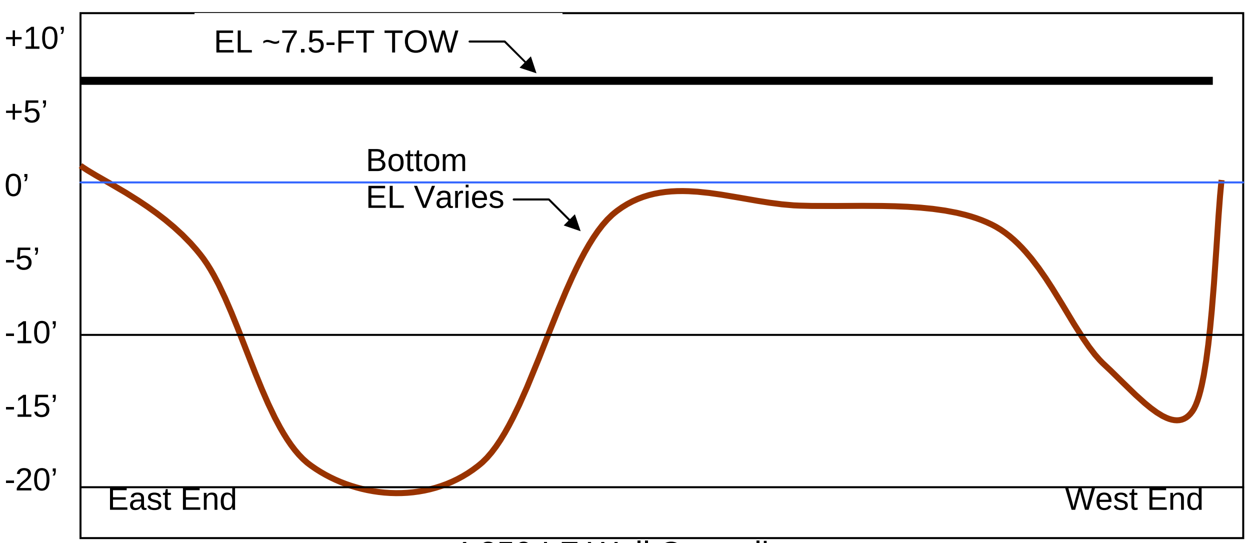
VALUE ENGINEERING COMMENTS

COMMENTS ON VALUE ENGINEERING SESSION IDEAS

The concept was developed to a limited stage for material quantity take-off and pricing for the VE study. A limited service life was applied for 50 years with full replacement. It is not recommended as the feature cost basis for initial plan authorization. It is however recommended for analysis during PED design phase where more detailed analysis can be applied.

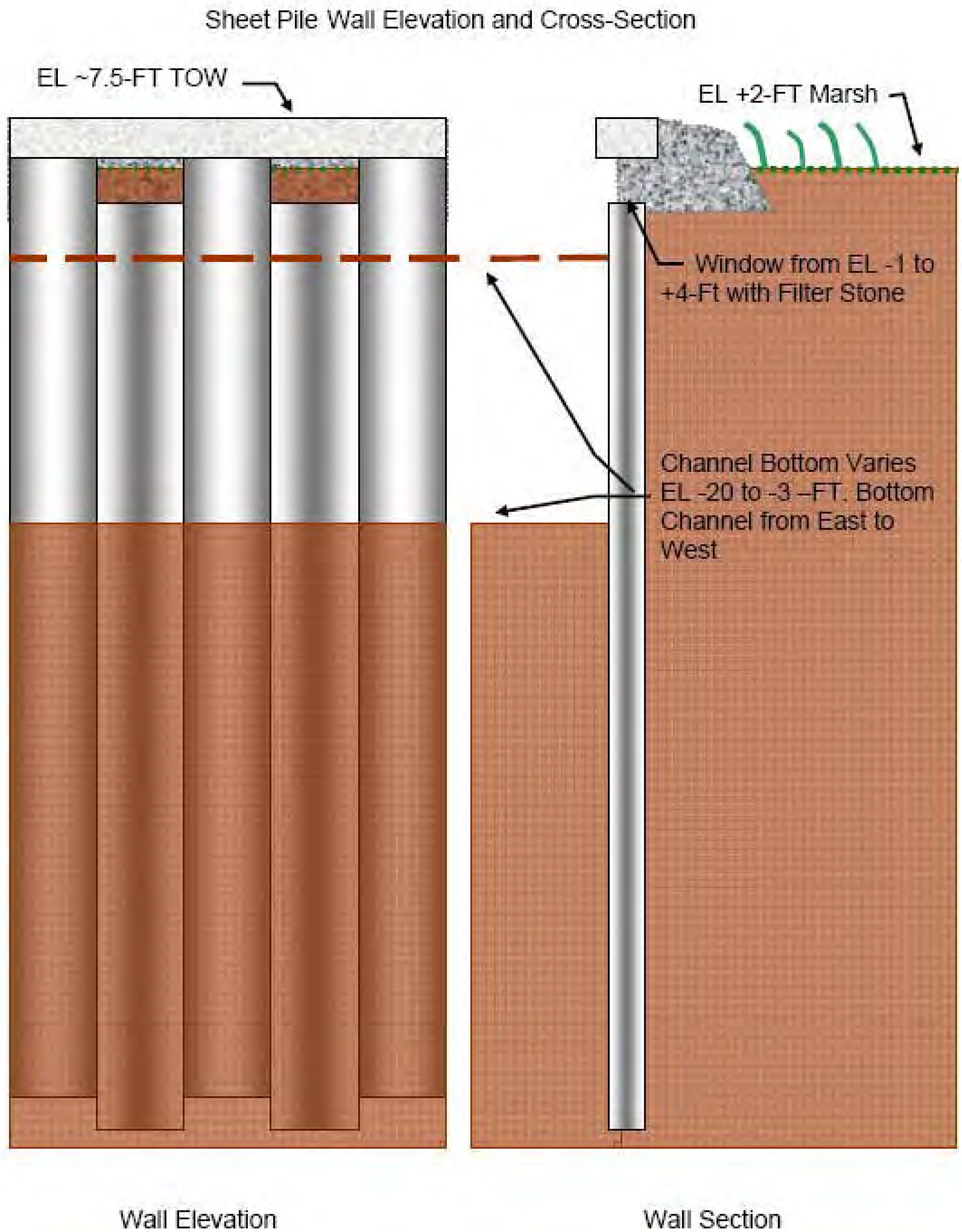
CURRENT TRAINING WALL PLAN AND PROFILE

S-1 Training Wall and Mitigation Area Plan



4,250 LF Wall Centerline
S-1 Profile

PROPOSED TRAINING WALL



COST ESTIMATE WORKSHEET

PROPOSAL DESCRIPTION: Develop Steel Sheet Pile Training Wall System

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
S-1 Filter Stone	CY	18,400	$183	$3,359,288
S-1 Armor Stone	CY	36,900	$436	$16,099,101
FIlter Fabric	SY	34,556	$3.82	$132,004
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$19,590,393

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
S-1 Sheet Pile (PZC-18 - 35' to 47' deep)	LF	4,250	$4,179	$17,760,368
Wailer/Tie-back/Toe & Filter Stone/Conc Cap				$0
Replaced Year 50 - Present Worth 4.7/8%	LS	1	$1,644,000	$1,644,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$19,404,368
	Net Cost Decrease/Increase			$186,025
*	Mark-ups	0.00%		$0
	Total Cost Decrease/Increase			$186,025

* Mark-ups: Gen. Contractor Mark-up - (Field Office/Home Office/Profit/Bond); PED, Con Mgt; Contingencies included in unit prices

SUPPORTING DOCUMENTS

CONTACT DIRECTORY

APPENDIX A: CONTACT DIRECTORY & VE STUDY TEAM MEMBERS

CONTACT NAME	ORGANIZATION	TELEPHONE NUMBER
Steve Ross,	SAJ-DP-C	904-232-1363
Richard Powell,	SAJ-PD-PN	904-232-1694
Paul Stodola,	SAJ-PD-EA	904-232-3271
Samantha Borer,	SAJ-PD-PN	904-232-1066
Steve Conger,	SAJ-EN-DW	904-232-1601
Brian Blake,	SAJ-EN-C	904-232-1003
Stephen Myers,	SAJ-EN-GG	904-232-3914
Brian Cornwell,	SAJ-EN-WM	904-232-2915
Jason Spinning,	SAJ-DP-C	904-232-1231
Fred McAuley,	SAJ-EN-T	904-232-1903

SPECULATION LIST

VALUE ENGINEERING TEAM STUDY

APPENDIX B: SPECULATION LIST

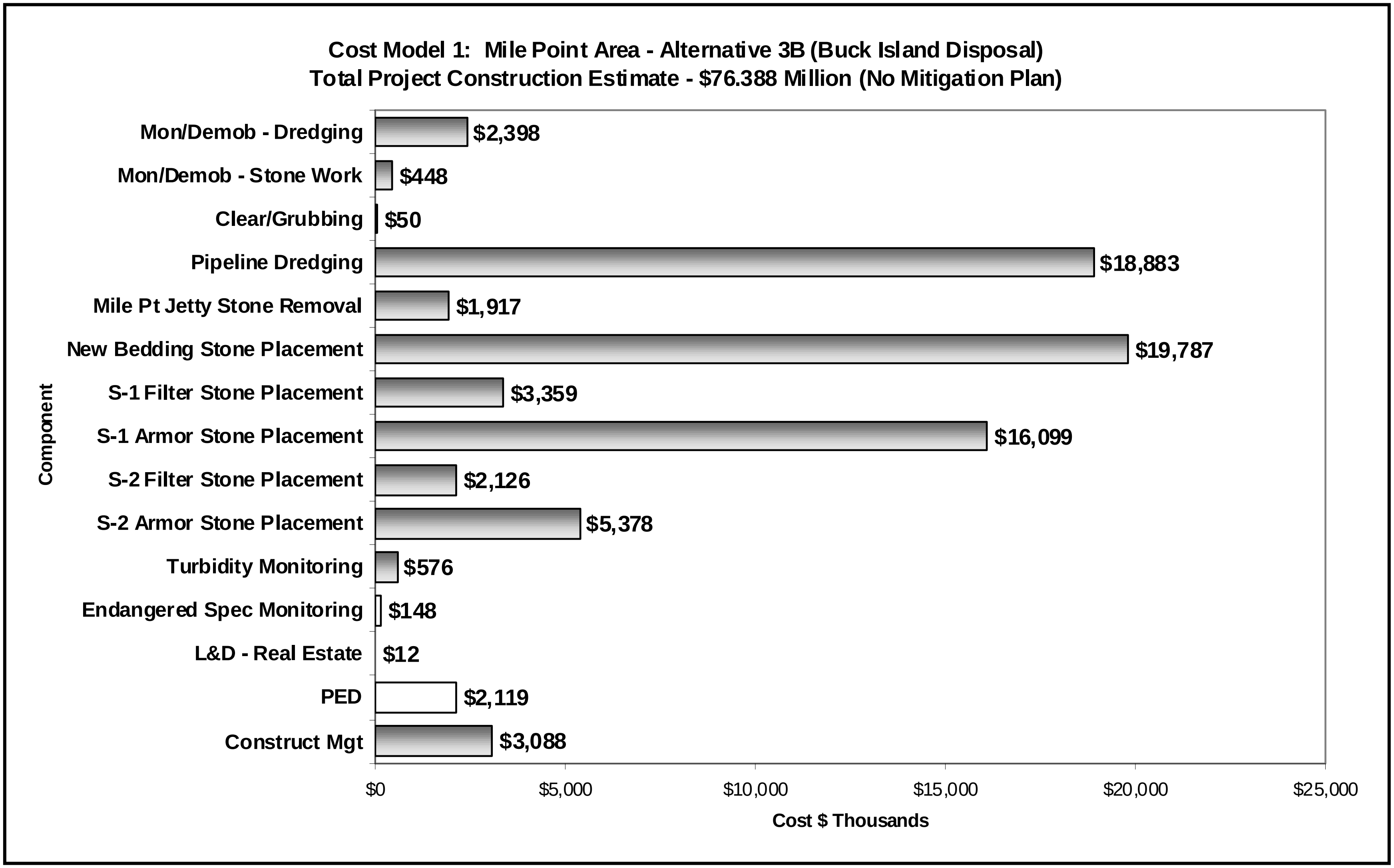
Speculation List for Mile Point Navigational Improvements - Plan Alternative 3B (Relocate Training Wall)			
No.	DescriptionActions: D = Develop; X = Deleted; C = Comment; BD = Done	Action	Assigned
1	Alternative wall systems - sheetpile, concrete Core-lok, Dolos	C	FM/ SM
2	Develop optimal training wall section - scour toe and delete 25 Ac bedding stone	C	BC/SC
3	Remove training wall rock in future for reuse (Alt 2)	X	
4	Sheetpile with rock toe	X	
5	Composite sheet pile	X	
6	Revisit need for 25 acres of stone - reduce to minimal required	D	BC, SC
7	Use articulated concrete mat for erosion protection (Commercial or MVD systems)	D	FM
8	Reduce southern length western leg of training wall at GMI (Design phase)	C	SC
9	Endorse 40 acre mitigation alternative (+ close disposal; + equipment)	D	SC/PS
10	Develop required mitigation up to 40 acres with options for cells and future completion (Match excavation/fill)	See 9	"
11	Use overdepth as material source as needed	See 9	"
12	Reuse rock Hellen Cooper-Floyd Park (if Alternative 2)	X	
13	Material source options to include Chicopit Bay	C	SC
14	Explore containment berm alternatives for mitigation site	See 15,16, 20	FM
15	Use water dam or rock for containment berm	See 14	FM
16	Use dredge sand for containment berm	See 14	FM
17	Identify 40 acre vs. 25 acre mitigation alternative as a lift	C	PS
18	Procurement alternatives supported include small business, use of best value RFP or IFB	C	BB/FM
19	Consider reduced depth 16' vs. 14' vs. 12'	D	BC/SC
20	Consider geotubes - minimal or maximum life	See 14	FM
21	Use natural openings for culverts for mitigation feature	C	FM
22	Planting by contract or natural	C	PS
23	If mitigation borrow is needed use high ground on Great Marsh Island (eliminate exotics)	C	PS
24	Use existing 8 acre seed source for reseeding new mitigation area	C	PS
25	Develop east side as mitigation area	X	
26	Alternate 3B - No disposal at Buck Island (See Mayport, dig dry material first - Design refinement - balance excavation to mitigation fill)	D	PS/SC/BB
27	Look to lower rock spec for the western wall (lower risk exposure)	X	SM
28	Reuse existing training wall rock for east wall	BD	SM/BC
29	Fill existing S-2 low areas to minimize rock quantities	D	SC
30			

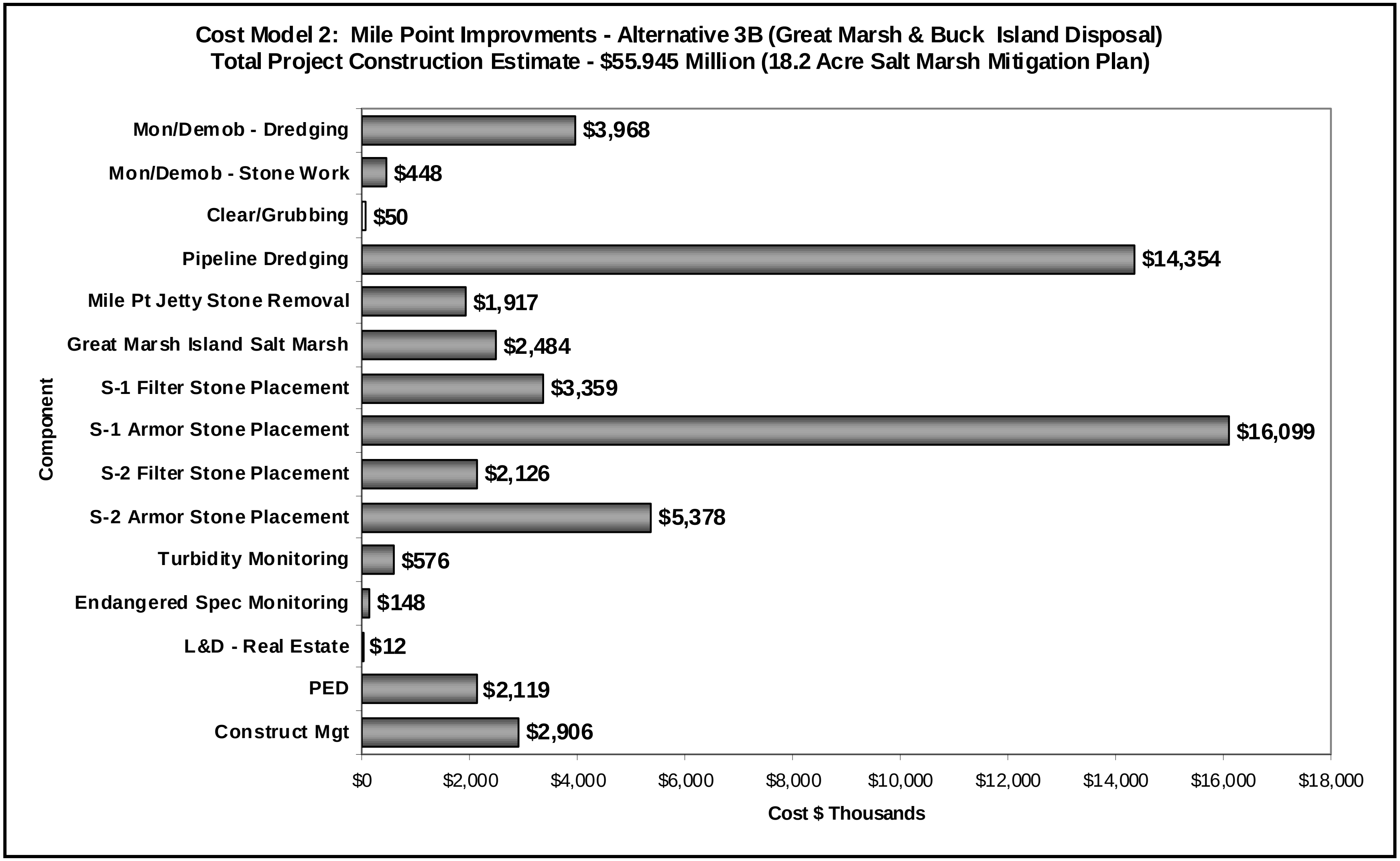
COST MODEL

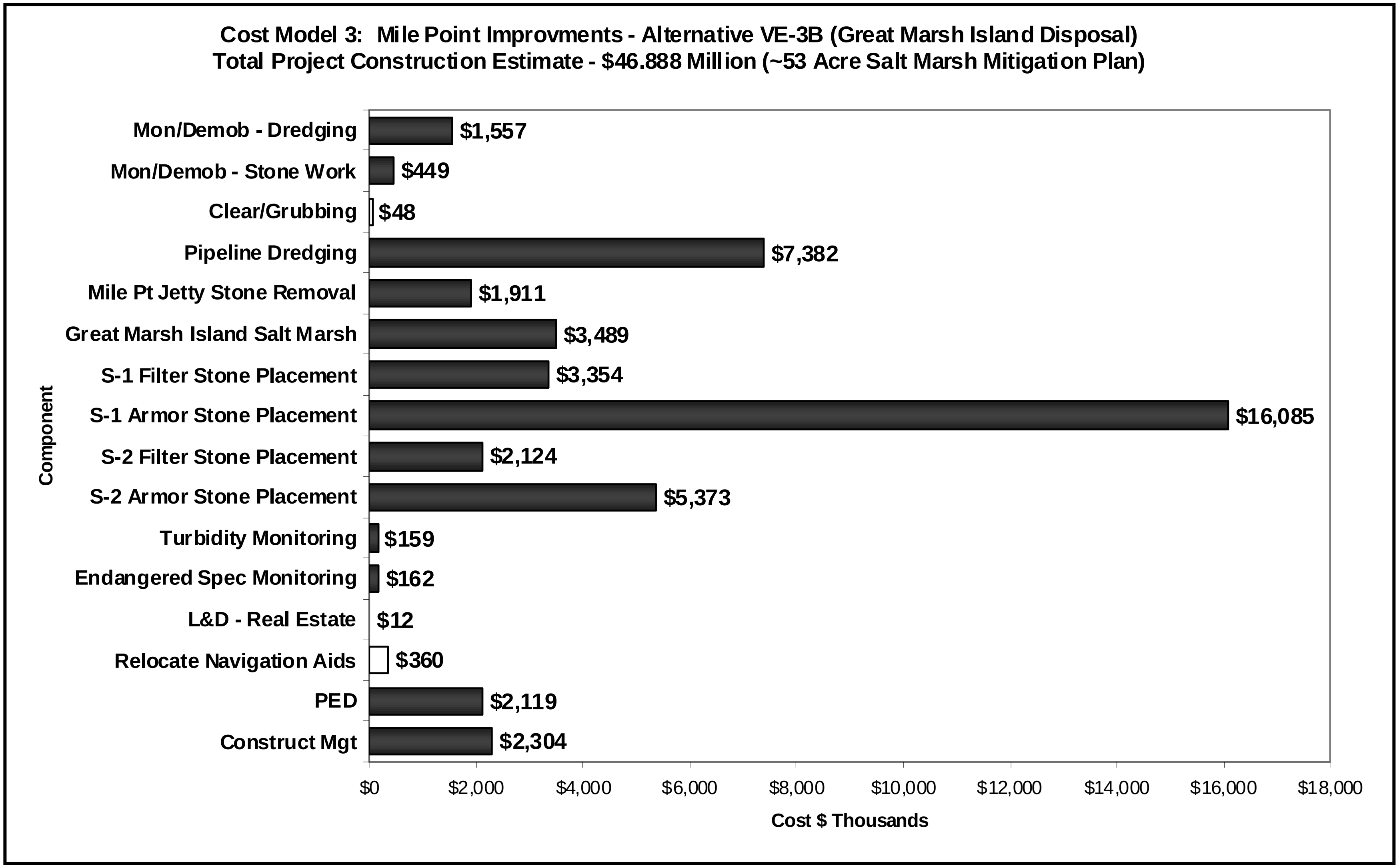
Cost Model 1: Mile Point Alternative 3B (No Mitigation Plan)

Cost Model 2: Mile Point Alternative 3B (18.2 Acre Mitigation Plan)

Cost Model 3: Mile Point Alternative VE-3B (53 Acre Mitigation Plan)

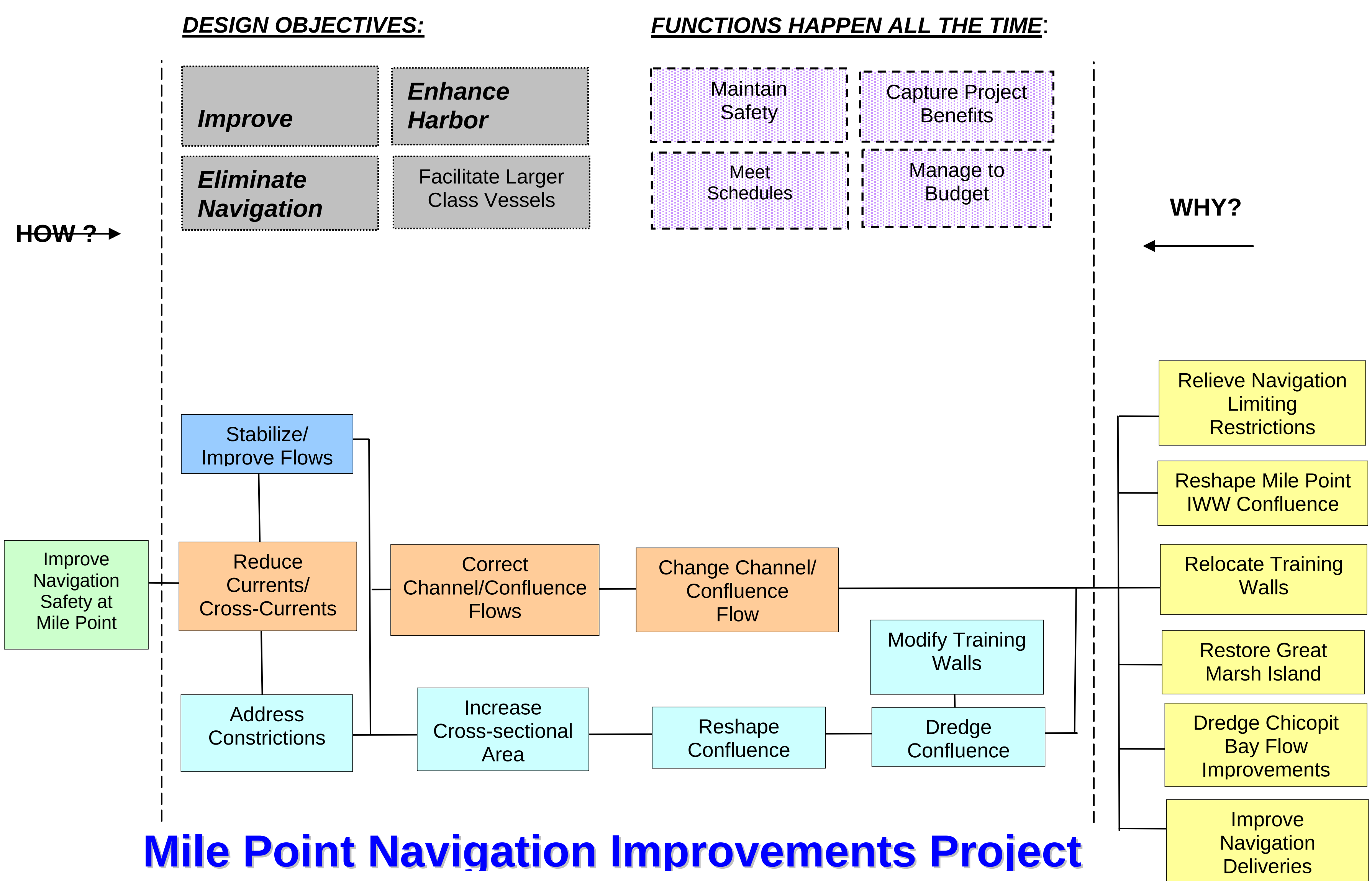

Cost Model 1: Mile Point Area - Alternative 3B (Buck Island Disposal)
Total Project Construction Estimate - $76.388 Million (No Mitigation Plan)
Mon/Demob - Dredging
$2,398
Mon/Demob - Stone Work
$448
Clear/Grubbing
$50
Pipeline Dredging
$18,883
Mile Pt Jetty Stone Removal
$1,917
New Bedding Stone Placement
$19,787
S-1 Filter Stone Placement
$3,359
S-1 Armor Stone Placement
$16,099
S-2 Filter Stone Placement
$2,126
S-2 Armor Stone Placement
$5,378
Turbidity Monitoring
$576
Endangered Spec Monitoring
$148
L&D - Real Estate
$12
PED
$2,119
Construct Mgt
$3,088
Component
$0
$5,000
$10,000
$15,000
$20,000
$25,000
Cost $ Thousands


Cost Model 2: Mile Point Improvments - Alternative 3B (Great Marsh & Buck Island Disposal)
Total Project Construction Estimate - $55.945 Million (18.2 Acre Salt Marsh Mitigation Plan)
Mon/Demob - Dredging
$3,968
Mon/Demob - Stone Work
$448
Clear/Grubbing
$50
Pipeline Dredging
$14,354
Mile Pt Jetty Stone Removal
$1,917
Great Marsh Island Salt Marsh
$2,484
S-1 Filter Stone Placement
$3,359
S-1 Armor Stone Placement
$16,099
S-2 Filter Stone Placement
$2,126
S-2 Armor Stone Placement
$5,378
Turbidity Monitoring
$576
Endangered Spec Monitoring
$148
L&D - Real Estate
$12
PED
$2,119
Construct Mgt
$2,906
Component
$0
$2,000
$4,000
$6,000
$8,000
$10,000
$12,000
$14,000
$16,000
$18,000
Cost $ Thousands



Cost Model 3: Mile Point Improvments - Alternative VE-3B (Great Marsh Island Disposal)
Total Project Construction Estimate - $46.888 Million (~53 Acre Salt Marsh Mitigation Plan)
Mon/Demob - Dredging
$1,557
Mon/Demob - Stone Work
$449
Clear/Grubbing
$48
Pipeline Dredging
$7,382
Mile Pt Jetty Stone Removal
$1,911
Great Marsh Island Salt Marsh
$3,489
S-1 Filter Stone Placement
$3,354
S-1 Armor Stone Placement
$16,085
S-2 Filter Stone Placement
$2,124
S-2 Armor Stone Placement
$5,373
Turbidity Monitoring
$159
Endangered Spec Monitoring
$162
L&D - Real Estate
$12
Relocate Navigation Aids
$360
PED
$2,119
Construct Mgt
$2,304
Component
$0
$2,000
$4,000
$6,000
$8,000
$10,000
$12,000
$14,000
$16,000
$18,000
Cost $ Thousands

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM



Mile Point Navigation Improvements Project

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST DIAGRAM)

U.S. ARMY CORPS OF ENGINEERS,
JACKSONVILLE DISTRICT

U.S. ARMY CORPS OF ENGINEERS

ATTACHMENT F - VE STUDY FY'11

VALUE ENGINEERING STUDY REPORT

113114 Mile Point Improvements Feasibility Study Value Engineering Proposal Using Concrete Structural Units for West Training Wall

Jacksonville - Duval County, Florida

Sponsored By: Jacksonville Port Authority and U.S. Army Engineering District, Jacksonville

January 2011

VALUE ENGINEERING TEAM STUDY

DOD SERVICE: USACE **VALUE ENGINEERING OFFICER:** Fred McAuley
CONTROL NO: CE-SAJ-VE-2011-002C

Value Engineering Study Report

113114 Mile Point Improvements Feasibility Study Value Engineering Proposal Using Concrete Structural Units for the West Training Wall

Jacksonville – Duval County, Florida

January 2011

STUDY SPONSOR: JaxPort & USACE, Jacksonville District

VALUE ENGINEERING FIRM: Jacksonville District
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Jacksonville, FL 32232-0019
TELEPHONE: (904) 232-1903

VALUE ENGINEERING STUDY TEAM LEADER:
Fred McAuley, Jr., EN-T

VALUE ENGINEERING STUDY TEAM MEMBERS:

Steve Ross, SAJ-DP-C	Richard Powell, SAJ-PD-PN
Paul Stodola, SAJ-PD-EA	Samantha Borer, SAJ-PD-PN
Steve Conger, SAJ-EN-DW	Brian Blake, SAJ-EN-C
Stephen Myers, SAJ-EN-GG	Brian Cornwell, SAJ-EN-WM
Jason McKinnon, SAJ-EN-GS	Paul Stroup, SAJ-EN-DS

113114 Mile Point Improvements Feasibility Study
Value Engineering Proposal Using Concrete Structural Units
for the West Training Wall
Jacksonville, Florida

INTRODUCTION: The Mile Point Improvements Feasibility Study recommends navigation safety improvements to remove existing navigation restrictions by modifications to the southern confluence point of the St. Johns River Federal Channel and the Intracoastal Waterway by deepening and widening this area. Modifications will also include reconfiguring and relocating the Mile Point Training walls. The East Training Wall will reuse existing armor stone being excavated from the current training wall, and West Training Wall will require approximately 70,000 tons new armor stone at a first cost of approximately $18 million. Total armor and filter stone for both training wall structures is estimated to cost approximately $29 million. This cost for stone materials represents approximately 58% of the cost for the pending recommended plan.

Due to concerns for the cost of the recommended Mile Point improvements, a second alternative West Training Wall system was conceptually identified and developed for cost estimating using stacked Geotubes to replace the West Training Wall stone structure. The East Training Wall was to continue using existing recovered stone. While initial cost reductions were identified, concerns about reliability, repair and replacement were also recognized. It was therefore desired to further identify and develop a more sustainable lower maintenance alternative system with less frequent repair and replacement.

The PDT met on 18 November 2011 to discuss and identify other possible alternative solutions. A Value Engineering Proposal (VEP) introducing a West Training Wall conceptual configuration using Concrete Structural Units (CSU) system was identified by the District Project Development Team (PDT). The third alternative has been developed for consideration and incorporation into the Mile Point Improvements Feasibility Study. The following Table provides a summary of three alternative plans under consideration and the associated cost for construction, O&M and PED:

Alternative West Training Wall	Construction Cost Estimate	Relative Wall O&M Cost Estimate (PW)	PED Cost	Total Project Cost *
1. Stone Wall	$47,375,000	$0	$2,841,000	$50,216,000
2. Geotube Wall	$25,705,000	$6,986,000	$1,200,000	$33,891,000
3. Concrete Structural Unit Wall	$28,896,000	$0	$1,200,000	$30,096,000

These estimates reflect quantities and estimated unit costs through December 2010. Both Construction and forecasted PED estimated costs are under coordination and refinement through February-March 2011. One equal cost modification item is the additional localized fill in deep areas of the West Training Wall foundation using geotubes and/or geobags. This cost remains under development and applies equally to each alternative plan. Also, updated cost estimates will reflect Sources Sought input for alternatives structural systems, and the NED Plan Cost Schedule Risk Analysis (CSRA), in order to obtain a revised Cost Center of Expertise Project Cost Certification. This Risk Assessment will establish applied contingency using Concrete Structural Units. See Value Engineering Cost Estimates shown as Figures 9A through

CURRENT PROJECT CONCEPTS: Alternative 1, the initial Draft Feasibility Study Final NED Plan featured a combination of bedding and armor stone for the 4,250 LF wall. See the Mile Point Area Plan and West Training Wall Section shown in Figures 1 and 2. This stone training wall system was estimated at $22,391,000. The estimated construction and PED cost for the Mile Point Improvements Project totals $50,216,000 with this system.

Alternative 2, an alternative West Training Wall for the Mile Point Improvements Feasibility Study was developed to identify potential reductions in project cost. The alternative featured stacked Geotubes to replace the West Training Wall stone structure. The Geotube alternative training wall section, using three large-diameter stacked Geotubes, would serve as the initial dredge disposal containment system and secondarily as shoreline erosion protection along the nearly 4,000 FT closed gap between the current existing Great Marsh Island land features shown in Figure 3. The stacked Geotubes are placed with two Geotubes as a foundation (Placed on a scour apron) supporting a third top Geotube to achieve the elevation of +7.5 FT (+2.5 FT above MHW).

The original project plan also used single layer of Geotubes along the south side of the new marsh mitigation area. With this alternative, Geotubes are to be placed on both sides of the marsh restoration area with smaller Geotubes remaining on the south side. The 16-Inch dredging plant forecasted to be used for the project is complimentary for Geotube placement. Both Geotube applications will have a second fabric cover added to the top of the Geotube for extended UV protection. The corresponding ROM for the Geotube West Training Wall estimate is $1,642,000, and is based on a barebones Geotube configuration with no additional protection applications such as stone or earth fill on the riverside. A minor adjustment for the south Geotube was also included in the cost update using the most current Geotube assembly and unit costs.

The total estimated initial construction and PED cost for the Mile Point Improvements Project totals $26,905,000 with a Geotube system.

Risk evaluation for the three alternatives identified the riverside as being more critical and complicated with the stacked large-diameter Geotubes. A series of applicable risk exposure conditions were developed for life cycle cost estimating. Basic risks include UV degradation, vandalism and damage from debris and navigation impact exposure. It is assumed the geotubes would require a repair/replacement action on a five year cycle. It is considered that this would be coordinated with future O&M dredging cycles and the initial contract costs for the O&M project would fund equipment mobilization and dredging of maintenance material. A minor cost ($7.50/CY above normal O&M dredge unit costs) would be applied to the Geotube restoration for dredge material placement (31,078 CY) to Mile Point for Geotube filling. The two upper and front Geotubes are at greater risk for damage and fatigue, although the bottom Geotube could also fail due to load stresses, damage from debris and potential exposure to navigation impact.

To identify potential life cycle cost, a future replacement factor was applied for replacement of the west training wall Geotubes at a five year period. The five year frequency was selected based on potential stress and damage failure and it also matched planned O&M dredge cycles in the project area. Total cost for each five year period replacement cycle is estimated as $1,952,000. See the Life Cycle Cost Costs Calculations in Figure 8. The Geotube repair and replacement activities for a 50 year service period are estimated as $6,986,000 in Present Worth dollars. The First Cost for the Geotube training wall is $1,642,000, plus $6,986,000 in PW O&M costs totals $8,628,000. The total PW estimated construction and PED cost for the Mile Point Improvements Project totals $33,891,000 with the Geotube system with O&M cost applied.

No additional annual O&M cost burden was applied as normal maintenance such as periodic inspection and vegetation control as these would be nearly equally to either stone, Geotubes, or CSU.

PROPOSED PROJECT SOLUTION: It is recommended that the project delivery team develop an Alternative 3 using a Concrete Structural Units (CSU) as alternative for the West Training Wall. The specific concrete structure will require development for project performance conditions at Mile Point. CSU's will need to provide both shoreline erosion protection and containment of dredge material placed within the Great Marsh Island salt marsh restoration area. They should also provide tidal connectivity for the salt marsh mitigation area and plants. The performance of the CSU system could be an added environmental mitigation measurement effort to produce enhanced oyster and fish habitat and further water quality deliveries – these are not provided by Geotubes and would be more effectively provided by CSU system than natural stone.

Two options may be considered for development of the structural units for the West Training Wall. The first option would be the specific design of a structural unit for fabrication and placement by contractors. This would be developed by the design PDT during the PED phase. A second option would be the development of a clear detailed performance specification supporting development and delivery of an acceptable concrete training wall structural unit by plan holders. Typically this would provide an existing system, or structural unit, and would require documentation for performance and experience with placement in similar applications as Mile Point. To help the PDT identify potential existing systems, a Sources Sought Solicitation was issued seeking industry input for structural systems to develop a training wall feature for the Mile Point Navigation Improvements project. This Request for Information (RFI) remains open through early March 2011. The purpose of the request for information is to gather industry-wide feedback on alternative materials and systems that have been developed and used for coastal and river structures similar to the currently presented stone training wall structure. It is intended that with industry input providing various alternative structures, this will preclude approval for sole source procurement for single system or structural unit.

One response to the RFI was submitted by Living Shoreline Solutions, Inc. The Wave Attenuation Device System (WADS), developed by Living Shoreline Solutions, is recommended for review as a high performance and long term structural concrete system as an alternative to the Geotube and natural stone training wall systems. The WADS system has been identified as an effective shoreline erosion protection system with excellent performance in a wave energy regime. Recent regional projects include a 2004 WADS application for mitigation of storm damage to Saw Grass Point Salt Marsh, on Dauphine Island, Alabama, which was supported by the National Sea Grant College Program by NOAA. This application proved to be cost effective, as well as successful with delivery of erosion protection and sustaining of salt marsh, bird, fish and oyster habitat within the Mobile Bay estuary. With over 13 years of research & development and Peer Reviewed technologies with proven project success rates that are well documented.

Furthermore, the ph neutral marine concrete WADS structure provides a hard surface for potential oyster habitat. Approximately 20 oysters per square foot can be expected for submerged portions of the structures. This corresponds to approximately 1 million oysters for the West Training Wall. This level of performance should be also achievable with a new CSU unit. The WADS structures are hollow cast concrete with triangular windows that invites fish population of the structures both inside and nearby for nesting and refuge from predators. This further adds to the environmental interest for the project. The engineering performance and enhanced environmental deliveries can be studied for wider applications for other Jacksonville District coastal and navigation projects.

Information on Living Shorelines Solutions WADS units is provided in Figures 4, 5A and 5B, and is shown for background on the WADS use in a similar application. The West Training Wall is assumed to require a single row of opposing triangular structures placed at approximately elevation -2-FT for the full 4,250 LF of wall. The units would be approximately 9.5-FT high and each base side would be 15-FT. A total 567 units would be required. Some additional grading fill work is recommended to limit the final height of the units to 9.5-FT. A stone bedding layer placed over a geotextile fabric is provided for the foundation.

A modified structure may be adapted from the Reefball system, a well established concrete structure typically used for artificial reef and in mitigation deliveries of broad marine habitats. It is currently moving more into shoreline erosion protection in both bay and coastal applications. A specially designed 40 FT by 6.6 FT Reefball mat system is under development for use with the Miami-Dade Shoreline Demonstration project scheduled for placement this FY. The Reef Ball Foundation is a non-profit organization that functions as an international environmental protection and recovery of reef systems through coral rescue, propagation and transplant operations, mitigation projects, mangrove restorations and nursery development. Reef Ball also participates in education and outreach regarding environmental stewardship and coral reefs.
The Reef Ball Foundation now operates all aspects of the business as a non-profit organization. By 2007, the foundation has deployed 550,000 reef balls worldwide in over 70 countries. A response to the Sources Sought request is expected to be submitted by Reef Innovations, the regional commercial manufacturer and point of contact for Reefball structures.

Information on Reefball systems is provided in Figures 6 and 7. The West Training Wall is assumed to require a double row of Reefball structures placed at approximately elevation -2-FT for the full 4,250 LF of wall. The wall would require approximately 802 units if placed on a diagonal or 1,133 units is placed parallel with the shoreline. Selection of the alignment will depend on unit performance and modeling. Some additional grading fill work is recommended to limit the final height of the units to 9.5-FT. A stone bedding layer placed over a geotextile fabric is provided for the foundation.

The project will be constructed through a general contractor with the CSU's or other structures as a performance specification item of work. The input for site specific design requirements of the CSU units would be by the PDT. If selected by the general contractor, the design of the alternative structural units would be included in the procurement action by the licensed dealer of any selected patented technology. The site specific design of other types of units would be by the contractor.

Estimated cost for the CSU alternative for the West Training Wall is $4,937,000. This cost can further be refined during PED phase with broader project team participation and support by others with existing structural systems identified for possible use on the Mile Point project. For the present, the Life Cycle Cost for the CSU training wall is considered to be equal to the Stone Training Wall and are not further developed because future Life Cycle Costs for repair and replacement only applies to the Geotube system.

JUSTIFICATION: In summary, this recommended Concrete Structure Unit (CSU) or the selected commercial training wall structure should prove to be both cost effective and it provides the reliability for an 80- to 100-year training wall. It provides better tidal exchange to marsh area, and adds oyster and fish habitat over the other systems. Structural units can be casted near the project area and barged for placement on the prepared foundation described. The units to be used on both ends can also be reduced with change in existing elevations at both existing land features of Great Marsh Island. This could use reduced unit heights of approximately 5-FT over these portions of the training wall.

By design, the CSU or other viable system will be uniquely configured to remain stable in moderate to high wave energy environments. Wave energy attenuation can be delivered for desired project performance conditions. The near proximity of the Mile Point project site offers opportunities to easily monitor both environmental and technical performance of the training wall and marsh restoration. The data and lessons learned will have broad applications to coastal and navigation project district-wide. Identifying the use of the CSU system as an environmental and technical monitoring study effort along with the expected performance with an actual project should help justify replacement alternatives using stone on other coastal and river navigation projects. Unlike some pilot projects with a limited period of performance, Mile Point will remain in service delivering benefits for many years.

Both periods of service and price comparisons for the three training wall alternatives is revealing. The stone training wall is the most expensive of the three alternatives by a significant measure. The original plan using stone, estimated as $50,216,000, can be reduced to $26,905,000 using a Geotube training wall system, initially with project first cost avoidance of $23,311,000. The Geotube alternative represents a barebones containment alternative for placement of all dredge materials from the Mile Point Improvements Project. It assumes future repair and replacement would fall within O&M program coverage for the next 50 years. The Geotube alternative cost avoidance is reduced to $16,325,000 when Present Worth costs for future repair and replacement cycles (estimated as $6,986,000) is applied.

The estimated cost for the Mile Point Improvements Project using the CSU or acceptable commercial structure for the West Training Wall feature is $30,096,000. This estimate is based on the December scope, materials and quantities and may represent an approximately 90% level of accuracy. The PDT will continue developing detailed costs through March 2011. Each of the three alternatives may be assumed to have the same level of accuracy. Adding approximately 10% would result with the following estimated costs:

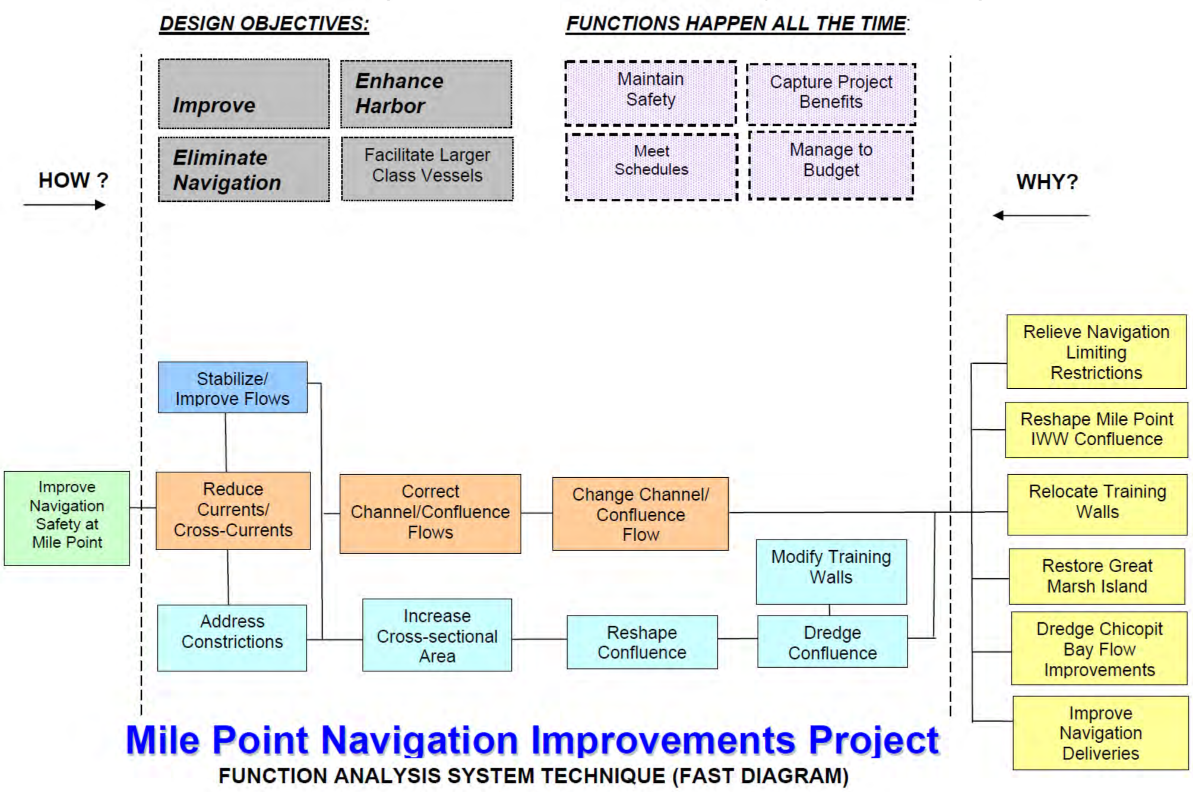
1. Stone Wall -- $50.216 million to $55.234 million (No significant O&M cost risk).
2. Geotube Wall: -- $33.891 million ($25.705 million, plus $6.986 million PW O&M) to $37.280 million.
3. Concrete Structural Unit Wall -- $30.096 million to $33.106 million (No significant O&M cost risk).

Compared to the stone training wall alternative, approximately $20,120,000 can be reduced from the stone training wall with use of the CSU system. The CSU alternative has an initial first cost increase of $3,191,000 when compared to the Geotube training wall alternative; however, adjustments for future Geotube repair and replacement results in a reduced or net cost decrease for the WADS system of $3,795,000. Therefore, the CSU training wall will result in a minor initial cost while delivering a lower life cycle cost. It has a broader habitat delivery than either the stone or Geotube. It has the possibility of broad application to regional coastal and navigation projects and placement with the Mile Point Project can help Jacksonville District realize more sustainable efficiencies and environmental effectiveness for many projects.

West Training Wall Value Engineering Function Analysis Lists (Verb-Noun Functions)

Primary Functions:	Secondary Functions:
Improve Navigation Safety	Resolve Navigation Restrictions
Open Confluence Constrictions	Dredge/Wider/Deeper Confluence
Reestablish River Shoreline	Backfill Great Marsh Island Breach
Reconnect Great Marsh Island	Contain Dredge Material
Establish Salt Marsh Mitigation Area	Protect Salt Marsh Remediation
Prevent Shoreline Erosion	Deliver Tidal Exchange to Marsh
Deliver Safe Navigation	Eliminate Navigation Restrictions

Mile Point Navigation Improvements Project FAST Diagram



Mile Point Improvements Feasibility Study PDT/VE Team

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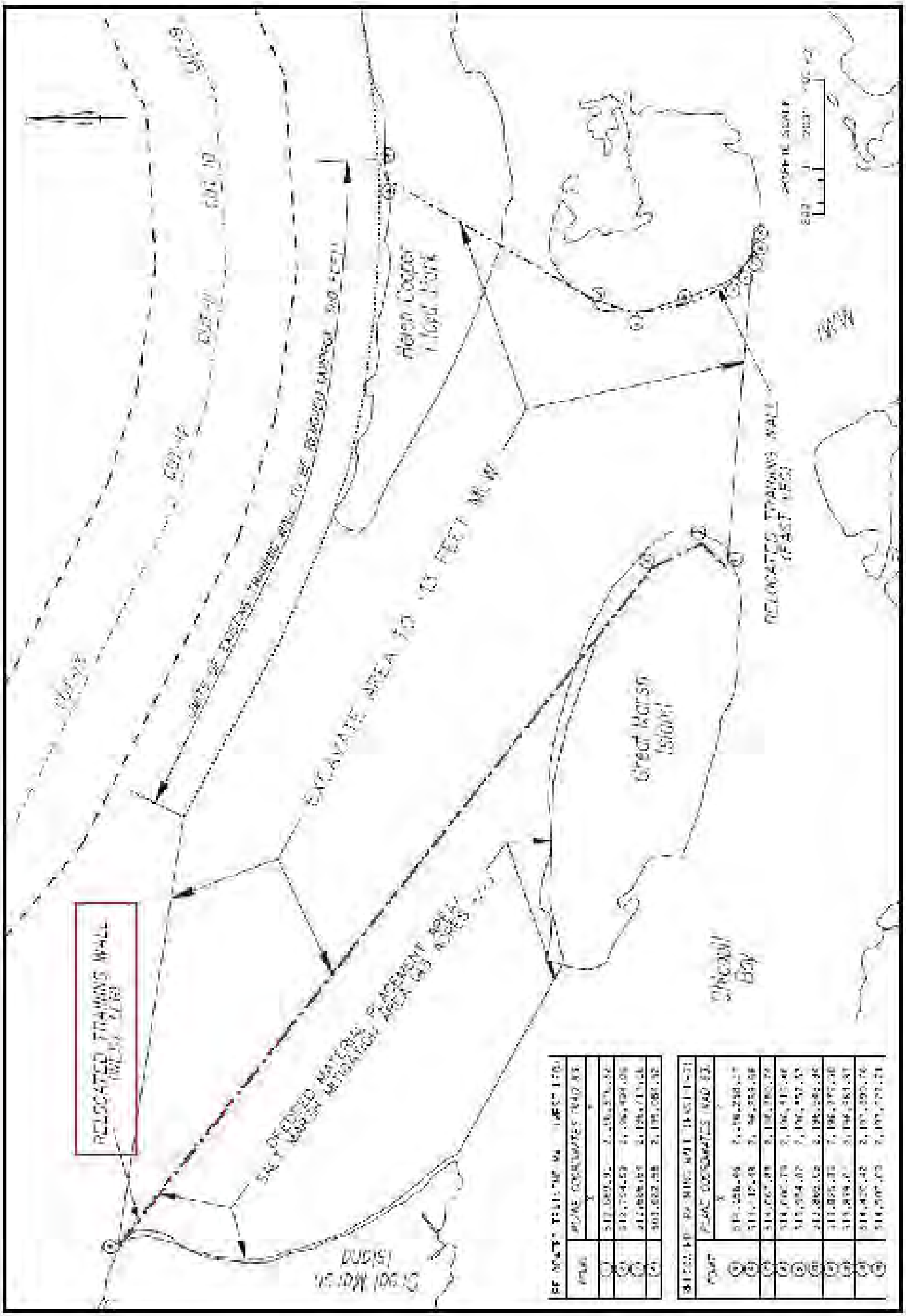
FIGURE 1: MILE POINT AREA PLAN WITH 4,250 LF WEST TRAINING WALL



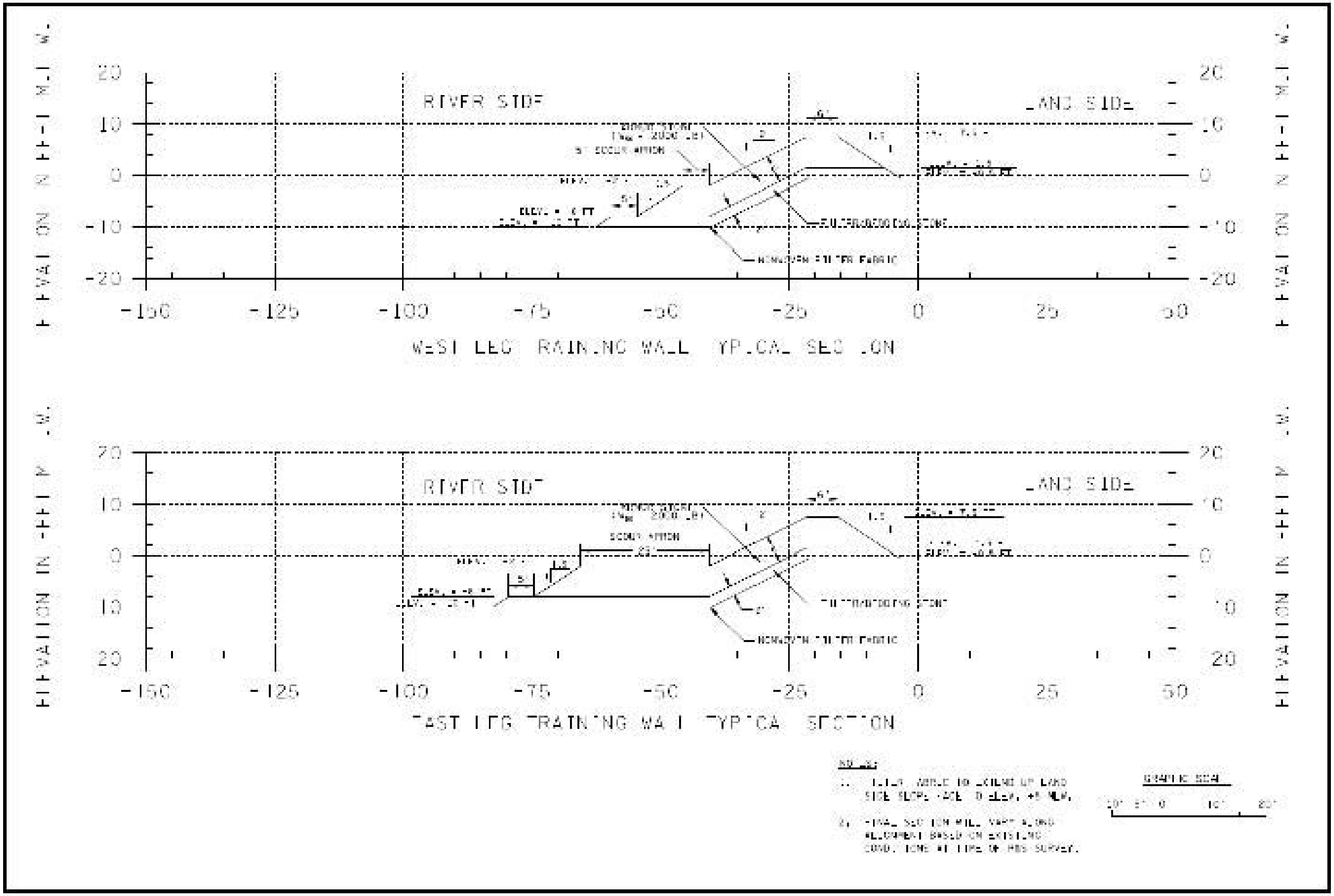


FIGURE 2: MILE POINT WEST TRAINING WALL SECTION

FIGURE 3: ALTERNATIVE MILE POINT WEST TRAINING WALL SECTION (APPROXIMATELY ~12-FT HIGH GEOTUBE SECTION)

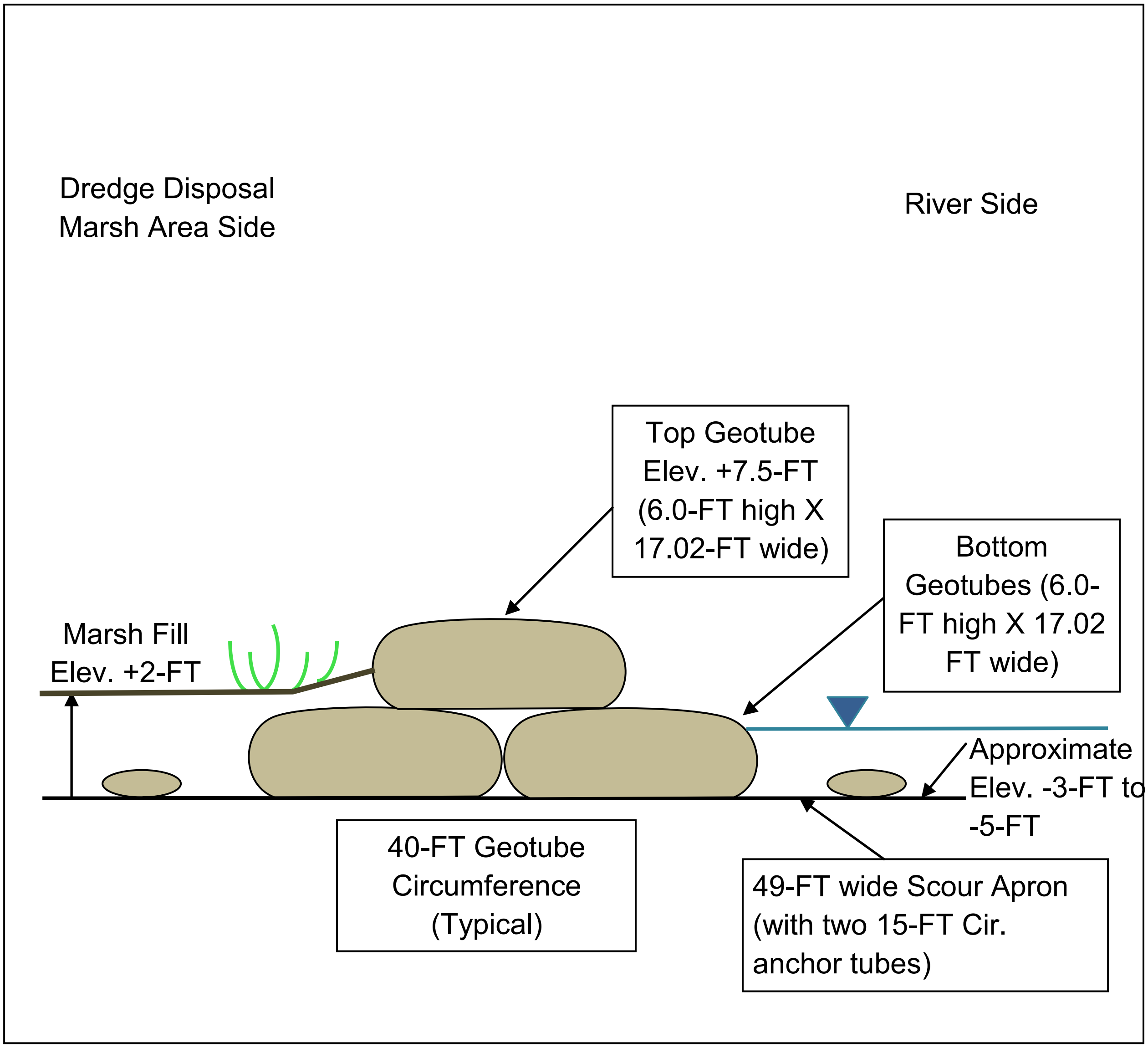


FIGURE 4: MILE POINT WEST TRAINING WALL WAVE ATTENUATION DEVICE SECTION (APPROXIMATELY 9.5-FT HIGH WAD STRUCTURE SECTION)

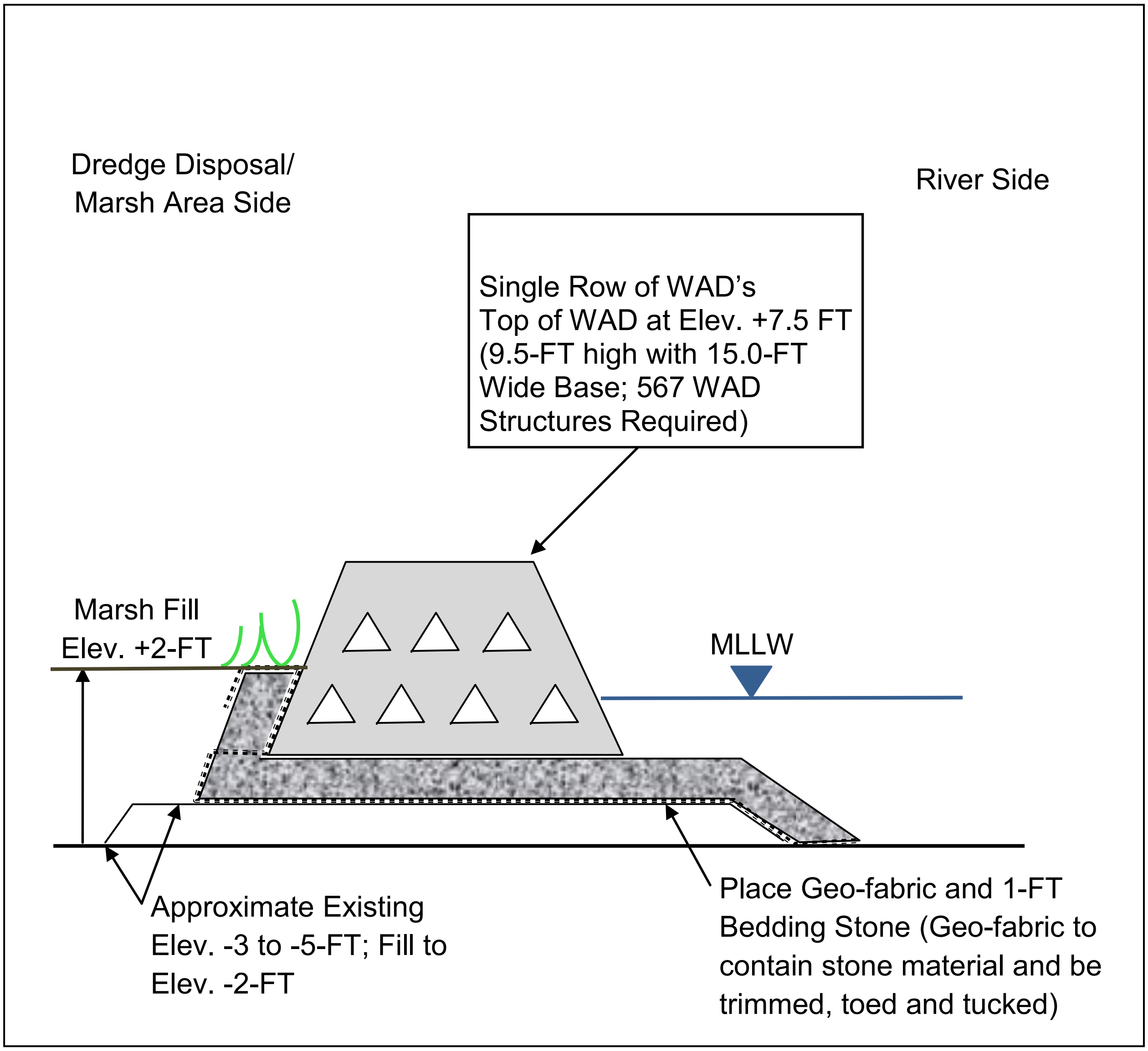


FIGURE 5A: EXAMPLE FOR SHORELINE PROTECTION WITH A HIGH ENERGY DOUBLE ROW WAVE BREAK WAVE ATTENUATION DEVICE APPLICATION
(Living Shoreline Solutions, Inc.)

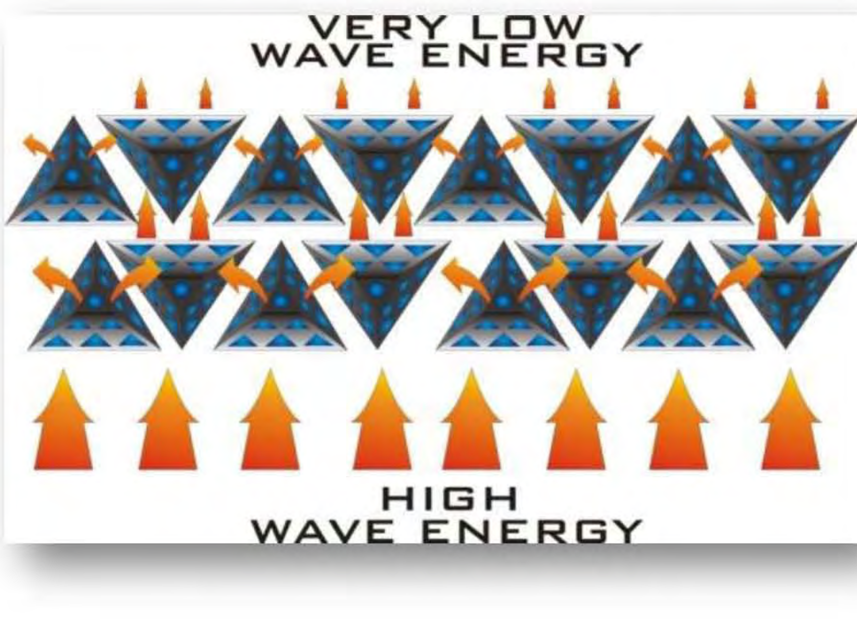


FIGURE 5B:EXAMPLE FOR SHORELINE PROTECTION AND FILL CONTAINMENT WITH WAD AND GEOTEXTILE FABRIC
(Gulf Breeze, Florida – 2007)

FIGURE 6: MILE POINT WEST TRAINING WALL REEFBALL STRUCTURAL UNIT SECTION (APPROXIMATELY ~9.5-FT HIGH RSU SECTION)

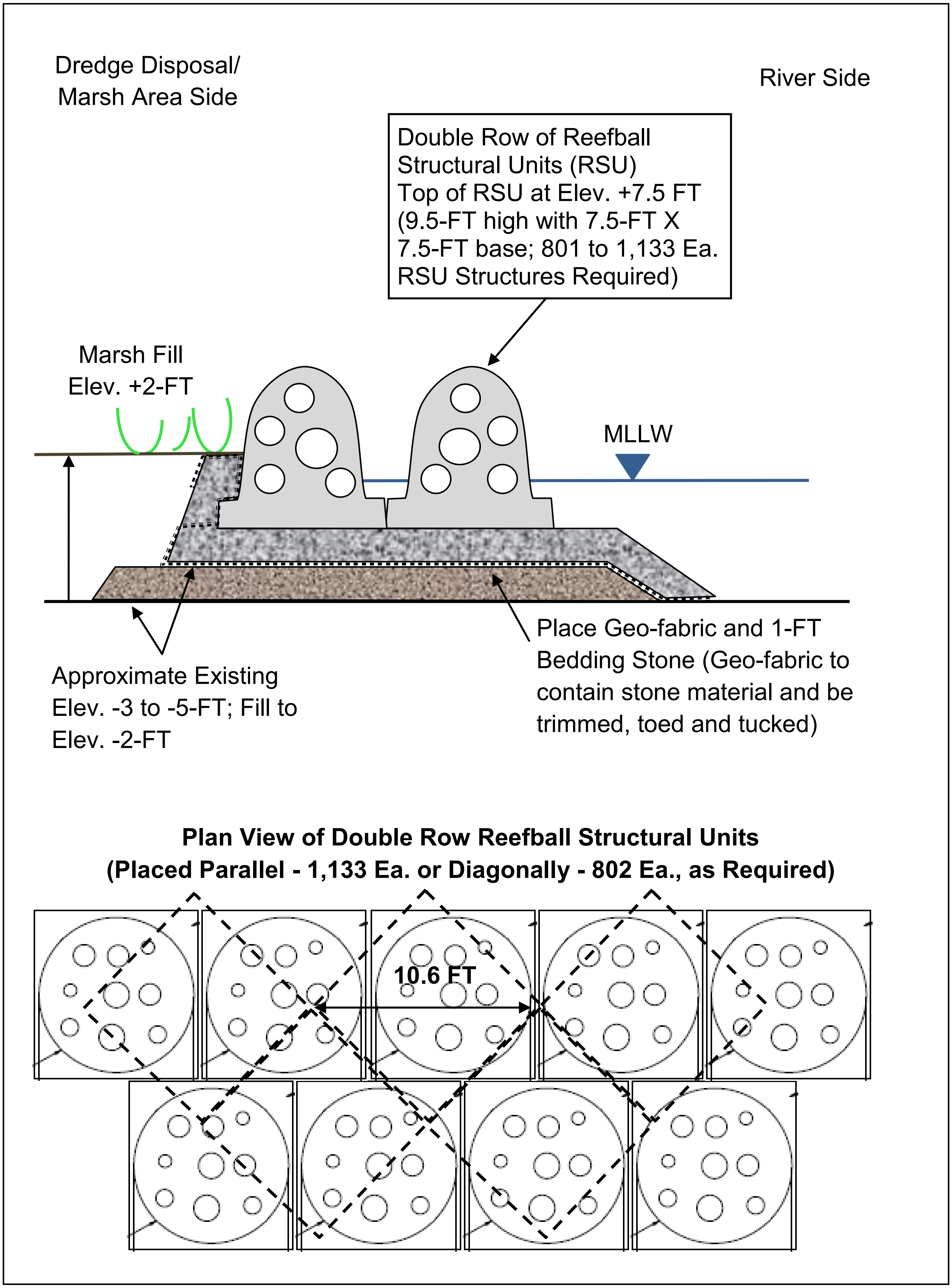


FIGURE 7: EXAMPLE FOR MILE POINT WEST TRAINING WALL REEFBALL STRUCTURAL UNIT SECTION APPLICATION (http://www.reefball.org/)

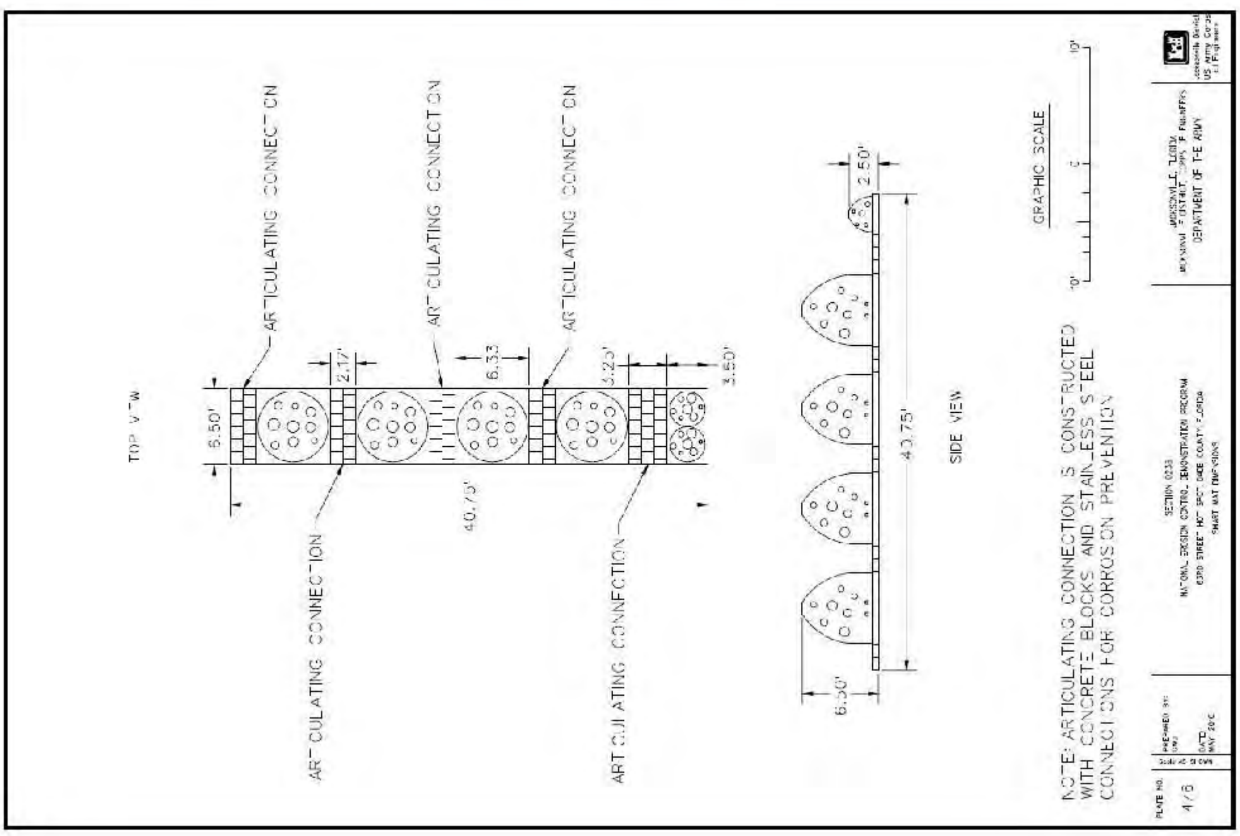


FIGURE 8: LIFE CYCLE COST COSTS CALCULATIONS

LIFE CYCLE COST ESTIMATE WORKSHEET						
Alternative West Training Wall Analysis for Mile Point Improvements Feasibility Study						
Alternative 1: ***West Training Wall with Stone System vs. Alternative 2: West Training Wall with Geotube System***						
(Systems Service Life: 50-Years)						
ANNUAL PERCENTAGE RATE: ***4.375%***			***Original Alternative 1***		***Alternative 2***	
INITIAL COST			PRESENT WORTH		PRESENT WORTH	
Original Alternative 1 Capital Cost: Mile Point Project with Stone Training Wall			***$50,216,000***			
Alternative 2 Capital Costs: Mile Point Project with Geotube Training Wall					***$26,905,000***	
SUBTOTAL			***$50,216,000***		***$26,905,000***	
(Given: i = 4.375%) SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Replace Geotube	***5***	***0.80727***	***$0***	***$0***	***$1,952,174***	***$1,575,927***
Replace Geotube	***10***	***0.65168***	***$0***	***$0***	***$1,952,174***	***$1,272,195***
Replace Geotube	***15***	***0.52608***	***$0***	***$0***	***$1,952,174***	***$1,027,002***
Replace Geotube	***20***	***0.42469***	***$0***	***$0***	***$1,952,174***	***$829,065***
Replace Geotube	***25***	***0.34284***	***$0***	***$0***	***$1,952,174***	***$669,278***
Replace Geotube	***30***	***0.27676***	***$0***	***$0***	***$1,952,174***	***$540,286***
Replace Geotube	***35***	***0.22342***	***$0***	***$0***	***$1,952,174***	***$436,156***
Replace Geotube	***40***	***0.18036***	***$0***	***$0***	***$1,952,174***	***$352,094***
Replace Geotube	***45***	***0.14560***	***$0***	***$0***	***$1,952,174***	***$284,234***
	50	***0.11754***	***$0***	***$0***	***$0***	***$0***
SALVAGE VALUE	***0***	***0***	***$0***	***$0***	***$0***	***$0***
SUBTOTAL				***$0***		***$6,986,236***
(Given: i = 4.375%) ANNUAL EXPENDITURE	YEAR	UNIT PMT PW FACTOR	ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
	25	***15.02087***	***$0***	***$0***	***$0***	***$0***
	50	***20.17058***	***$0***	***$0***	***$0***	***$0***
	75	***21.93609***	***$0***	***$0***	***$0***	***$0***
	100	***22.54137***	***$0***	***$0***	***$0***	***$0***
SUBTOTAL				***$0***		***$0***
TOTAL PRESENT WORTH				***$50,216,000***		***$33,891,000***
TOTAL LIFE CYCLE SAVINGS				***-$16,325,000***		***$16,325,000***
Annual O&M reflects annual cost. Future major maintenance/replacement are identified as Single Expenditure and is not						

Alternative West Training Wall Analysis for Mile Point Improvements Feasibility Study

Operation and Maintenance Forecast

Original Alternative 1 Capital Cost: Mile Point Project with Stone Training Wall

No.	Replacement Activity/Action	Unit	Unit Cost	Quantity	Total
1					$0
2					$0
3	Total				$0

Alternative 2 Capital Costs: Mile Point Project with Geotube Training Wall

No.	Replacement Activity/Action*	Unit	Unit Cost	Quantity	Total
1	Repair/replace geotubes	LF	$386.21	4,250	$1,641,393
2	Dredge material for geotubes	CY	$7.50	41,438	$310,781
3	Total				$1,952,174

NOTES:
- Federal discount rate for FY 2010 is 4.375% for 50-years.
- Repair/replacement of 100% of Geotubes each five years.
- Geotube Fill Volume = 3.25 CY/LF X 3 Geotubes X 4,250 LF = 41,437.5 CY

FIGURE 9A: COSTS ESTIMATES

COST ESTIMATE WORKSHEET					
	PROPOSAL DESCRIPTION: Alternative 1 - Mile Point Navigation Improvement Projects with West Training Wall with Stone System vs. Alternative 2 - West Training Wall with Geotube System				
DELETIONS - Alternative 1					
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
1	Mob/Demob - Prep Work	LS	1	$2,239,548.00	$2,239,548
2	Pipeline Dredging	LS	1	$5,625,459.00	$5,625,459
3	Mile Pt Jetty Stone Removal	LS	1	$1,957,059.00	$1,957,059
4	Stone Structures	LS	1	$30,575,059.00	$30,575,059
5	Turbidity Monitoring	LS	1	$275,103.00	$275,103
6	Endangered Spec Monitoring	LS	1	$169,615.00	$169,615
7	L&D - Real Estate	LS	1	$72,000.00	$72,000
8	Great Marsh Island Salt Marsh	LS	1	$3,729,421.00	$3,729,421
9	Relocate Navigation Aids	LS	1	$378,000.00	$378,000
10	PED	LS	1	$2,841,490.00	$2,841,490
11	Construction Mgt	LS	1	$2,352,915.00	$2,352,915
12					$0
13					$0
14					$0
15					$0
16					$0
			Total Deletions		$50,215,669
ADDITIONS - Alternative 2					
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
1	Mob/Demob - Pipeline Dredging	LS	1	$1,683,000.00	$1,683,000
2	Mile Pt Training Wall Mob/Demob	LS	1	$503,000.00	$503,000
3	Mile Pt Training Wall Relocation	LS	1	$1,295,000.00	$1,295,000
4	Mile Pt Training Wall Disposal	LS	1	$615,000.00	$615,000
5	Mile Pt Training Wall Extension	LS	1	$8,318,000.00	$8,318,000
6	Chicopit Bay Channel Dredging	LS	1	$266,000.00	$266,000
7	IWW Dredging & Disposal	LS	1	$4,156,000.00	$4,156,000
8	Great Marsh Island Geotube Containment	LS	1	$2,731,000.00	$2,731,000
9	Construction Environmental Monitoring	Mo	6.80	$63,970.59	$435,000
10	L&D - Real Estate	LS	1	$72,000.00	$72,000
11	Relocate Navigation Aids	LS	1	$369,000.00	$369,000
12	Great Marsh Island Salt Marsh Mitigation	l	1	$3,662,000.00	$3,662,000
13	PED	LS	1	$1,200,000.00	$1,200,000
14	Construction Mgt	LS	1	$1,600,000.00	$1,600,000
15					$0
			Total Additions		$26,905,000
	Alternate 2	Net Cost Savings			$23,310,669
	*	Mark-ups	0.00%		$0
	Alternate 2	Total Cost Savings (Minus O&M PW)			$16,324,433
	Alternate 2	Present Worth (O&M Replacement)			$6,986,236
	Alternate 2	Total First Cost, Plus O&M (PW)			$33,891,236
*	Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond); Contingencies - 26.0% are included in Unit Prices.				
**	Repair/replacement of 100% of Geotubes each five years.				

FIGURE 9B: COSTS ESTIMATES

COST ESTIMATE WORKSHEET					
	PROPOSAL DESCRIPTION: Alternative 1 - Mile Point Navigation Improvement Projects with West Training Wall with Stone System vs. Alternative 3 - West Training Wall with Concrete Structural Unit (CSU)				
DELETIONS - Alternative 1					
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
1	Mob/Demob - Prep Work	LS	1	$2,239,548.00	$2,239,548
2	Pipeline Dredging	LS	1	$5,625,459.00	$5,625,459
3	Mile Pt Jetty Stone Removal	LS	1	$1,957,059.00	$1,957,059
4	Stone Structures	LS	1	$30,575,059.00	$30,575,059
5	Turbidity Monitoring	LS	1	$275,103.00	$275,103
6	Great Marsh Island Salt Marsh	LS	1	$3,729,421.00	$3,729,421
7	Endangered Spec Monitoring	LS	1	$169,615.00	$169,615
8	L&D - Real Estate	LS	1	$72,000.00	$72,000
9	Relocate Navigation Aids	LS	1	$378,000.00	$378,000
10	PED	LS	1	$2,841,490.00	$2,841,490
11	Construction Mgt	LS	1	$2,352,915.00	$2,352,915
12					$0
13					$0
14					$0
15					$0
16					$0
			Total Deletions		$50,215,669
ADDITIONS - Alternative 3					
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
1	Mob/Demob - Pipeline Dredging	LS	1	$1,683,144.00	$1,683,144
2	Mob/Demob - Stone Work	LS	1	$460,733.00	$460,733
3	Clear/Grubbing	Ac	13	$3,257.64	$42,349
4	Pipeline Dredging	LS	1	$5,491,519.00	$5,491,519
5	Mile Pt Jetty Stone Removal	CY	14,600	$130.85	$1,910,410
6	S-2 Filter Stone Placement	CY	11,900	$199.78	$2,377,382
7	S-2 Armor Stone Placement	CY	12,300	$482.98	$5,940,654
8	Fill & Grade West Train Wall Foundation	CY	9,900	$6.25	$61,875
9	Bedding Stone	CY	5,000	$201.79	$1,008,950
10	Geotextile fabric	SY	20,300	$12.04	$244,412
11	CTWS Containment Structures	Ea	567	$6,396.00	$3,626,532
12	Turbidity Monitoring	Mo	6.80	$39,493.11	$268,553
13	Endangered Spec Monitoring	Mo	6.80	$24,349.54	$165,577
14	L&D - Real Estate	LS	1	$72,000.00	$72,000
15	Relocate Navigation Aids	LS	1	$369,000.00	$369,000
16	Great Marsh Island Mitigation Salt Marsh	LS	1	$3,661,990.00	$3,661,990
17	PED	LS	1	$1,200,000.00	$1,200,000
18	Construction Mgt	LS	1	$1,716,003.00	$1,716,003
			Total Additions		$30,301,083
	Alternate 3	Net Cost Savings			$19,914,586
	*	Mark-ups	0.00%		$0
	Alternate 3	Total Cost Savings			$19,914,586
	Alternate 3	Total First Cost (No O&M Increase)			$30,301,083
*	Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond); Contingencies - 26.0% are included in Unit Prices.				

APPENDIX A-2

COST ENGINEERING

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TABLE OF CONTENTS

APPENDED TO APPENDIX A-2

APPENDIX A-2A– PROJECT COST AND SCHEDULE RISK ANALYSIS REPORT

A. COST ESTIMATES

A.1 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 Sep 2007
- CECW-CE Memorandum For Distribution, Subject: Application of Cost Risk Analysis Methods To Develop Contingencies For Civil Works Total Project Costs, 3 Jul 2007
- Cost and Schedule Risk Analysis Process (CSRA) Guidance, 17 May 2009

The goals of the cost estimating for the Duval County, Jacksonville Harbor (Mile Point) Navigation Study are to present a Total Project Cost (construction and non-construction costs) for the recommended plans at the current price level to be used for project justification/authorization and to project costs forward in time 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 also yielded 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 Breakdown Structure (CWBS) format to the sub-feature level. The cost estimate supporting the National Economic Development (NED) plan (Recommended Plan/Locally Preferred Alternative Plan) is prepared in MCACES/MII format to the CWBS 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 risk analysis was prepared that addresses uncertainties in and sets contingencies for the Recommended Alternative Plans cost items. The final Cost Schedule Risk Analysis Report produced by the Walla Walla District Cost Center of Expertise is appended to this appendix.

A.1.1 **Recommended Alternative Plans**

The final Recommended Plan (NED and Locally Preferred Alternative) were chosen by the Project Delivery Team 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 Recommended Alternative Plans is found in Appendix A, Engineering. The MCACES/MII cost estimate for the Recommended Alternative Plans (Section B.3, below) is based on that scope and is formatted in the CWBS. The notes provided in the body of the estimate detail the estimate parameters and assumptions. These include pricing at the Fiscal Year 2011 price level (1 October 2010-30 September 2011). For project justification purposes the estimate cost are categorized under the appropriate CWBS code and include both construction and non-construction costs.

The construction costs fall under the following feature codes:

- 02 Relocations
- 06 Fish and Wildlife Facilities
- 12 Navigation Ports and Harbors

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

- 01 Lands and Damages
- 30 Planning, Engineering and Design
- 31 Construction Management

A.1.2 **Construction Cost**

The MCACES/MII estimate on the final Recommended Plan contains contingencies as noted in the estimate (below). These contingencies were determined as a result of the risk analysis. Additional information follows on the risk analysis. Major risk factors are shown in the sensitivity analyses.

A.1.3 **Non-construction Cost**

Non-construction costs include Real Estate, Planning, Engineering and Design (PED), and Construction Management (Supervision and Administration, S&A). Real Estate costs were provided by Real Estate Division. These costs are best described in the Real Estate Appendix, Appendix D. They include lands costs and administrative costs and are distinguished as non-Federal sponsor costs or government costs. Contingencies for the Real Estate costs were also determined during risk analysis based on direct input from the Real Estate PDT representative. The Real Estate risk analysis is further described below. Planning, Engineering and Design costs are broken down into Preconstruction, Engineering and Design (PED), or preparation of contract plans and specifications; Engineering During Construction (EDC); and the Project Implementation Report (PIR). PED costs were solicited from Engineering Division via the Project Manager, as suggested by the guidance Construction Management costs was solicited from Construction-Operations Division via the Project Manager, again as suggested by the guidance. Eight percent of total construction cost is used as the rate for Construction Management costs for the cost estimate for the Recommended Plan. This percentage is based on actual funds spent for construction management on past contracts. When this percentage is calculated by Construction-Operations Division for planning projects it is itemized to show amounts allocated for each task anticipated to occur during construction. Only the gross percentage is shown herein.

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).

A.1.4 **Plan Formulation Cost Estimates**

For the plan formulation cost estimates, unit prices for each major or variable construction element were developed in MCACES/MII. These unit prices were entered into spreadsheets that differentiated each plan by the quantities required to construct the plans. Designs and quantities for the construction elements were provided to Cost Branch by the Engineering Technical Lead (see the Engineering Appendix for construction methods, design assumptions and design data). Preconstruction, Engineering and Design costs and Construction Management costs were calculated using percentages at this level of estimating.

The plan formulation process for this study involved numerous iterations. Since the costs for the plans were calculated via spreadsheet software it was fairly simple to adjust them as time went by (for example, as unit prices increased due to changes in price level), as plan components changed and as plans were added or removed from consideration. Refer to the Economics Section in the Main Report for the final Plan Formulation cost tables.

A.1.5 **Construction Schedule**

A construction schedule was prepared by the Engineering PDT in conjunction with the Planning Technical Lead and the construction-operations team member that reflected all project construction components. The schedule considered not only durations of individual components but also timing of construction contracts. This schedule was coupled with the project schedule in preparation for the generation of the Total Project Cost Summary as well as for the completion of the risk analysis. The construction schedule will change as design of the project proceeds in the plans and specifications phase and then it will change again when the contract is awarded and the contractor provides his schedule, which may be based on multiple crews with shift work and overtime. Both the construction schedule and the project schedule are provided below. The official schedule is the project schedule and it is given precedence herein wherever a conflict appears between these two schedules.

A.1.6 **Total Project Cost Summary**

The Total Project Cost Summary includes escalation through project completion. The cost estimate for the Recommended Plan is prepared with an identified price level date. 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.

A.5 RISK AND UNCERTAINTY ANALYSIS

A.5.1 Risk Analysis Methods

The risk analysis was conducted according to the procedure outlines in the manual entitled, 'Cost and Schedule Risk Analysis Process,' dated 17 May 2009 and downloaded from the Corps' Cost Center of Expertise website. First, members of the PDT met to identify risk items, in both the construction cost estimate and the construction schedule. Then, the Risk Register was completed. After that, the Risk Model was customized using commercially available 'Crystal Ball' software. 'Most likely,' 'high,' and 'low' values were assigned to estimate items using the software's 'Assumption' function and the triangular distribution. 'Forecasts' were defined and the model run.

For the features costed by the Corps it is assumed that the work will be performed by a prudent contractor at a fair and reasonable cost. While the cost estimate analyzed in the risk analysis may contain adjustments due to quotations on direct and indirect costs, it contains no separate adjustment due to competitiveness or bid strategies (ETL 1110-2-573, 30 Sep 2008). Market conditions such as the current price of fuel are included in the estimate.

After the model was run the results were documented by extracting the sensitivity chart, the forecast chart and the percentiles table for major items. The percentiles were used to determine the contingency at the 80% confidence level. At this time, risk reduction efforts were discussed within the Engineering PDT for further discussion.

The appropriate contingencies were then applied to the MCACES/MII estimate for the NED and Locally Preferred Plans, producing the 'After Risk Analysis' cost estimate contained herein. Upon completion of this estimate the Total Project Cost Summary was prepared.

A.5.2 Risk analysis results

Refer to the Final Cost Schedule Risk Analysis Report produced by the Walla Walla District Cost Center of Expertise at the attached sub-appendix.

A.6 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 SAP and the official project schedule. The TPCS includes Federal and non-Federal costs for lands and damages, all construction features, PED, and S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the WBS and uses Civil Works Construction Cost Indexing System 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 prepared using the MCACES/MII cost estimate on the Recommended Plans with contingencies set by the risk analysis (and the exceptions as described above) and the official project schedule. In performing the risk analysis by meeting with the PDT to discuss the construction schedule to prepare the risk register, a schedule was derived that is slightly different from the official schedule in that it has slightly shorter construction duration. A risk analysis was run on that schedule taking into consideration variations in construction duration, authorization date and appropriation date, and yet a third schedule developed, this one based on the risk analysis results at the 80% confidence level. A TPCS (Figure X+1) was prepared using this schedule as well. These timelines and costs are summarized in Table 18. They show the impact of delayed authorization and appropriation on the fully funded cost despite a slightly shorter construction duration.

The Cost Risk Analysis based total project contingency of 29 percent determined under the External Risk analysis in was applied to the Total Project Cost Summary along with the contingency adjusted total project schedule presented in Table B.5.3.

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

PROJECT: Mile Point Navigation Improvements
LOCATION: Jacksonville Harbor, Duval County, Florida

DISTRICT: SAJ   PREPARED: 3/24/2011
POC: CHIEF, COST ENGINEERING, Tracy T. Leeser, P.E.

This Estimate reflects the scope and schedule in report; INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

						Program Year (Budget EC): 2012						FULLY FUNDED PROJECT ESTIMATE		
						Effective Price Level Date: 1 OCT 11								
					BASE COST				**FIRST COST**	Spent Thru:				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	24-Mar-11 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
02	RELOCATIONS	$327	$96	29%	$424	1.6%	$333	$98	**$431**			$348	$103	$451
06	FISH & WILDLIFE FACILITIES	$2,349	$691	29%	$3,040	1.6%	$2,386	$702	**$3,088**			$2,498	$735	$3,234
12	NAVIGATION PORTS & HARBORS	$21,917	$6,452	29%	$28,369	1.6%	$22,261	$6,554	**$28,815**			$23,022	$6,778	$29,799
	#N/A		-			-								
	#N/A		-			-	$0		**$0**			$0		$0
	CONSTRUCTION ESTIMATE TOTALS:	$24,593	$7,240		**$31,833**	1.6%	$24,979	$7,354	**$32,333**			$25,868	$7,616	$33,484
01	LANDS AND DAMAGES	$75	$22	29%	$97	1.6%	$77	$23	**$99**			$77	$23	$99
30	PLANNING, ENGINEERING & DESIGN	$1,562	$460	29%	$2,022	3.2%	$1,612	$475	**$2,087**			$1,634	$481	$2,115
31	CONSTRUCTION MANAGEMENT	$1,430	$421	29%	$1,851	3.2%	$1,476	$434	**$1,910**			$1,598	$470	$2,068
	PROJECT COST TOTALS:	$27,660	$8,143	29%	**$35,804**	1.7%	$28,144	$8,286	**$36,429**			$29,177	$8,590	$37,767

CHIEF, COST ENGINEERING, Tracy T. Leeser, P.E.

PROJECT MANAGER, Steven R. Ross, P.E.

CHIEF, REAL ESTATE, John Baker

CHIEF, PLANNING,xxx

CHIEF, ENGINEERING, xxx

CHIEF, OPERATIONS, xxx

CHIEF, CONSTRUCTION, xxx

CHIEF, CONTRACTING,xxx

CHIEF, PM-PB, xxxx

CHIEF, DPM, xxx

ESTIMATED FEDERAL COST:	75%	**$28,325**
ESTIMATED NON-FEDERAL COST:	25%	**$9,442**
ESTIMATED TOTAL PROJECT COST:		**$37,767**

O&M OUTSIDE OF TOTAL PROJECT COST: N/A

Filename: TPCS-Jacksonville Harbor Mile Point 032611 - GRM.xlsx
TPCS

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

**** CONTRACT COST SUMMARY ****

PROJECT: Mile Point Navigation Improvements
LOCATION: Jacksonville Harbor, Duval County, Florida
This Estimate reflects the scope and schedule in report; INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

DISTRICT: SAJ PREPARED: 3/24/2011
POC: CHIEF, COST ENGINEERING, Tracy T. Leeser, P.E.

Estimate Prepared: 24-Mar-11
Effective Price Level: 24-Mar-11

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	RISK BASED CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date P	ESC (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	PROJECT CONSTRUCTION													
02	RELOCATIONS	$327	$96	29%	$424	1.6%	$333	$98	$431	2015Q1	4.7%	$348	$103	$451
06	FISH & WILDLIFE FACILITIES	$2,349	$691	29%	$3,040	1.6%	$2,386	$702	$3,088	2015Q1	4.7%	$2,498	$735	$3,234
12	NAVIGATION PORTS & HARBORS	$21,917	$6,452	29%	$28,369	1.6%	$22,261	$6,554	$28,815	2014Q2	3.4%	$23,022	$6,778	$29,799
	#N/A													
	#N/A													
	CONSTRUCTION ESTIMATE TOTALS:	$24,593	$7,240	29%	**$31,833**		$24,979	$7,354	$32,333			$25,868	$7,616	$33,484
01	LANDS AND DAMAGES	$75	$22	29%	$97	1.6%	$77	$23	$99	2012Q3	0.4%	$77	$23	$99
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$131	$39	29%	$170	3.2%	$135	$40	$175	2012Q3	1.0%	$137	$40	$177
	Planning & Environmental Compliance	$196	$58	29%	$254	3.2%	$203	$60	$262	2012Q3	1.0%	$205	$60	$265
	Engineering & Design	$986	$290	29%	$1,276	3.2%	$1,017	$299	$1,317	2012Q3	1.0%	$1,028	$303	$1,330
	Engineering Tech Review ITR & VE			29%										
	Contracting & Reprographics	$71	$21	29%	$92	3.2%	$73	$22	$95	2012Q3	1.0%	$74	$22	$96
	Engineering During Construction	$52	$15	29%	$68	3.2%	$54	$16	$70	2014Q2	8.3%	$59	$17	$76
	Office of Counsel (PPA)	$16	$5	29%	$21	3.2%	$17	$5	$22	2014Q2	8.3%	$18	$5	$24
	Project Operations	$109	$32	29%	$141	3.2%	$113	$33	$146	2012Q3	1.0%	$114	$34	$147
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$1,430	$421	29%	$1,851	3.2%	$1,476	$434	$1,910	2014Q2	8.3%	$1,598	$470	$2,068
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$27,660	$8,143		**$35,804**		$28,144	$8,286	$36,429			$29,177	$8,590	**$37,767**

A.7 COST DX TPCS CERTIFICATION

JACKSONVILLE HARBOR (MILE POINT)
NAVIGATION STUDY
USACE - JACKSONVILLE DISTRICT

COST ENGINEERING DX TPCS RE-CERTIFICATION

The Jacksonville Harbor (Mile Point) Navigation Study presented by Jacksonville District has undergone a successful cost Agency Technical Review (ATR) as performed by Cost DX representatives. The ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies in accordance with ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of 29 March2011, the Walla Walla District, Cost Engineering Directory of Expertise (Dx) for Civil Works, certifies the estimated total project cost of the Jacksonville Harbor (Mile Point) Navigation Study estimated values of:

FY 2012 Price Level:	$36,429,000
Fully Funded Amount:	$37,767,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report.

29-MAR-2011
Date

Kim C. Callan, PE, CCE, PM1
Chief, Cost Engineering
Walla Walla District

APPENDIX A-2A

PROJECT COST AND SCHEDULE RISK ANALYSIS REPORT

US Army Corps of Engineers®

Jacksonville Harbor, Mile Point Navigation Improvements

Jacksonville, Florida - Feasibility Study,

Revised Final NED Plan - Alternative VE-3B - Concrete Structural Units System VE Alternative

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

March 28, 2011

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EXECUTIVE SUMMARY

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 Jacksonville Harbor, Mile Point Navigation Improvements Jacksonville, Florida - Feasibility Study, Revised Final NED Plan - Alternative VE-3B - Concrete Structural Units System VE Alternative (Mile Point). 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 Mile Point Project, the most likely total project cost (at price level) is estimated at approximately $28 Million. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $8 Million, or 29%. This contingency includes $7.7 Million (28%) for cost growth potential due to risk analyzed in the base cost estimate and $420,000 (1.5%) for cost growth potential due to risk analyzed in the baseline schedule.

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

The following table ES-1 portrays the development of contingencies. The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Most Likely Cost Estimate	**$27,660,467**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$27,319,884	-1.23%
50%	$32,776,924	18.50%
80%	**$35,804,452**	**29.44%**
95%	$38,270,714	38.36%

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

MILE POINT		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
01	LANDS AND DAMAGES	75	22	97
02	RELOCATIONS	327	95	422
06	FISH AND WILDLIFE FACILITIES	2,349	681	3,030
12	NAVIGATION PORTS AND HARBORS	21,917	6,356	28,273
30	PLANNING, ENGINEERING, & DESIGN	1,562	453	2,015
31	CONSTRUCTION MANAGEMENT	1,430	415	1,845
	TOTAL PROJECT COSTS	**27,660**	**8,022**	**35,682**
	Schedule Completion with Contingency	**20 Nov 2014**	**30 months**	**18 May 2017**

Notes:
1) All costs include the recommended contingency of 29%.
2) Costs exclude O&M and Life Cycle Cost estimates.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis are Risks CT-4 (Bidding Climate), EN-C-3 (Equipment Availability), and EN-C-2 (Quantity Estimates), which together contribute 82 percent of the statistical cost variance. CT-4 (Bidding Climate) represents the risk that ultimate bidding climate at time of contract award could cause a variance in costs, due to the market being either more or less favorable. EN-C-3 (Equipment Availability) represents the risk that the equipment available regionally (i.e. 16-inch vs. 24-inch pipeline dredge) could cause a variance in the ultimate contract costs. EN-C-2 (Quantity Estimates) represents the risk that variation in the estimated quantities of materials would cause variance in the ultimate contract costs.

The key schedule risk drivers identified through sensitivity analysis are Risks PD-E-4 (Permit Delays), DP-3 (Schedule Delays), and CT-2 (Protests), which together contribute 77 percent of the statistical schedule variance. PD-E-4 (Permit Delays) represents the risk that delays in obtaining permits may cause significant delay on the project. DP-3 (Schedule Delays) represents the risk of significant project implementation delay due to the uncertainty in obtaining authorization and appropriation, as currently planned. CT-2 (Protests) represents the risk that a bidder protest may significantly delay the start of project execution, if it occurred.

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 Jacksonville Harbor, Mile Point Navigation Improvements, Revised NED Plan (Mile Point).

2.0 BACKGROUND

The Revised Final NED Plan - Alternative VE-3B - Concrete Structural Units System VE Alternative (Training Wall Reach Widening) and 3B (Relocate Mile Point Training Wall) were selected as having the greatest net benefits. The NED Plan is to relocate and widen the Training Wall Reach, including dredging and disposal of the Little Jetty Training Wall and Chicopit Bay Circulation Channel, including the construction of a 1,400 LF containment berm for hydraulic disposal at Great Marsh Island.

As a part of this effort, Jacksonville District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx) 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 most likely 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 Dx. 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 Dx.

- 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 Cost Dx assembled a team, also relying on local Jacksonville District staff to further augment labor, expertise and information gathering. The Cost Dx team consisted of one senior civil cost engineer. The Jacksonville staff included two cost estimators, as well as coordination support from project management and the assigned project delivery team (PDT).

The Jacksonville PDT conducted a risk identification and qualitative analysis meeting prior to beginning the risk analysis effort. The two estimators then traveled to Walla Walla District to begin the risk analysis effort 22-23 April 2009. The Cost Dx conducted several subsequent iterations of the cost risk model at the request of the Jacksonville PDT, based on results of new research and the implementation of risk mitigation efforts. The first cost risk model was completed and results reported on June 8, 2009.

The results of the original cost and schedule risk analysis (CSRA) completed in June 2009 revealed that External Risk PD-E-3 (Environmental Restrictions) was a critical risk, adding a minimum of $5 Million in cost impacts and 36 months in schedule impact. This was due to the uncertainty of a very significant cultural resource discovery, which was moderately probable, as substantial cultural resource investigations had not been completed. This prompted the project leadership to conduct more investigations to mitigate the risk prior to submission for authorization and approval. According to project leadership, these investigations have concluded that such a discovery is extremely unlikely, lowering the overall risk threshold and risk rating from "High" to "Low."

Additionally, the Jacksonville has obtained information regarding bidding climate and market conditions, External Risk CT-4 (Bidding Climate), suggesting that ultimate construction costs are trending toward more favorable pricing (due to economic strains on the industry). Therefore, Cost Dx remodeled the CSRA with the new data and results reported to the Jacksonville PDT on August 5, 2010.

Finally, the final revision to the NED plan and estimate occurred January through February 2011. The updated estimates and inputs were provided to the Cost Dx for update of the CSRA March 3, 2011. The CSRA, with the new changes incorporated, was reworked with preliminary results provided March 17, 2011. Some changes to the estimate were required through the process of the Cost Engineering portion of the Agency Technical Review (ATR). The changes were made and incorporated into the CSRA March 24, 2011. The changes were incorporated within the CSRA with final results and the final CSRA report provided to the Jacksonville PDT on March 27, 2011.

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 any desired level of cost confidence.

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 Dx 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.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT was obtained using creative processes such as brainstorming or other facilitated risk assessment meetings.

Formal PDT meetings are held for the purposes of identifying and assessing risk factors. The meetings should include capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/Program managers
- Contracting/acquisition
- Real Estate
- Relocations
- Environmental
- Civil and Coastal Design
- Cost and schedule engineers
- Construction
- Key Sponsors

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

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 with- and without-project conditions at Jacksonville Harbor, Mile Point Navigation Improvements.

a. The MII MCACES (Micro-Computer Aided Cost Estimating Software) file "JHFMILEPT2011-5-Final NED Plan FY11 no contingency.mlp" was the basis for the cost and schedule risk analyses herein.

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. The schedule was analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and monthly recurring costs (unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay).

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for Florida is 0.94, meaning that this project is not susceptible to differential between the local market and OMB inflation factors for future construction.

e. Per the data in the estimate, the Job Office Overhead (JOOH) amount for the Contract Cost comprises approximately 3.46% of the Project Cost at Baseline. Thus, the assumed monthly recurring rate for this project is 3.46%. For the P80 schedule, this comprises approximately 1.52% of the total contingency due to the accrual of residual fixed costs associated with delay.

f. The Cost Dx 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" for further monitoring and evaluation.

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

Table 1 provides the raw 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 $8 Million at the P80 confidence level (29.4% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 18.5% and 54.6% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Project Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$27,660,467	$5,116,457	18.50%
80% Confidence Level			
Project Cost	$27,660,467	$8,143,985	29.44%
100% Confidence Level			
Project Cost	$27,660,467	$15,105,868	54.61%

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 total 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 monthly recurring 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 monthly recurring costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)	Contingency (%)
50% Confidence Level			
Total Project Duration	68	23	33%
80% Confidence Level			
Total Project Duration	68	30	44%
100% Confidence Level			
Total Project Duration	68	45	67%

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

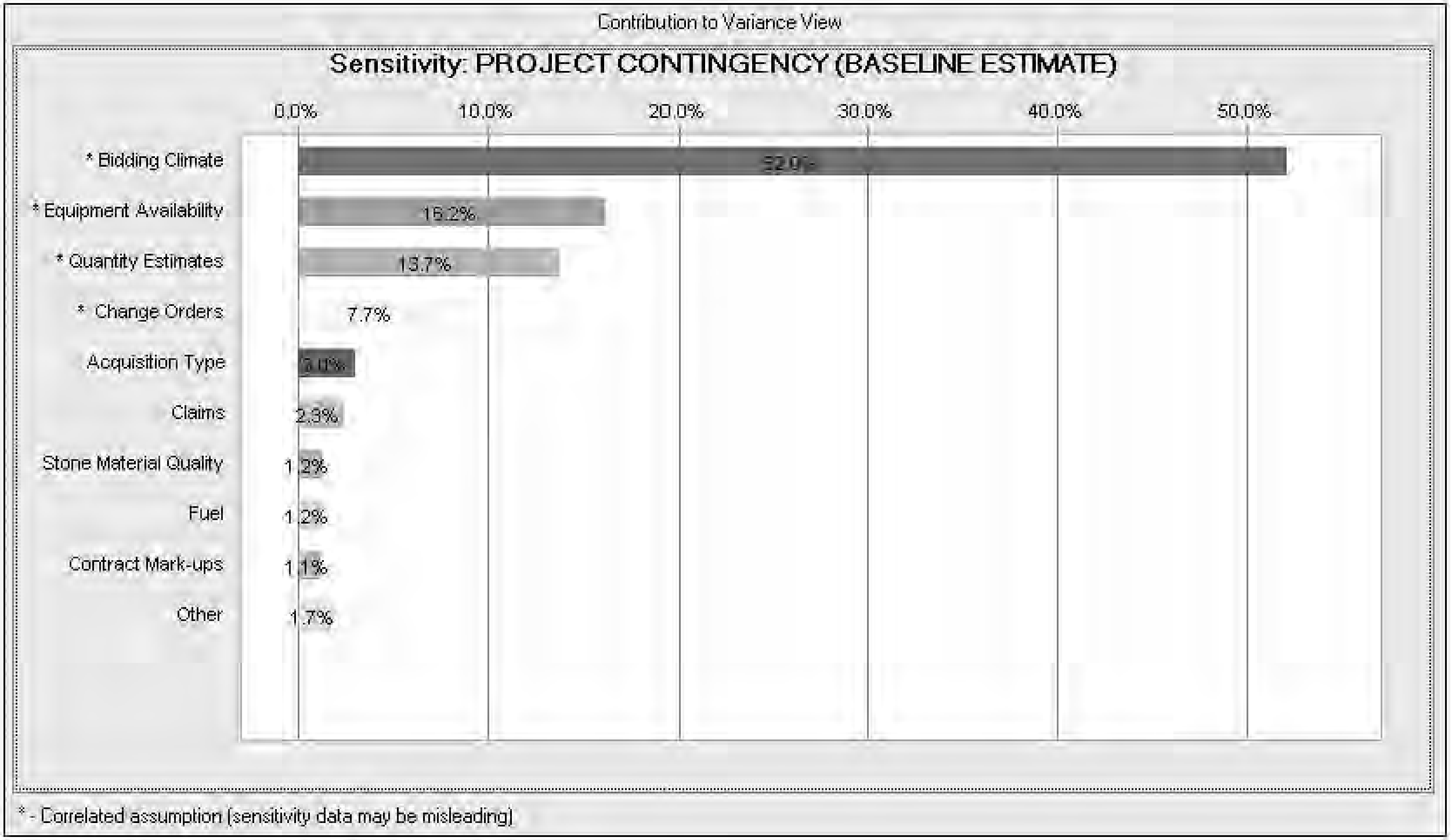
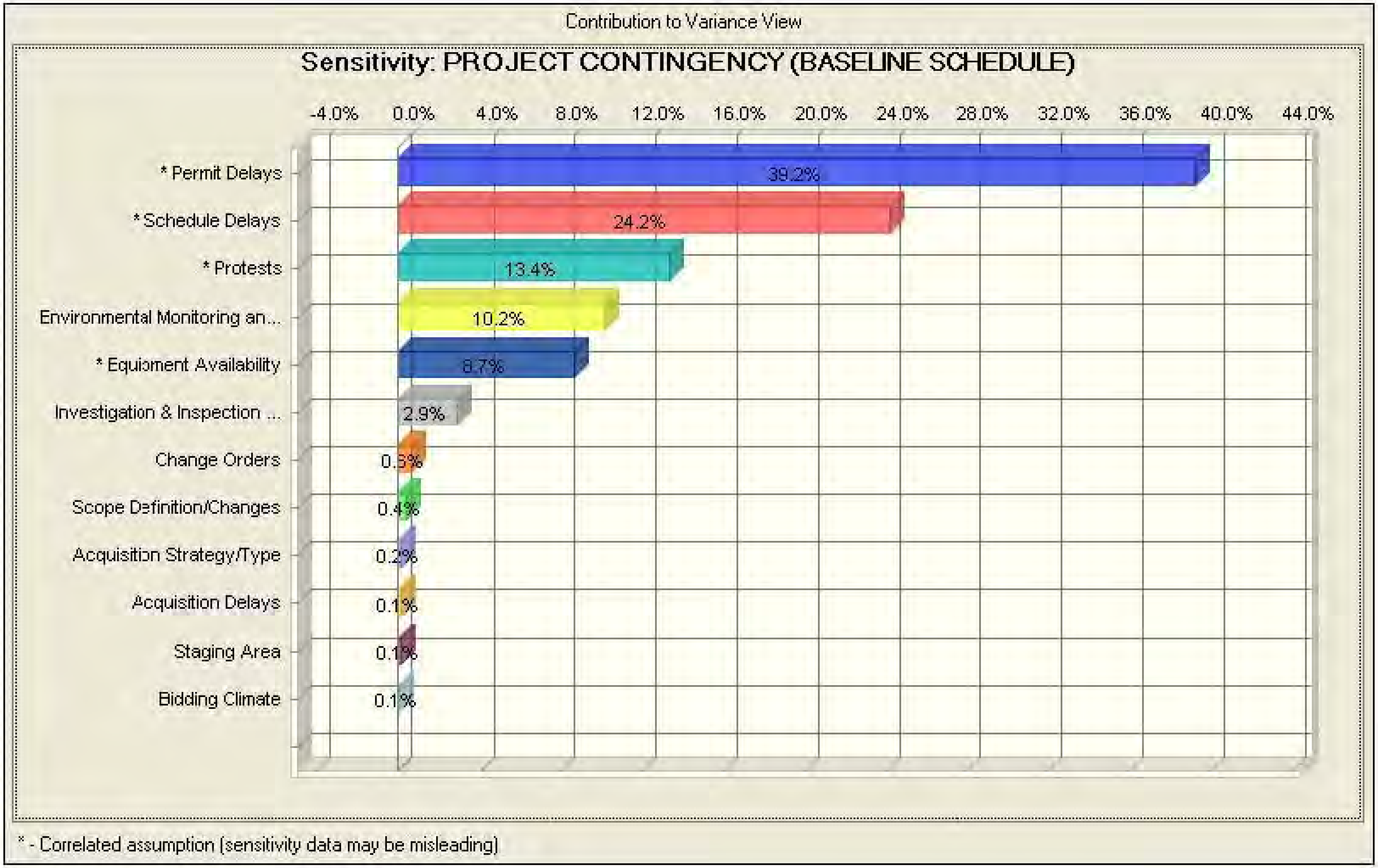


Figure 2. Schedule Sensitivity Analysis



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

Total 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 CT-4 (Bidding Climate), EN-C-3 (Equipment Availability), and EN-C-2 (Quantity Estimates), which together contribute 82 percent of the statistical cost variance.

2. The key schedule risk drivers identified through sensitivity analysis are Risks PD-E-4 (Permit Delays), DP-3 (Schedule Delays), and CT-2 (Protests), which together contribute 77 percent of the statistical schedule variance.

3. The schedule was not resource loaded and contains 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 monthly recurring costs. Resource impacts related to potential schedule delays could not be evaluated.

4. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full lifecycle 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

Confidence Level	Project Cost ($)	Contingency (%)
P0	**$22,656,136**	**-18.09%**
P5	**$27,319,884**	**-1.23%**
P10	**$28,323,970**	**2.40%**
P15	**$29,061,427**	**5.06%**
P20	**$29,672,679**	**7.27%**
P25	**$30,270,680**	**9.44%**
P30	**$30,843,997**	**11.51%**
P35	**$31,341,319**	**13.31%**
P40	**$31,826,234**	**15.06%**
P45	**$32,311,775**	**16.82%**
P50	**$32,776,924**	**18.50%**
P55	**$33,240,512**	**20.17%**
P60	**$33,728,730**	**21.94%**
P65	**$34,216,760**	**23.70%**
P70	**$34,689,217**	**25.41%**
P75	**$35,237,230**	**27.39%**
P80	**$35,804,452**	**29.44%**
P85	**$36,427,500**	**31.70%**
P90	**$37,189,845**	**34.45%**
P95	**$38,270,714**	**38.36%**
P100	**$42,766,335**	**54.61%**

Figure 3. Project Cost Summary

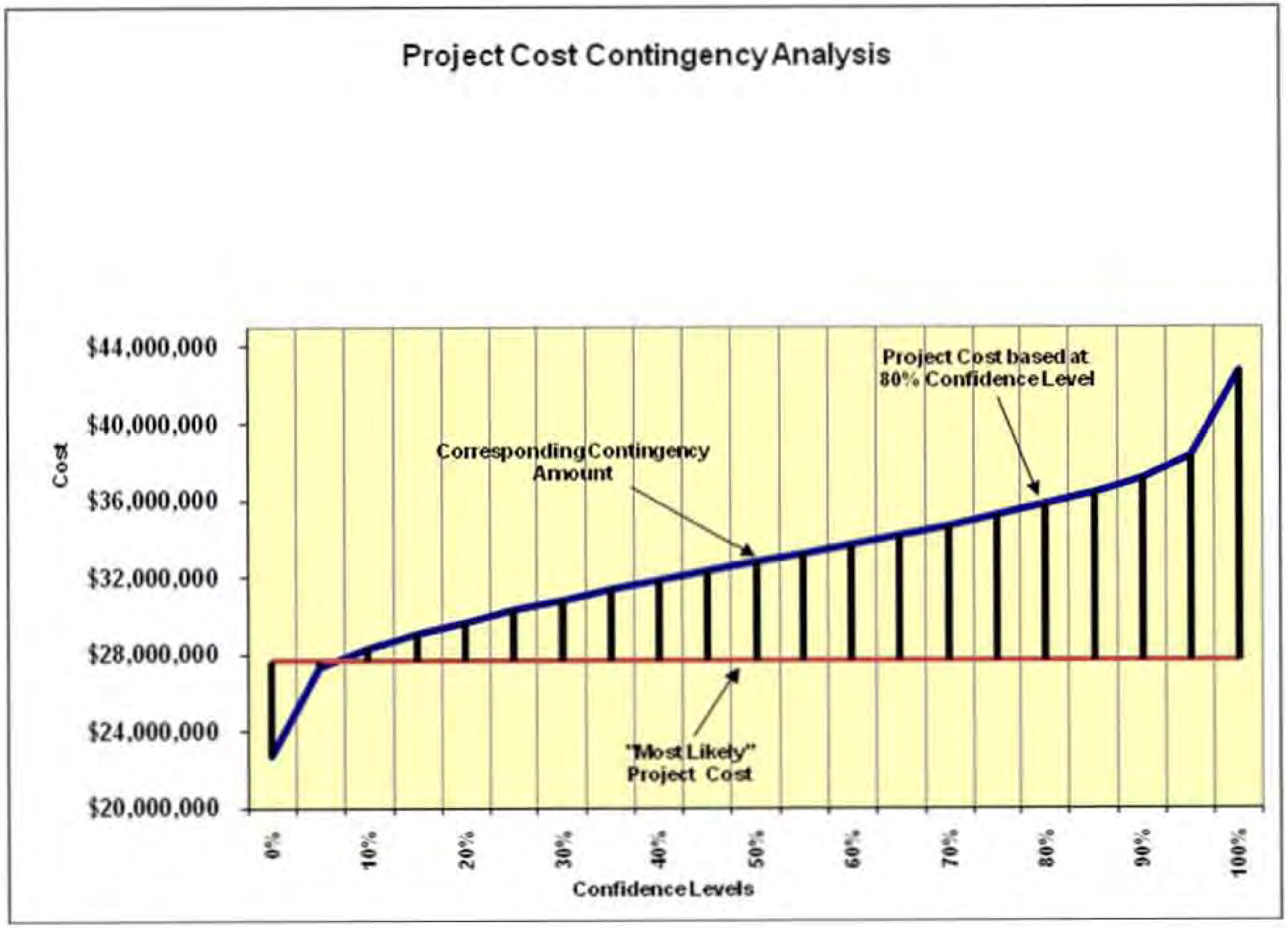
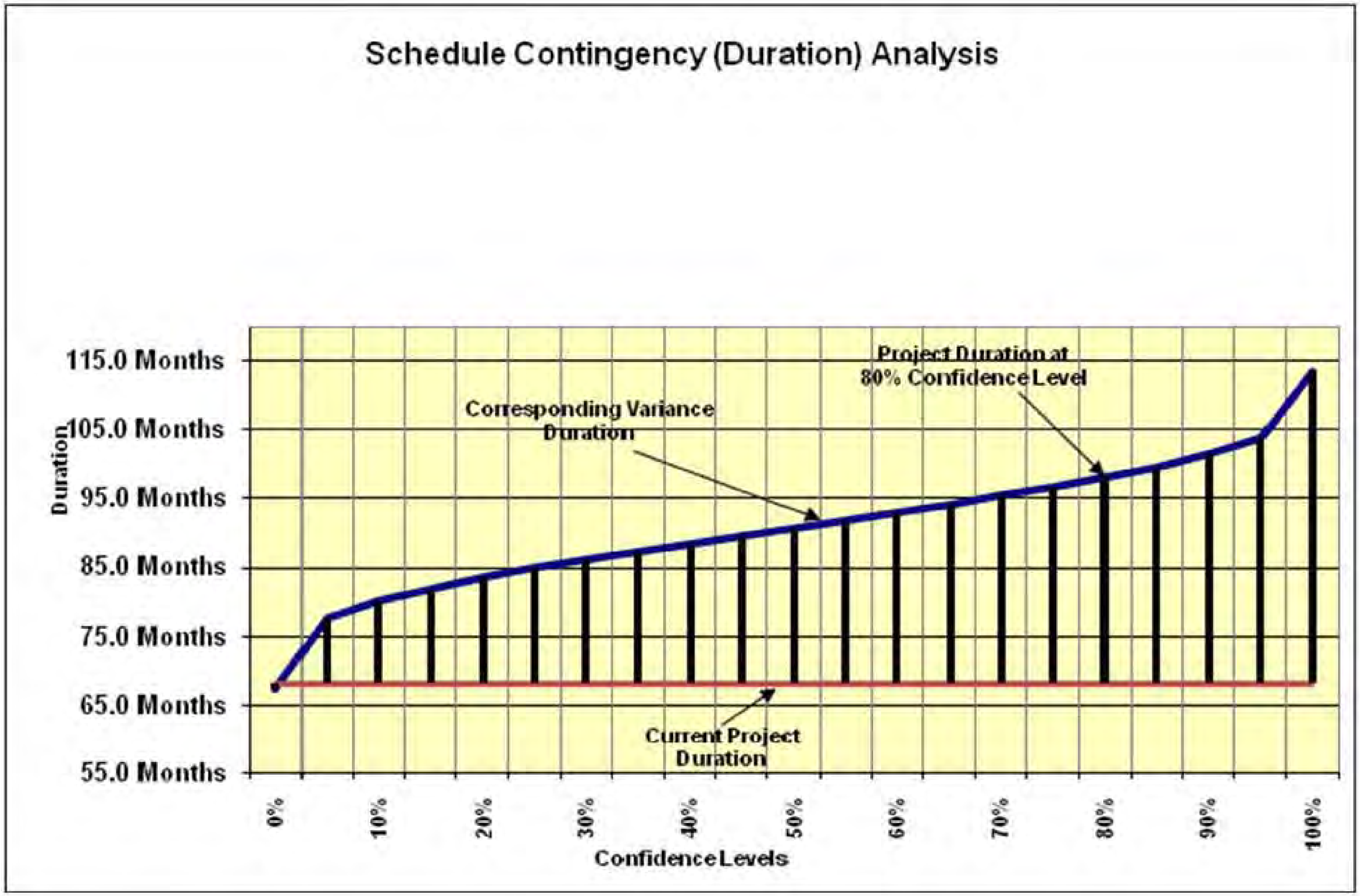


Figure 4. Project Duration Summary



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 proactive management of risks does 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 CT-4 (Bidding Climate), EN-C-3 (Equipment Availability), and EN-C-2 (Quantity Estimates), which together contribute 82 percent of the statistical cost variance.

a) Bidding Climate: Project leadership should continuously monitor price fluctuations and behaviors in the regional industry, and certainly as part of the PDT's ongoing market research. Project leadership should craft the acquisition strategy with respect to the market trends to minimize the impact of industry contraction or saturation and to maximize competition.

b) Equipment Availability: Project leadership should conduct market research to determine the regional trends regarding the availability of equipment to meet the requirements in parallel to the general market research being conducted. The PDT may also consider changing the engineering requirements or methodologies to increase competition and/or the likelihood of equipment being available.

c) Quantity Estimates: Project leadership should conduct further research and/or survey to validate the scope and quantities estimated, as well as the production/estimate structure within the project scoping documents.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis are Risks PD-E-4 (Permit Delays), DP-3 (Schedule Delays), and CT-2 (Protests), which together contribute 77 percent of the statistical schedule variance.

a) Permit Delays: Project leadership should take proactive measures with respect to obtaining required permits as well as proactive monitoring and control. Changes to anticipated permit timelines should be communicated to management in a timely manner.

b) Schedule Delays: Project leadership should take proactive measures with respect to the schedule and the timeline for budget approval and disbursement of project funds. Changes to the anticipated timeline with respect to schedule should be controlled and reported to management for expeditious schedule recovery efforts.

c) Protests: Project leadership should account for the probability of contractor protests both in budgeting protest and bid preparation fees, as well as crafting an acquisition plan and solicitation that minimizes the likelihood of protest.

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

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - PDT Risk Register

Risk Level

Likelihood of Occurrence					
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
	Negligible	Marginal	Significant	Critical	Crisis

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	Discussion and Concerns	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Project Cost: Rough Order Impact ($)	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Project Schedule: Rough Order Impact (mo)	Correlation to Other(s)	Responsibility/POC	Affected Project Component	Project Implications	
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
CD-1	Change Orders	Time and cost impacts vary greatly on individual issues. Changes near end of project don't impact schedule.	Very Likely	Significant	HIGH	5 - 10%	Very Likely	Significant	HIGH	3 mo.	EN-W-1	Construction Division	Construction Cost & Schedule	Cost & Schedule	
CD-2	Safety Issues	Don't usually shut project down	Likely	Negligible	LOW	Minimal	Likely	Negligible	LOW	< 10 days		Construction Division	Construction Cost & Schedule	Cost & Schedule	*Updated Schedule Impact to reflect ROI*
CD-3/ LS-2	Staging Area	Potential for problems with location; issues w/ runway; lights needed for cranes @ certain ht; aircraft- impact ht. restriction; Impacts contractor's operation	Unlikely	Siginificant	MODERATE	1 - 2%	Very Likely	Marginal	MODERATE	1 mo.		Construction Division	Project Cost & Schedule	Cost & Schedule	
CD-4	Claims	Claims are likely to occur, but not cause a drastic delay in project schedule	Likely	Significant	HIGH	5 - 15%	Very Likely	Negligible	LOW	0 mo.	DP-3	Construction Division	Project Cost & Schedule	Cost & Schedule	
CT-1	Acquisition Type	Impacts effort in award, some contract vehicles more conducive to lower cost; Prefer Best Value RFP w/ source selection plan; Increased cost/time to implement multiple awards	Unlikely	Significant	MODERATE	10%	Unlikely	Significant	MODERATE	2 mo.		Acquisition Strategy Board	Construction Cost & Schedule	Cost & Schedule	*Combined CT-6 Acquisition Strategy cost info as it was determined to be duplicated*
CT-3	Acquisition Delays	If the Sole-Source J&A does not get approved, could impact the schedule by up to 12 months while the PDT comes up with another alternative.	N/A	N/A	N/A	N/A	Likely	Significant	HIGH	12 mo.		Acquisition Strategy Board	Construction Cost & Schedule	Cost & Schedule	*Updated to reflect only schedule impact, no cost impact; Updated Likelihood, Impact and ROI based on input provided by Beau Corbett CT on 1/31/2011*
CT-5	Acquisition Plan	Could split into multiple contracts if small business can do dredging	Very Unlikely	Significant	LOW	< 1%	N/A	N/A	N/A	N/A		Acquisition Strategy Board	Construction Cost	Cost	
CT-6/ EN-D-4	Proprietory Materials Procurement	This item is added in support of the possible sole source of the concrete structures, since there were no responses to the sources sought solicitation. If it is determined that a Sole-Source Justification and Approval (J&A) is required, the schedule may need to be increased to accomodate this effort. It could take 2-6 months to get sole sources approved through HQ.	N/A	N/A	N/A	N/A	Likely	Critical	HIGH	6 mo.		Contracting Division	Construction Cost	Cost & Schedule	*Added this risk item and assigned Likelihood, Impact and ROI based on input provided by Beau Corbett CT on 1/31/2011 and Steve Conger EN-D 2/4/2011. Removed from risk register 3/2/11 due to responses from sources sought solicitation*
CT-7/ DP-1	Project Component Sequencing	Subsequent proj. execution, if separate contracts for each phase/mult. contract (dredge/placement)	Unlikely	Marginal	LOW	$200,000	N/A	N/A	N/A	N/A		PM/Planner/Contracting	Project Schedule	Schedule	
DP-2	Funding Stream	In short term, delays based on $ amt. of contract are likely; delay in execution of proj. components	N/A	N/A	N/A	N/A	Likely	Marginal	MODERATE	Captured by DP-3	DP-3	PM	Project Schedule	Schedule	*Removed from Study -Captured by DP-3*
DP-3	Schedule Delays	Hard to fund if not in 2013 budget- automatic sched. delay; In short term, delays based on $ amt. of contract are likely; delay in execution of proj. components	Very Unlikely	Marginal	LOW	< 1%	Likely	Marginal	MODERATE	4 mo.	CT-2, EN-C-3, CD-4, EN-C-4, EN-G-1, EN-G-2, PD-E-2, PD-E-3, PD-E-4, DP-2		Project Cost & Schedule	Cost & Schedule	*Updated Notes 2/9/2011 per input from Steve Ross DP-C*
DP-4/ EN-D-2	Scope Definition/Changes	Scope is well defined; little likelihood of scope increase or changes from current docs used for estimate development; Engineering pt. of view- if the project lingers, conditions may change	Very Unlikey	Critical	LOW	$3,000,000	Unlikely	Significant	MODERATE	3 mo.	EN-C-2, EN-D-3	PM/Planner	Construction Cost & Schedule	Cost & Schedule	*Updated ROI 2/9/2011 per input from Steve Ross DP-C and Steve Conger EN-DW*
EN-C-1	Production Estimates	Unit price per cubic yard	Likely	Marginal	MODERATE	$4 M	N/A	N/A	N/A	N/A		Cost Engineering	Equipment/Production Rates	Cost	
EN-C-2	Quantity Estimates	Quantity over/under runs	Likely	Significant	HIGH	15%	N/A	N/A	N/A	N/A	EN-D-1, DP-4/ EN-D-2	Cost Engineering/Design Branch	Construction Cost	Cost	
EN-C-5	Awardable Range Increase	An additional 15% above the approximate 10% profit	Likely	Significant	HIGH	Captured by CT-4	N/A	N/A	N/A	N/A		Cost Engineering	Funding	Cost	*Risk Item covered by CT-4 Bidding Climate*
EN-C-8	Contract Mark-ups		Likely	Marginal	MODERATE	$1.7 M	N/A	N/A	N/A	N/A					
EN-D-1	Design Costs	Haven't fully calculated full PED; compared to 8%, unlikely to exceed 4 million in PED costs	Unlikely	Marginal	LOW	<10%	Unlikely	Marginal	LOW	minimal to none	EN-D-3, EN-C-2	Cost Engineering/Design Branch	Construction Cost & Schedule	Cost & Schedule	
EN-D-3	Quantity Changes	Depends on time lapse- future condition vs. current; area is dynamic & can change	Likely	Significant	HIGH	Captured by EN-C-2	N/A	N/A	N/A	N/A	EN-D-1, DP-4/ EN-D-2	Design Branch	Construction Cost	Cost	*Risk item covered by EN-C-2 Quantity Estimates*

EN-G-3	Investigation & Inspection Costs	I looked back at the JAX Harbor drilling completed in 2010. We had IGE est of ~$300,000 for the mobilization alone for the drilling jack up. We were fortunate to get a lower cost rig, but under duress of construction, we may have to take what we can find. Therefore, $300,000 isn't unreasonable. Cost per day for equipment is ~$9000 times 10 days max=$90,000, and $5,000 per day for crew times 10 days = $50,000. These are the big ticket items. Worst case would put total project costs for additional 10 holes would be less than $700,000 instead of the $1.3M shown. The risk of this happening is low.	Unlikely	Marginal	LOW	$700,000	Unlikely	Significant	MODERATE	6 mo.		Geotechnical Branch	Project Cost & Schedule	Cost & Schedule	*Updated Likelihood, Impact and ROI based on new feedback from Steve Myers EN-GG in email dated 3/1/2011; Cost aspect removed from risk analysis*
EN-W-1	Modeling Accuracy	Pretty heavily refined model- 3D model; high level of confidence	N/A	N/A	N/A	N/A	Very Unlikely	Critical	LOW	1 mo.	CD-1; EN-W-2	H&H Branch	Construction Schedule	Schedule	*Changed Schedule Impact to reflect ROI and feedback from Brian Cornwell EN-W*
EN-W-2	Erosion Estimates	Erosion of adjacent shorelines and resultant shoaling; risk is that model is not accurate and proj. does not reduce erosion on Mile Pt. area	N/A	N/A	N/A	N/A	Very Unlikely	Significant	LOW	1 mo.	EN-W-1	H&H Branch	Construction Schedule	Schedule	
LS-1	Site Access	Has loading facility to load stone on barges- not a prob. since we own to gate on Blount Island; have rail into Tallyrand to load there as well	Unlikely	Marginal	LOW	$0	Unlikely	Marginal	LOW	0 mo.		Sponsor	Project Cost & Schedule	Cost & Schedule	
LS-3	Highway Restrictions	Will probably truck in small aggregate; not expected to tear up road; stone by rail to terminal, then use barges	Very Unlikely	Significant	LOW	$0	Unlikely	Marginal	LOW	0 mo.		Sponsor	Project Cost & Schedule	Cost & Schedule	*Downgraded Schedule Likelihood due to research*
LS-4	Cost Sharing	Prepared for it; risk may be a factor when it is time to sign agreement	N/A	N/A	N/A	N/A	Very Likely	Negligible	LOW	1 mo.		Sponsor	Project Schedule	Schedule	
LS-5	Public Support and Involvement	Currently a high level of support for project; only foresee small amt. of people having problem; people writing to Congress regularly	N/A	N/A	N/A	N/A	Likely	Negligible	LOW	1 mo.	DP-5/ PD-N-2	Sponsor	Project Schedule	Schedule	
OC-1	Project Partnership Agreement	Delay in project implementation	N/A	N/A	N/A	N/A	Very Unlikely	Critical	LOW	0.5-2 mo.		Counsel	Project Schedule	Schedule	
OD-1	Project Maintenance Requirements	50 yr. standpoint- not much maint. for training wall; dredging- area will naturally remain scoured	Very Unlikely	Marginal	LOW	1.0%	Very Unlikely	Marginal	LOW	1.0%		Operations Division	Project Cost & Schedule	Cost & Schedule	*Updated Cost and Schedule ROI 2/1/2011 per email input from John Bearce OD-N*
OD-2	Monitoring Surveys	Don't plan on monitoring anymore than what we already require	Unlikely	Marginal	LOW	1.0%	Likely	Negligible	LOW	1.5%		Operations Division	Project Cost & Schedule	Cost & Schedule	*Updated Cost and Schedule ROI 2/1/2011 per email input from John Bearce OD-N*
OD-3	O&M Funding	Already have funding for surveys, so unlikely to cause delays or additional costs to proj.	Unlikely	Negligible	LOW	1.0%	Unlikely	Negligible	LOW	1.0%		Operations Division	Project Cost & Schedule	Cost & Schedule	*Updated Cost and Schedule ROI 2/1/2011 per email input from John Bearce OD-N*
PD-N-1	Economic Changes to Benefits	Feasibilty level of study w/ high level of design; port level and administrative level; Any impacts to benefit analysis (ie, change in fleet, commodity growth rates) would affect study costs, not project construction costs. he Hanjin construction completion seems to be a moving target, and already changed from 2015 (what is says in the Milepoint draft report) to 2017 (what it will say in the Jax Harbor GRR2 report) and who knows what in the future (the original Hanjin completion was suppose to be by end of 2011). That's not to say that the traffic cannot be made up by another entity (such as MOL) -- but that would not likely occur until the MOL/TraPac terminal reaches capacity (it is less than a quarter of capacity right now).	Likely	Significant	HIGH	$0	N/A	N/A	N/A	0 mo.		Planning Economics	Project Cost	Cost	*Updated Cost Likelihood rating based on 2/22/2011 email input from Dan Abecassis*
PD-N-3	Project Approval	Already capturing cost growth. Project expected to gain approval so unlikely that it will not get approved, however if delays to project approval then significant impacts.	N/A	N/A	N/A	N/A	Unlikely	Marginal	LOW	3 mo.		Planning Economics	Project Schedule	Schedule	*Updated Schedule Impact rating 2/2/2011 per email input from Sam Borer PD-PN*
RE-1	Land Acquisition Delays	All lands belong to government entities	Very Unlikely	Negligible	LOW	< 1%	Very Unlikely	Negligible	LOW	0 mo.		Real Estate	Project Cost & Schedule	Cost & Schedule	

External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)

CT-2	Protests	Delay in project execution; Sole source- can't get approved or if there is a protest it can kill contract- high risk	N/A	N/A	N/A	N/A	Likely	Significant	HIGH	6 mo.	DP-3	Contracting Division	Project Schedule	Schedule	
CT-4	Bidding Climate	Severe economic swings can increase / decrease number of potential bidders.	Likely	Marginal	MODERATE	-20% to +15%	Likely	Marginal	MODERATE	1 mo.	EN-C-7, EN-C-3				*Updated Impact and ROI based on input provided by Beau Corbett CT on 1/31/2011*
DP-5/ PD-N-2	Project Review and Authorization Delays	Likely b/c of public comment; review policy to adhere to; not a huge sched. impact; Delay in execution of project components. Uncertainties with IEPR may impact schedule.	N/A	N/A	N/A	N/A	Unlikely	Marginal	LOW	1 mo.	LS-5	PM/Planning	Project Schedule	Schedule	*Updated Schedule Impact rating 2/2/2011 per email input from Sam Borer PD-PN*
EN-C-3	Equipment Availability	Dredge may have to come from further away, increasing mobilization costs or size / type of equipment available.	Likely	Significant	HIGH	$4.8 M	Likely	Marginal	MODERATE	1 mo.	DP-3, CT-4	Cost Engineering	Equipment	Cost & Schedule	*Updated Schedule Likelihood and ROI*
EN-C-4	Weather	Severe weather causing damage to project during construction.	Likely	Marginal	MODERATE	$1.8 M	Likely	Negligible	LOW	1 mo.	DP-3	Cost Engineering	Labor/Production Rates	Cost & Schedule	*Updated Schedule Impact since weather days already accounted for*
EN-C-6	Fuel	$x.xx per gallon was used in the Sep 08 MII, increases will effect equipment operating costs.	Very Likely	Significant	HIGH	$446,000	N/A	N/A	N/A	N/A		Cost Engineering	Equipment	Cost	
EN-C-7	Labor	Labor Prices are fixed by Davis Bacon wage rates. Labor availability is subject to bidding climate.	Unlikely	Marginal	LOW	< 1%	N/A	N/A	N/A	N/A	CT-4	Cost Engineering	Labor/Production Rates	Cost	
EN-G-1	Stone Material Quality	Salvage stone- if quality of intended reusable stone is bad then need to purchase additional stone- slip in sched and increase to cost; EN-D feels the estimated 14,600CY of recoverable stone is conservative estimate of what is out there; don't know gradation of stone;	Unlikely	Significant	MODERATE	3.33%	Very Unlikely	Negligible	LOW	1 mo.	DP-3	Geotechnical	Project Cost & Schedule	Cost & Schedule	*Updated ROI 2/3/2011 per email input from Steven Myers EN-GG; $850,000 from EN-GG changed to 3.33% (~$830,000) based on assumption that potentially as much as 20% of estimated quantity of reusable stone is not suitable- would increase current construction cost by about 3.33%*
EN-G-2	Stone Material Availability	Have lots of nearby sources readily available	Very Unlikely	Significant	LOW	5%	Unlikely	Marginal	LOW	1 mo.	DP-3	Geotechnical	Construction Cost & Schedule	Cost & Schedule	*Updated ROI 2/3/2011 per email input from Steven Myers EN-GG; $850,000 from EN-GG changed to 5% of Construction Cost since item listed as significant impact and quick analysis showed increase in shipping costs from $60 to $100/ton yields about 5% increase*
OC-2	Court Injunctions	If we should receive a court injunction, all work on the project will come to a complete halt, an external factor that we cannot control	N/A	N/A	N/A	N/A	Very Unlikely	Critical	LOW	Years		Counsel	Project Schedule	Schedule	
PD-E-1	Environmental Monitoring and Mitigation	Predicting final marsh elevations difficult, may require future funding for long term monitoring	Unlikely	Significant	MODERATE	$1,000,000	Unlikely	Critical	MODERATE	12 mo.		Planning Environmental	Project Cost & Schedule	Cost & Schedule	
PD-E-2	Endangered Species Impact	Manatee takes, although unlikely, could create a slip in schedule during construction	Unlikely	Negligible	LOW	$240,000	Unlikely	Negligible	LOW	3 days	DP-3	Planning Environmental	Project Cost & Schedule	Cost & Schedule	*Updated Cost Impact rating to reflect $240,000 magnitude and Schedule Likelihood and Impact based on 2/10/2011 email input from Grady Caulk PD-EP*
PD-E-3	Environmental Restrictions	A potentially significant submerged prehistoric site has been identified in the proposed Great Marsh Island restoration area. The prefered alternative (restore marsh in Great Marsh Island) will have a "no adverse effect". Resulting in no mitigation cost. Other alternatives, which are very unlikely to be used, may result in an adverse effect determination requiring mitigation. If needed additional evaluation and mitigation activities may take at least 36 months.	Very Unlikely	Critical	LOW	$5,000,000+	Very Unlikely	Critical	LOW	36 mo.	DP-3	Planning Environmental	Project Schedule	Schedule	*Updated Cost and Schedule Likelihood & Impact rating to reflect feedback in 2/10/2011 email input from Grady Caulk PD-EP*
PD-E-4	Permit Delays	Anticipate time to get permit and meet that- not significant	Likely	Negligible	LOW	$20,000	Unlikely	Critical	MODERATE	12 mo.	DP-3	Planning Environmental	Project Schedule	Schedule	*Updated Schedule Impact Rating based on 2/10/2011 email input from Grady Caulk PD-EP*
RE-2	Property Values	Administrative costs only	Very Unlikely	Negligible	LOW	< 1%	Very Unlikely	Negligible	LOW	0 mo.		Real Estate	Project Cost & Schedule	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.

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost & Schedule Risk Analysis Model

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$27,660,467**
Baseline Estimate Cost Contingency Amount ->	$7,724,017
Baseline Estimate Construction Cost (80% Confidence) ->	**$35,384,484**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**68.2 Months**
Schedule Contingency Duration ->	29.9 Months
Project Schedule Duration (80% Confidence) ->	**98.1 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$419,968**

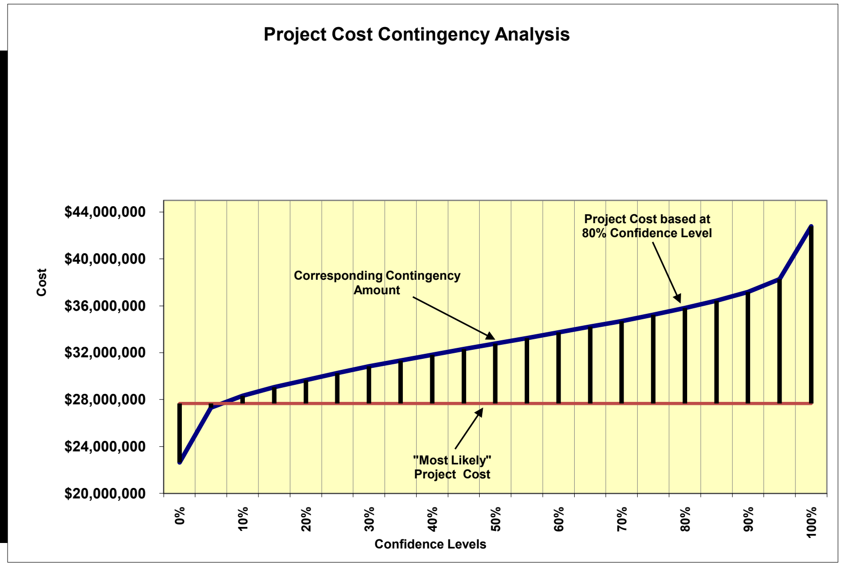
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$8,143,985**
Project Contingency Percentage (80% Confidence) ->	**29%**

Project Cost (80% Confidence) ->	**$35,804,452**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

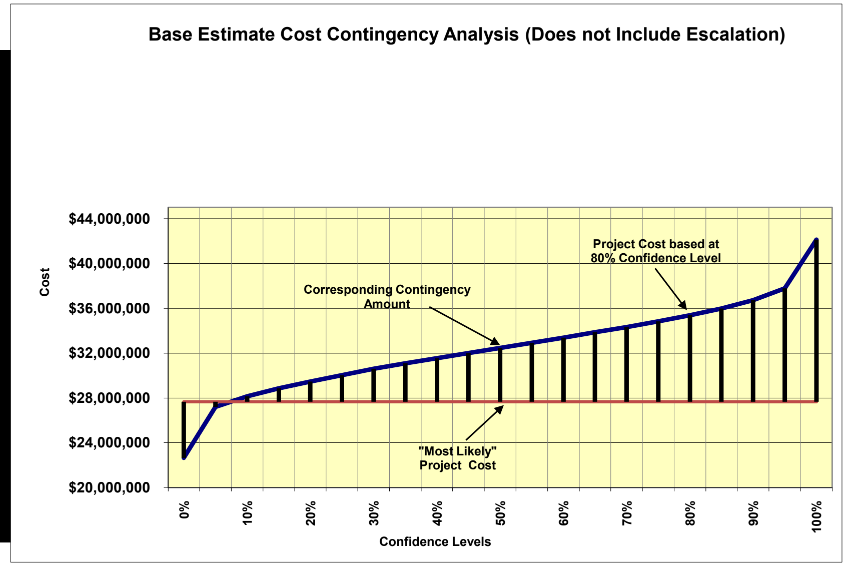
Most Likely Cost Estimate	$27,660,467		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$22,656,136	($5,004,330)	-18.09%
5%	$27,319,884	($340,583)	-1.23%
10%	$28,323,970	$663,504	2.40%
15%	$29,061,427	$1,400,960	5.06%
20%	$29,672,679	$2,012,212	7.27%
25%	$30,270,680	$2,610,214	9.44%
30%	$30,843,997	$3,183,531	11.51%
35%	$31,341,319	$3,680,852	13.31%
40%	$31,826,234	$4,165,767	15.06%
45%	$32,311,775	$4,651,308	16.82%
50%	$32,776,924	$5,116,457	18.50%
55%	$33,240,512	$5,580,045	20.17%
60%	$33,728,730	$6,068,264	21.94%
65%	$34,216,760	$6,556,294	23.70%
70%	$34,689,217	$7,028,750	25.41%
75%	$35,237,230	$7,576,764	27.39%
80%	$35,804,452	$8,143,985	29.44%
85%	$36,427,500	$8,767,033	31.70%
90%	$37,189,845	$9,529,378	34.45%
95%	$38,270,714	$10,610,247	38.36%
100%	$42,766,335	$15,105,868	54.61%



- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

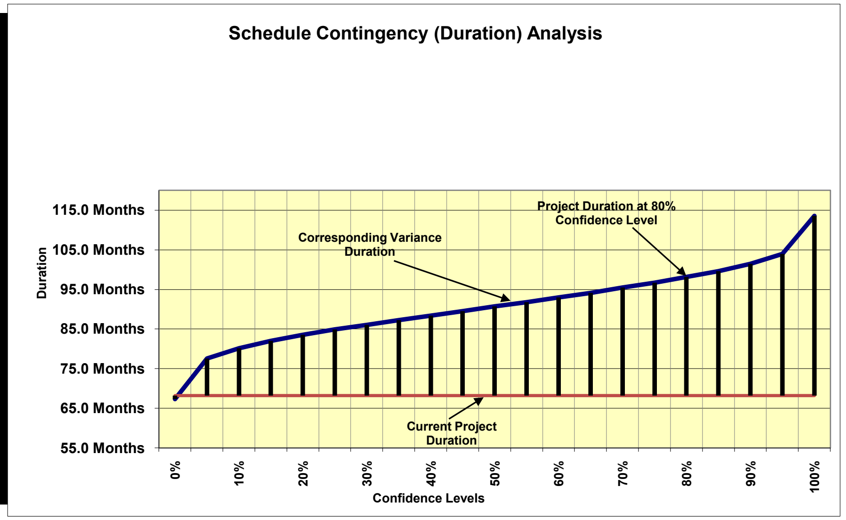
Most Likely Cost Estimate	$27,660,467		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$22,668,667	($4,991,799.40)	-18.05%
5%	$27,188,411	($472,055.28)	-1.71%
10%	$28,156,158	$495,691.57	1.79%
15%	$28,868,149	$1,207,682.35	4.37%
20%	$29,457,670	$1,797,202.95	6.50%
25%	$30,036,870	$2,376,403.41	8.59%
30%	$30,593,376	$2,932,909.36	10.60%
35%	$31,074,521	$3,414,054.54	12.34%
40%	$31,543,316	$3,882,849.87	14.04%
45%	$32,013,001	$4,352,534.47	15.74%
50%	$32,461,615	$4,801,147.91	17.36%
55%	$32,909,844	$5,249,377.37	18.98%
60%	$33,381,688	$5,721,221.52	20.68%
65%	$33,853,108	$6,192,641.37	22.39%
70%	$34,306,988	$6,646,521.56	24.03%
75%	$34,837,110	$7,176,643.86	25.95%
80%	$35,384,484	$7,724,017.34	27.92%
85%	$35,986,877	$8,326,410.06	30.10%
90%	$36,723,845	$9,063,378.12	32.77%
95%	$37,769,640	$10,109,173.57	36.55%
100%	$42,129,836	$14,469,369.01	52.31%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

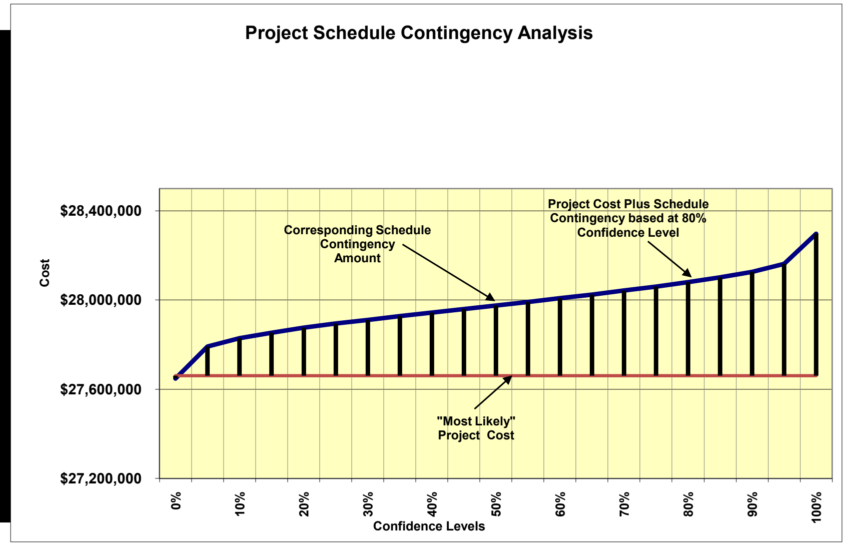
Most Likely Schedule Duration	68.2 Months		
Confidence Level	Project Duration	Contingency	Contingency %
0%	67.3 Months	-0.9 Months	-1.31%
5%	77.6 Months	9.4 Months	13.74%
10%	80.2 Months	12.0 Months	17.53%
15%	82.0 Months	13.8 Months	20.20%
20%	83.5 Months	15.3 Months	22.47%
25%	84.9 Months	16.7 Months	24.43%
30%	86.1 Months	17.9 Months	26.19%
35%	87.2 Months	19.0 Months	27.88%
40%	88.4 Months	20.2 Months	29.56%
45%	89.5 Months	21.3 Months	31.22%
50%	90.7 Months	22.5 Months	32.95%
55%	91.8 Months	23.6 Months	34.55%
60%	92.9 Months	24.7 Months	36.26%
65%	94.1 Months	25.9 Months	38.00%
70%	95.5 Months	27.2 Months	39.94%
75%	96.7 Months	28.5 Months	41.81%
80%	98.1 Months	29.9 Months	43.88%
85%	99.6 Months	31.4 Months	46.04%
90%	101.4 Months	33.2 Months	48.69%
95%	103.9 Months	35.7 Months	52.36%
100%	113.6 Months	45.4 Months	66.51%



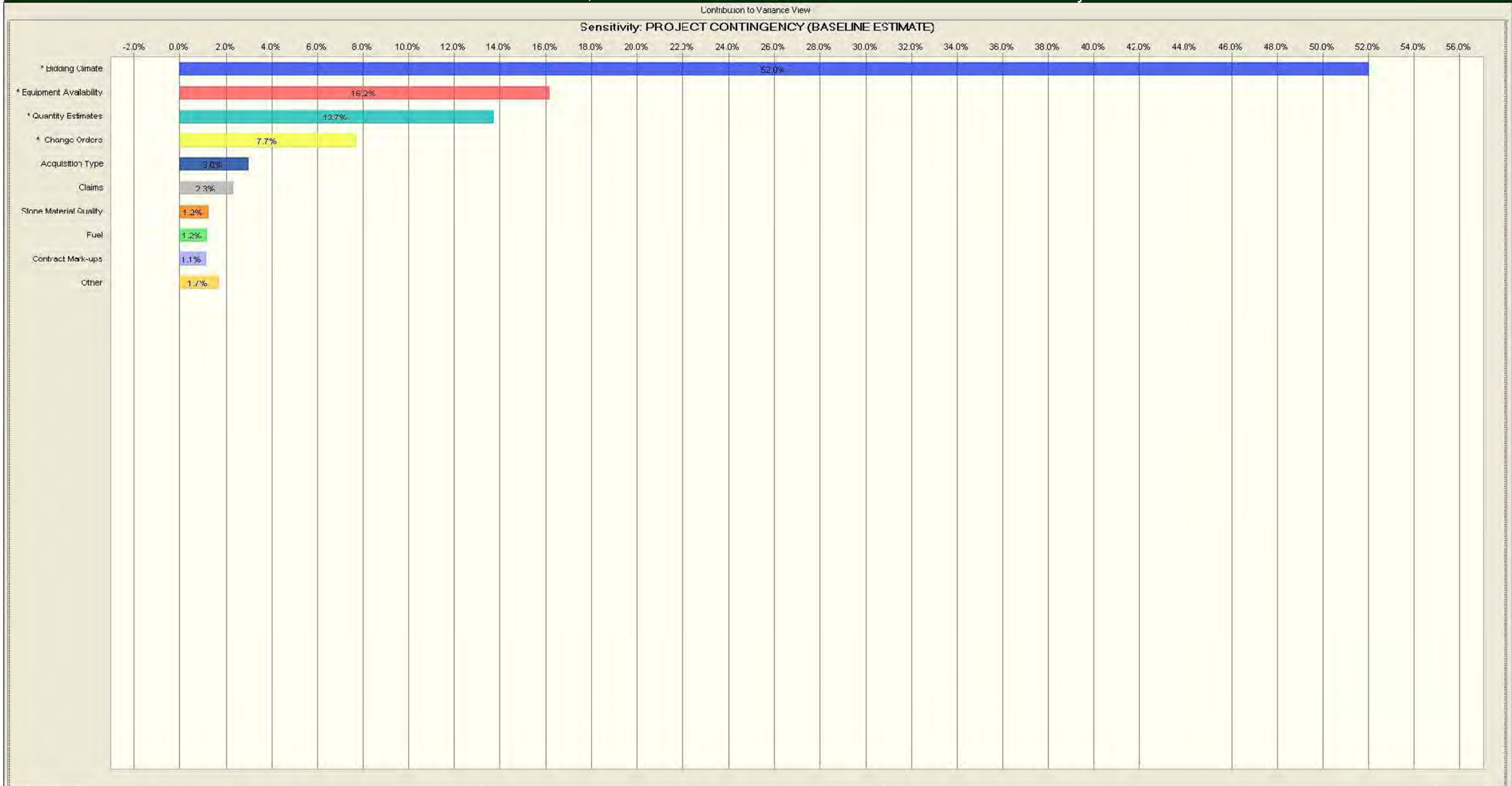
- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$27,660,467		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$27,647,936	($12,531)	-0.05%
5%	$27,791,939	$131,473	0.48%
10%	$27,828,279	$167,812	0.61%
15%	$27,853,744	$193,278	0.70%
20%	$27,875,476	$215,009	0.78%
25%	$27,894,277	$233,810	0.85%
30%	$27,911,088	$250,621	0.91%
35%	$27,927,264	$266,798	0.96%
40%	$27,943,384	$282,917	1.02%
45%	$27,959,240	$298,774	1.08%
50%	$27,975,776	$315,309	1.14%
55%	$27,991,134	$330,668	1.20%
60%	$28,007,509	$347,042	1.25%
65%	$28,024,119	$363,652	1.31%
70%	$28,042,695	$382,229	1.38%
75%	$28,060,586	$400,120	1.45%
80%	$28,080,434	$419,968	1.52%
85%	$28,101,090	$440,623	1.59%
90%	$28,126,466	$466,000	1.68%
95%	$28,161,541	$501,074	1.81%
100%	$28,296,966	$636,499	2.30%



JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model



* - Correlated assumption (sensitivity data may be misleading)

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

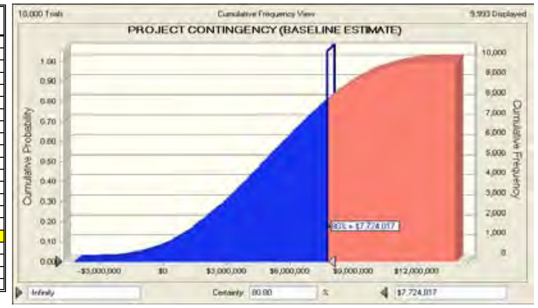
			Project Cost					Crystal Ball Simulation Expected Values ($$$)			Crystal Ball Simulation Expected Values (%s)		
Risk No.	Risk/Opportunity Event	Discussion and Concerns	Likelihood*	Impact*	Risk Level*	Variance Distribution	Correlation to Other(s)	Low	Most Likely	High	Low	Most Likely	High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)													
CD-1	Change Orders	Time and cost impacts vary greatly on individual issues. Changes near end of project don't impact schedule.	Very Likely	Significant	HIGH	Triangular	EN-C-2, EN-D-3, PD-E-3	$0	$0	$1,809,705	0.0%	0.0%	6.5%
CD-3/ LS-2	Staging Area	Potential for problems with location; issues w/ runway; lights needed for cranes @ certain ht; aircraft- impact ht. restriction; Impacts contractor's operation	Unlikely	Significant	MODERATE	Uniform		$0	$0	$293,583	0.0%	0.0%	1.1%
CD-4	Claims	Claims are likely to occur, but not cause a drastic delay in project schedule	Likely	Significant	HIGH	Uniform		$0	$0	$2,201,872	0.0%	0.0%	8.0%
CT-1	Acquisition Type	Impacts effort in award, some contract vehicles more conducive to lower cost; Prefer Best Value RFP w/ source selection plan; Increased cost/time to implement multiple awards	Unlikely	Significant	MODERATE	Uniform		$0	$0	$2,459,301	0.0%	0.0%	8.9%
EN-C-1	Production Estimates	Unit price per cubic yard	Likely	Marginal	MODERATE	Triangular		($356,860)	$0	$513,046	-1.3%	0.0%	1.9%
EN-C-2	Quantity Estimates	Quantity over/under runs	Likely	Significant	HIGH	Uniform	CD-1	($1,642,931)	$0	$2,464,397	-5.9%	0.0%	8.9%
EN-C-8	Contract Mark-ups		Likely	Marginal	MODERATE	Uniform		($621,072)	$0	$786,962	-2.2%	0.0%	2.8%
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)													
CT-4	Bidding Climate	Severe economic swings can increase / decrease number of potential bidders.	Likely	Marginal	MODERATE	Uniform	EN-C-3	($4,918,602)	$0	$3,688,951	-17.8%	0.0%	13.3%
EN-C-3	Equipment Availability	Dredge may have to come from further away, increasing mobilization costs or size / type of equipment available.	Likely	Significant	HIGH	Triangular	CT-4	$0	$0	$861,135	0.0%	0.0%	3.1%
EN-C-4	Weather	Severe weather causing damage to project during construction.	Likely	Marginal	MODERATE	Uniform		$0	$0	$1,136,875	0.0%	0.0%	4.1%
EN-C-6	Fuel	$x.xx per gallon was used in the Sep 08 MII, increases will effect equipment operating costs.	Very Likely	Significant	HIGH	Uniform		($409,067)	$0	$1,058,101	-1.5%	0.0%	3.8%
EN-G-1	Stone Material Quality	Salvage stone- if quality of intended reusable stone is bad then need to purchase additional stone- slip in sched and increase to cost; EN-D feels the estimated 14,600CY of recoverable stone is conservative estimate of what is	Unlikely	Significant	MODERATE	Uniform	EN-G-3	($782,791)	$0	$929,392	-2.8%	0.0%	3.4%
PD-E-1	Environmental Monitoring and Mitigation	Predicting final marsh elevations difficult, may require future funding for long term monitoring	Unlikely	Significant	MODERATE	Uniform		$0	$0	$1,000,000	0.0%	0.0%	3.6%
									$0				

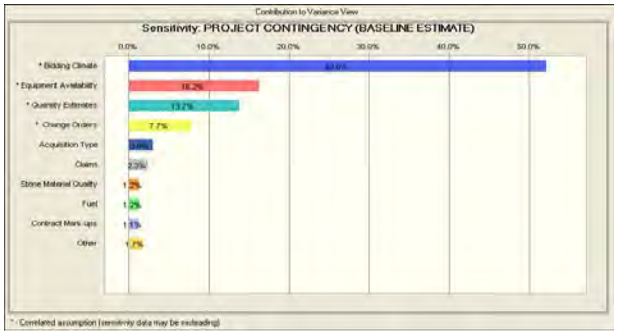
Not Part of Study - Placeholder for Project Summation Purposes Only

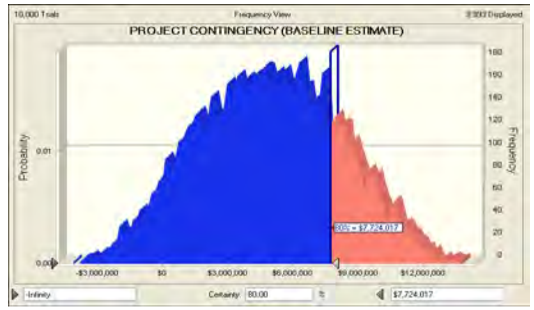
Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

Contingency Summary Table - Cost

PROJECT CONTINGENCY (BASELINE ESTIMATE)	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
	0%	$27,660,467	($4,991,799)	**$22,668,667**	**-18.05%**
	5%	$27,660,467	($472,055)	**$27,188,411**	**-1.71%**
	10%	$27,660,467	$495,692	**$28,156,158**	**1.79%**
	15%	$27,660,467	$1,207,682	**$28,868,149**	**4.37%**
	20%	$27,660,467	$1,797,203	**$29,457,670**	**6.50%**
	25%	$27,660,467	$2,376,403	**$30,036,870**	**8.59%**
	30%	$27,660,467	$2,932,909	**$30,593,376**	**10.60%**
	35%	$27,660,467	$3,414,055	**$31,074,521**	**12.34%**
	40%	$27,660,467	$3,882,850	**$31,543,316**	**14.04%**
	45%	$27,660,467	$4,352,534	**$32,013,001**	**15.74%**
	50%	$27,660,467	$4,801,148	**$32,461,615**	**17.36%**
	55%	$27,660,467	$5,249,377	**$32,909,844**	**18.98%**
	60%	$27,660,467	$5,721,222	**$33,381,688**	**20.68%**
	65%	$27,660,467	$6,192,641	**$33,853,108**	**22.39%**
	70%	$27,660,467	$6,646,522	**$34,306,988**	**24.03%**
	75%	$27,660,467	$7,176,644	**$34,837,110**	**25.95%**
	80%	$27,660,467	$7,724,017	**$35,384,484**	**27.92%**
	85%	$27,660,467	$8,326,410	**$35,986,877**	**30.10%**
	90%	$27,660,467	$9,063,378	**$36,723,845**	**32.77%**
	95%	$27,660,467	$10,109,174	**$37,769,640**	**36.55%**
	100%	$27,660,467	$14,469,369	**$42,129,836**	**52.31%**







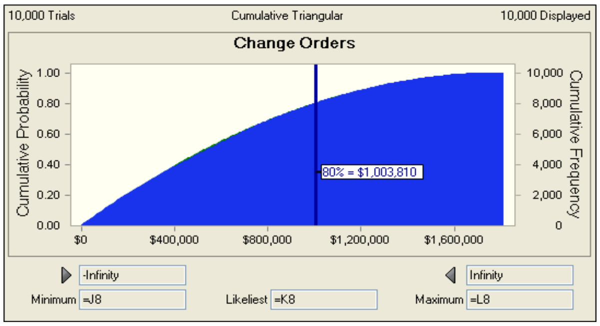
JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CD-1	Change Orders	$0	$0	$1,809,705

Notes: This item captures the risk of the change orders impacting construction costs.
Likely Most likely scenario assumes not changes to the baseline estimate.
Low Low assumes no change orders.
High High assumes up to 10% of the construction costs for contract modifications.

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

		**Used Contract Costs from MII
Construction Costs	$24,593,008	Construction Cost
Minus Dredging	$5,085,967	Construction Cost- Pipeline Dredging
Dredging Mob.	$1,409,992	Construction Cost- Mob, Demob and Prep Work
Construction less Dredging	**$18,097,049**	



Assumption: Change Orders

Percentile	Assumption values
0%	$98
10%	$93,050
20%	$189,680
30%	$299,662
40%	$419,445
50%	$544,106
60%	$675,458
70%	$824,554
80%	$1,003,810
90%	$1,241,109
100%	$1,795,973

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CD-3/ LS-2	Staging Area	$0	$0	$293,583

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

**Used Contract Costs from MII

Construction Cost- Bank Stabilize, Dikes & Jetties

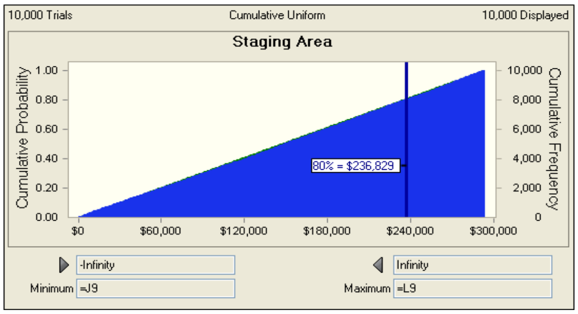
$14,679,144.38

Notes: This item captures the risk that there will be cost impact to the stone placement for the jetty work due to the unavailability of staging areas. The sponsor and the Corps is confident in the availability of the staging areas currently contemplated.

Likely Most likely assumes no change to the baseline estimate.

Low The baseline estimate was made on the most optimum conditions.

High High assumes that the availability of staging areas for cranes is less favorable, creating a total cost impact of up to 2% of the total of the jetty construction costs.



Assumption: Staging Area

Percentile	Assumption values
0%	$38
10%	$29,369
20%	$60,146
30%	$90,047
40%	$120,626
50%	$149,007
60%	$178,590
70%	$207,373
80%	$236,829
90%	$265,957
100%	$293,511

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CD-4	Claims	$0	$0	$2,201,872

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

**Used Contract Costs from MII

Construction Cost- Bank Stabilize, Dikes & Jetties

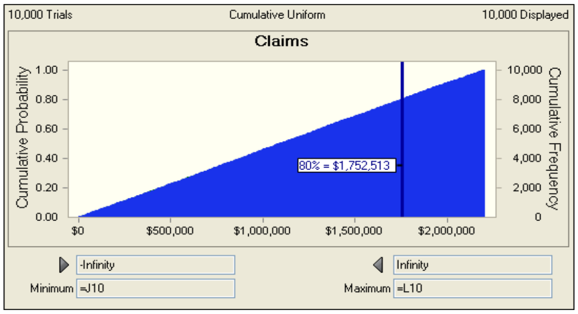
$14,679,144.38

Notes: This item captures the risk that there will be contractor claims due to issues with the existing site conditions (particularly in-water).

Likely Most likely assumes no change to the baseline estimate.

Low Low assumes no change to the baseline estimate as no claims are filed.

High High assumes that contractor claims create cost growth on the jetty construction by up to 15%.



Assumption: Claims

Percentile	Assumption values
0%	$252
10%	$221,828
20%	$443,809
30%	$661,525
40%	$878,396
50%	$1,089,936
60%	$1,311,122
70%	$1,534,138
80%	$1,752,513
90%	$1,969,110
100%	$2,201,841

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

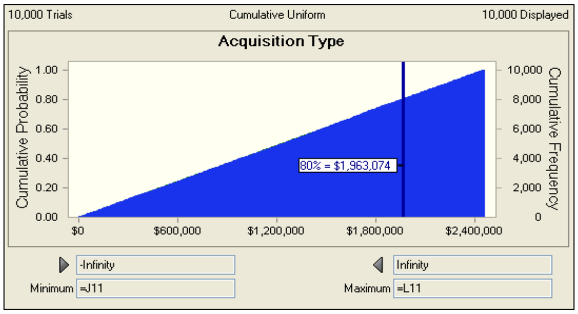
Risk Refer No.	Risk Event	Low	Most Likely	High
CT-1	Acquisition Type	$0	$0	$2,459,301

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

**Used Contract Costs from MII

Construction Cost
$24,593,007.98

Notes: This item captures the risk that the overall costs could increase due to the selected acquisition strategy.
Likely Most likely assumes no change to baseline estimate.
Low Low assumes no change from the baseline estimate.
High High assumes up to 10% increase due to acquisition strategy, particularly with the likelihood that best value tradeoff process will be used.



Assumption: Acquisition Type

Percentile	Assumption values
0%	$287
10%	$245,444
20%	$498,558
30%	$744,669
40%	$984,467
50%	$1,241,549
60%	$1,479,030
70%	$1,715,965
80%	$1,963,074
90%	$2,211,113
100%	$2,459,162

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-1	Production Estimates	($356,860)	$0	$513,046

Notes: This item captures the risk that dredging productivity could affect the dredging costs due to the actual characterization of materials or the effective work time due to navigation traffic disruptions.

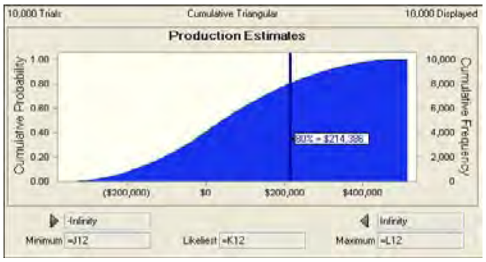
Likely Most likely assumes no changes to the baseline estimate.

Low Low assumes that the effective work time is up to 15% better than currently estimated.

High High assumes that the effective work time is up to 15% worse than currently estimated.

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011
**Changed EWT in CEDEP and transferred cost changes to MII to obtain values
**Used Contract Costs from MII

	Best	Worst	Likely	
16-inch LPP	88%	119%		
Excavation	$170,099	$229,390	$192,454	Construction Cost- Pipeline Dredging- Chicopit Bay Circ Channel Excavation & Disposal
16-inch	89%	116%		
Excavation	$2,725,578	$3,536,192	$3,060,082	Construction Cost- Pipeline Dredging- Little Jetty Training Wall Excavation & Disposal
Total	**$2,895,676**	**$3,765,582**	**$3,252,537**	
	88.38%	119.2%		
	89.07%	115.6%		



Assumption: Production Estimates

Percentile	Assumption values
0%	($353,988)
10%	($181,541)
20%	($107,571)
30%	($47,847)
40%	$1,519
50%	$43,561
60%	$95,153
70%	$150,242
80%	$214,386
90%	$297,979
100%	$500,287

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-2	Quantity Estimates	($1,642,931)	$0	$2,464,397

Notes: This item captures the risk that there will be a variation in quantity currently estimated (VEQ). This item captures the risk that there will be more quantity required due to dynamic changes over time of the confluence floor.

Likely Most likely assumes no change to the baseline estimate.

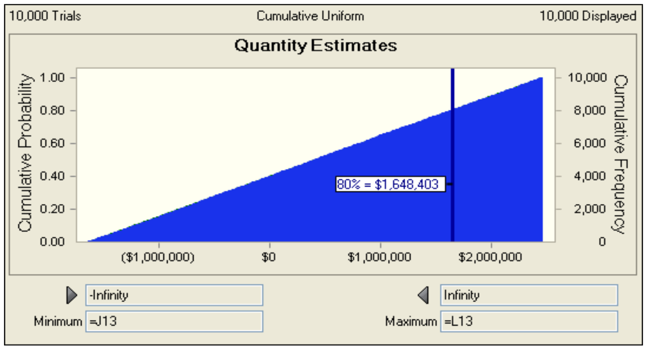
Low Low assumes that the the quantity of dredging and stone is up to 10% less than currently estimated.

High High assumes that the quantity of the dredging and stone is up to 15% more than currently estimated.

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

**Used Contract Costs from MII

	Best	Worst	Likely	
	90.00%	115.00%		
	90.00%	115.00%		
West Training Wall	$5,022,490	$6,417,626	$5,580,544	Construction Cost- Bank Stabilize, Dikes & Jetties- Western Training Wall Construction
East Training Wall	$6,836,607	$8,735,664	$7,596,230	Construction Cost- Bank Stabilize, Dikes & Jetties- Eastern Training Wall Realignment
Dredging 16-inch	$2,754,074	$3,519,095	$3,060,082	Construction Cost- Pipeline Dredging- Little Jetty Training Wall Excavation & Disposal
Dredging 16-inch LPP	$173,209	$221,323	$192,454	Construction Cost- Pipeline Dredging- Chicopit Bay Circ Channel Excavation & Disposal
Total	**$14,786,380**	**$18,893,707**	**$16,429,311**	
	90.00%	115.00%		
	90.00%	115.00%		



Assumption: Quantity Estimates

Percentile	Assumption values
0%	($1,642,291)
10%	($1,213,254)
20%	($810,730)
30%	($409,116)
40%	$10,188
50%	$406,692
60%	$814,274
70%	$1,225,612
80%	$1,648,403
90%	$2,063,398
100%	$2,464,077

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-8	Contract Mark-ups	($621,072)	$0	$786,962

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

**Used Contract Costs from MII

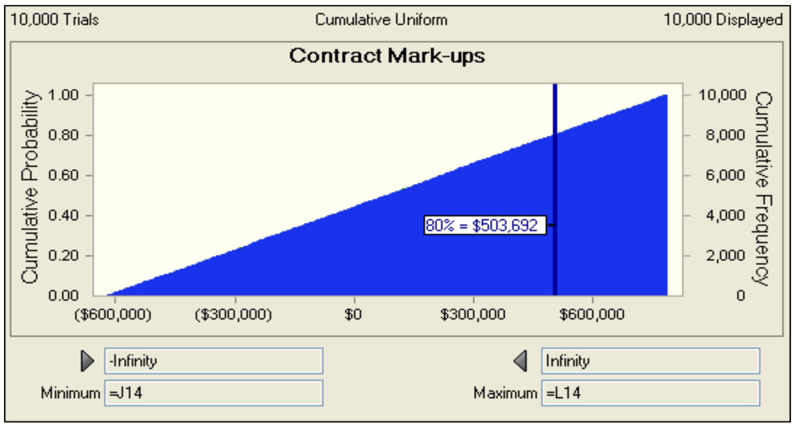
Construction Cost
$24,593,007.98

Notes: This item captures the risk that the contractor markups could significantly fluctuate, affecting total construction costs.

Likely Most likely is the contractor's markups cost from the baseline estimate.

Low Low assumes that FOOH could be as low as 4%, HOOH 5%, Profit 8%, and Bond 0.5%.

High High assumes that FOOH could be as high as 8%, HOOH 15%, Profit 12%, and Bond 2%.



Assumption: Contract Mark-ups

Percentile	Assumption values
0%	($620,872)
10%	($482,019)
20%	($337,993)
30%	($199,347)
40%	($56,670)
50%	$83,234
60%	$221,349
70%	$361,264
80%	$503,692
90%	$646,986
100%	$786,782

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CT-4	Bidding Climate	($4,918,602)	$0	$3,688,951

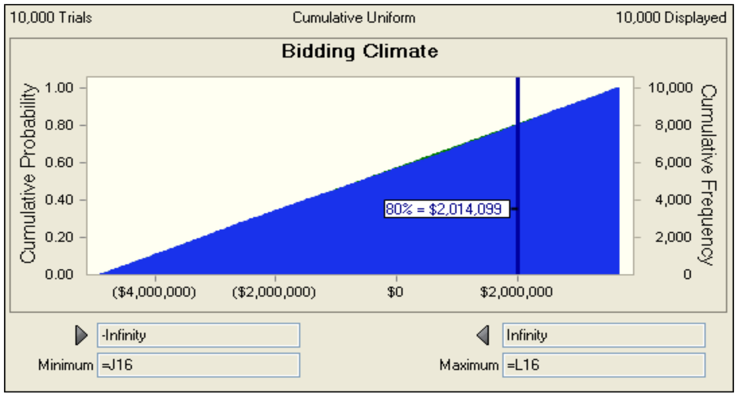
From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011
**Used Contract Costs from MII
Construction Cost
$24,593,007.98

Notes: This item captures the both the opportunity for considerable savings and the risk of considerably higher prices due to market conditions in the jetty and dredging construction industries.

Likely Most likely assumes no change from baseline estimate.

Low Low assumes that the use of an "industry day" could produce some savings (as it has on previous projects) by as much as 20%.

High High assumes that by the time the contract is let in 2013 (or later), market conditions could change (less favorable), increasing ultimate construction costs by up to 15%. Historical trends, per documentation received 6-28-10, is that high bids are coming in around 15% higher than the government estimates.



Assumption: Bidding Climate

Percentile	Assumption values
0%	($4,918,391)
10%	($4,054,611)
20%	($3,199,120)
30%	($2,380,493)
40%	($1,496,036)
50%	($581,819)
60%	$320,427
70%	$1,167,687
80%	$2,014,099
90%	$2,841,187
100%	$3,688,020

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-3	Equipment Availability	$0	$0	$861,135

Notes: This item captures the risk that the dredging costs could increased based on the limited availability of equipment in the dredging industry and regional market.

Likely Most likely assumes no change to the current estimate (using 16" pipeline).

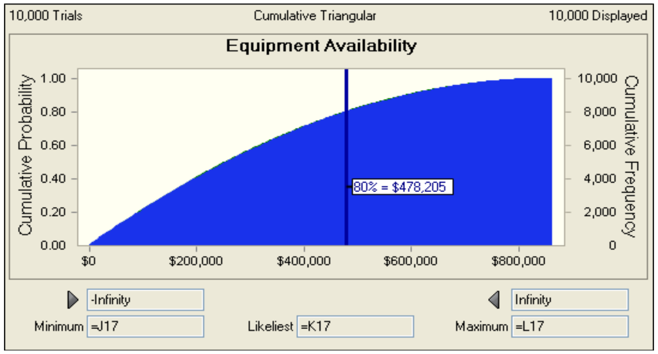
Low Low assumes no change from the most likely.

High High assumes that costs could increase up to as much as it would cost to mobilize and utilize a 24" pipeline.

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011

**Used Contract Costs from MII

	16-inch	24-inch		
16-inch LPP				
Excavation	$192,454	$200,964	1.04421769	Construction Cost- Pipeline Dredging- Chicopit Bay Circ Channel Excavation & Disposal
16-inch				
Excavation	$3,060,082	$3,186,532	1.04132231	Construction Cost- Pipeline Dredging- Little Jetty Training Wall Excavation & Disposal
Mob	$1,409,992	$2,136,167	1.51502111	Construction Cost- Mob, Demob and Prep Work
Total	**$4,662,528**	**$5,523,663**		



Assumption: Equipment Availability

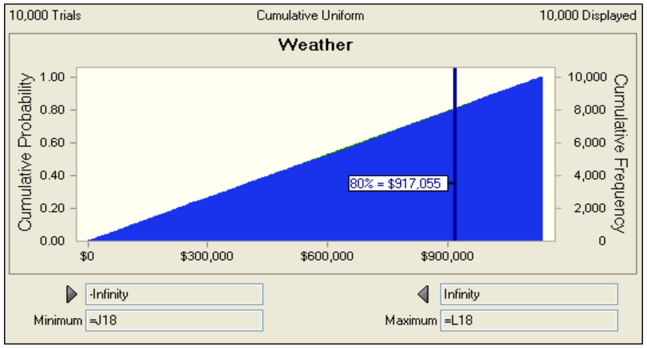
Percentile	Assumption values
0%	$63
10%	$44,669
20%	$93,098
30%	$143,031
40%	$197,544
50%	$257,128
60%	$322,175
70%	$393,342
80%	$478,205
90%	$595,296
100%	$856,654

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-4	Weather	$0	$0	$1,136,875

Notes: This item captures the risk of damage due to a severe storm.
Likely Most likely assumes no changes to the baseline estimate.
Low Low assumes no impact due to weather.
High High assumes that a severe weather event occurs, creating a 7 day period of standby and causing rework of a 100' section of jetty.

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011
**Used Contract Costs from MII



Jetty Storm Damage		**Duration**		
West Training Wall	$5,580,544	9/11/2013	232	Construction Cost- Bank Stabilize, Dikes & Jetties- Western Training Wall Construction
East Training Wall	$7,596,230	5/1/2014		Construction Cost- Bank Stabilize, Dikes & Jetties- Eastern Training Wall Realignment
Total	$13,176,774			
100' of damage	**$878,452**			

Standby Costs	
Total Construction	$13,176,774
Daily Burn	$56,796
One Week of Burn	$397,575
Total Standby	**$258,424**

Assumption: Weather

Percentile	Assumption values
0%	$423
10%	$113,346
20%	$225,207
30%	$343,245
40%	$455,358
50%	$574,435
60%	$692,411
70%	$798,936
80%	$917,055
90%	$1,022,755
100%	$1,136,796

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-6	Fuel	($409,067)	$0	$1,058,101

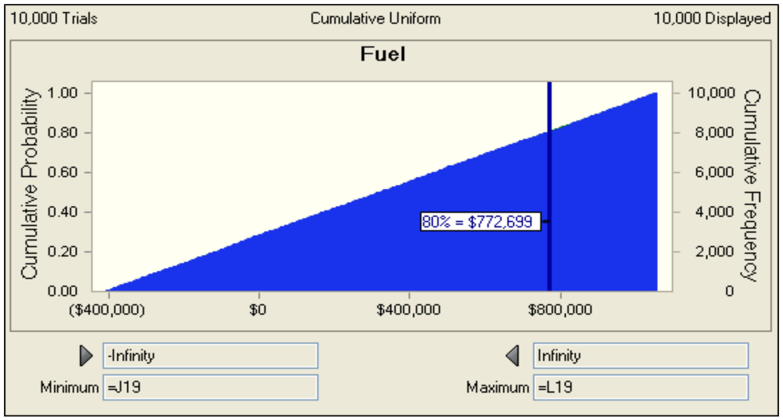
Notes:

This item captures the risk of fluctuations in fuel affecting the overall project cost.

Likely Most likely assumes no change to the baseline estimate.

Low Low assumes that the fuel price for off-road and marine diesel to be $2.30/gallon.

High High assumes that the fuel price for off-road and marine diesel to be $4.80/gallon.



Assumption: Fuel

Percentile	Assumption values
0%	($408,877)
10%	($265,629)
20%	($115,515)
30%	$23,773
40%	$171,858
50%	$320,549
60%	$469,718
70%	$613,805
80%	$772,699
90%	$912,368
100%	$1,057,950

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2
From CEDEP file: JHFMIPT 2011-1 6 INCH PORTABLE.xlsm dated 1/21/2011
From CEDEP file: JHFMIPT 2011-1 16 INCH CHICOPIT FC.xlsm dated 1/21/2011
From CEDEP file: JHFMIPT 2011-1 16 INCH PABLO CK FW.xlsm
**Used Equipment Costs from MII
**Used Equipment Operating Costs from CEDEP

Equipment Costs	Likely	Worst	Best	
MII	$1,808,094	$1,882,770	$1,744,677	Construction Cost
CEDEP Portable 6-Inch	$60,398	$91,466	$49,475	
CEDEP 16-Inch	$1,707,926	$2,660,283	$1,373,199	
Total	**$3,576,418**	**$4,634,519**	**$3,167,351**	

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

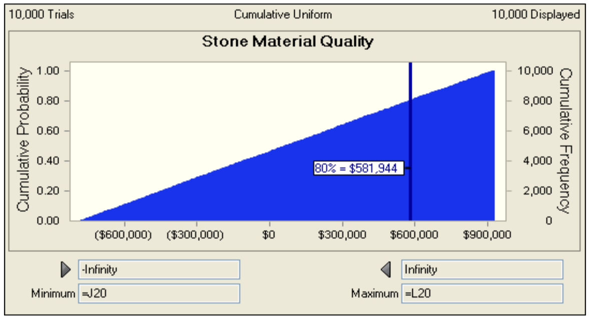
Risk Refer No.	Risk Event	Low	Most Likely	High
EN-G-1	Stone Material Quality	($782,791)	$0	$929,392

Notes: This item captures the risk that the material planned on being salvaged and reused will not be suitable for placement in the jetty construction.

Likely Most likely assumes no change to the baseline estimate.

Low Low assumes that there is more recovered reusable stone than estimated, decreasing the amount of purchase stone by 15% and resulting in an overall cost savings of 2.83% (based on input from geotechnical design and analysis by EN-C).

High High assumes that there is approx 15% less recovered reusbale stone than estimated, increasing the amount of purchase stone and resulting in an increase in the project cost by up to 3.36% (based on input from geotechnical design and analysis by EN-C).



Assumption: Stone Material Quality

Percentile	Assumption values
0%	($782,673)
10%	($611,251)
20%	($445,472)
30%	($279,037)
40%	($109,732)
50%	$63,878
60%	$239,901
70%	$403,546
80%	$581,944
90%	$755,323
100%	$929,347

From MII File: JHFMILEPT2011-3-Final NED Plan FY11 no contingency.mlp dated 3/1/2011
**Used Contract Costs from MII

Per phone conversation with Steve Conger 2/22/2011 it is expected to recover approximately 14,600 CY of reusable armor stone, which is a conservative estimate. There may be more recovered reusable stone which would decrease the amunt needed to be purchased.

Stone Material Quality:

High would be less reusable stone than what is considered in estimate, increasing the amount of stone to be purchased. VEQ clause limits to 15% variation in expected quantity.

Estimated Amt of Reusable Stone	% Not Suitable (as decimal)	CY Not Suitable	$/CY	Potential Cost Increase	% of Construction Costs
14,600	0.15	2190	$383	$837,806	3.36%

Low would be more reusable stone than what is considered in estimate, decreasing the amount of stone to be purchased. VEQ clause limits to 15% variation in estimated quantit

Estimated Amt of Purchased Stone	15% Variaition	CY Decrease	$/CY	Potential Cost Savings	% of Construction Costs
12,300	0.15	1,845	$383	$705,823	2.83%

If there is 15% less reusable stone (2190 CY less), the contractor would need to purchase the difference (2190 CY) which is more than a 15% increase (17.8%) to the estimated amount of stone to purchase. This quantity overrun would not be subject to the VEQ clause and the price of the additional stone over 15% would need to be negotiated.

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost Risk Analysis Model

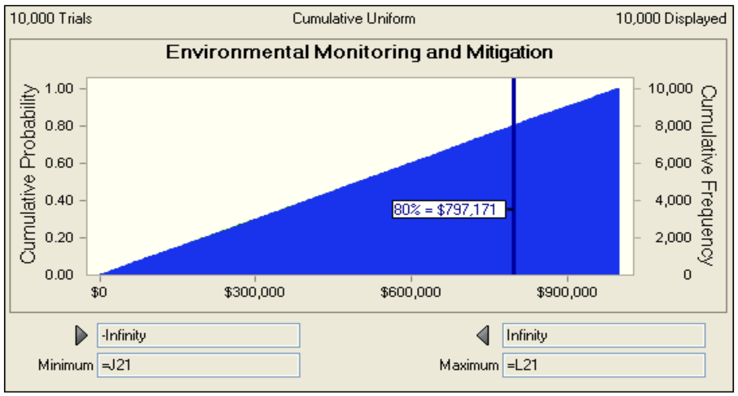
Risk Refer No.	Risk Event	Low	Most Likely	High
PD-E-1	Environmental Monitoring and Mitigation	$0	$0	$1,000,000

Notes: This item captures the risk that there will be more moniotring and mitigation required due to changing conditions in the marsh elevations.

Likely Most likely assumes no change to the baseline estimate.

Low Low assumes no change to the baseline estimate.

High High assumes that monitoring and mitigation efforts could cost up to $1 Million more.



Assumption: Environmental Monitoring and Mitigation

Percentile	Assumption values
0%	$63
10%	$99,408
20%	$202,629
30%	$302,679
40%	$401,879
50%	$499,994
60%	$599,099
70%	$697,531
80%	$797,171
90%	$897,819
100%	$999,733

Crystal Ball Report - Full
Simulation started on 3/26/2011 at 4:28 PM
Simulation stopped on 3/26/2011 at 4:28 PM

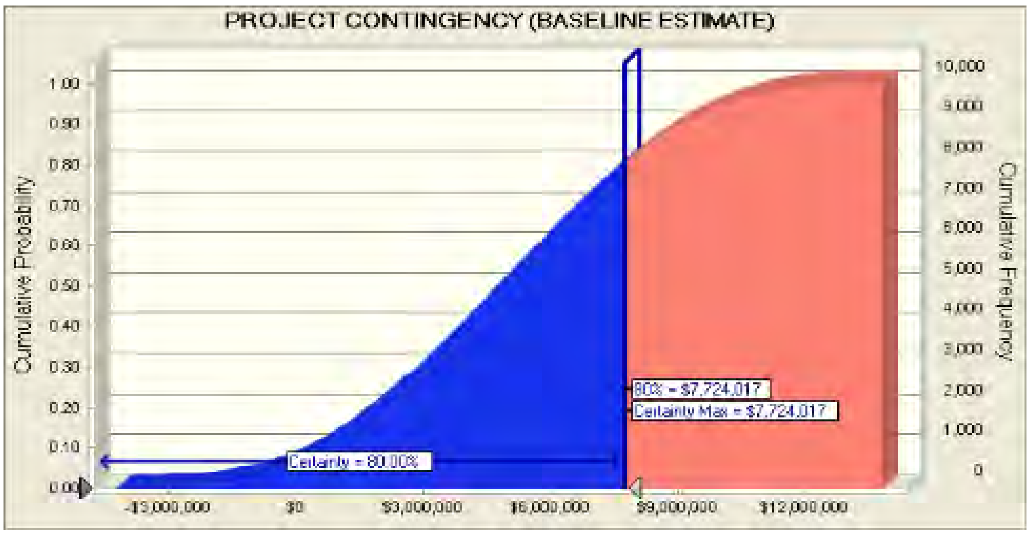
Run preferences:	
Number of trials run	10,000
Monte Carlo	
Seed	999
Precision control on	
Confidence level	95.00%
Run statistics:	
Total running time (sec)	11.30
Trials/second (average)	885
Random numbers per sec	11,505
Crystal Ball data:	
Assumptions	13
Correlations	2
Correlated groups	2
Decision variables	0
Forecasts	1

Forecasts

Worksheet: [Risk Analysis (Cost)-Milepoint_3-26-11 - GRM Review.xlsx]Cost Risk Model

Forecast: PROJECT CONTINGENCY (BASELINE ESTIMATE) **Cell: K23**

Summary:
- Certainty level is 80.00%
- Certainty range is from -Infinity to $7,724,017
- Entire range is from -$4,991,799 to $14,469,369
- Base case is $0
- After 10,000 trials, the std. error of the mean is $32,453



Statistics:	Forecast values
Trials	10,000
Base Case	$0
Mean	$4,792,883
Median	$4,801,313
Mode	---
Standard Deviation	$3,245,338
Variance	$10,532,220,166,484
Skewness	0.0152
Kurtosis	2.44
Coeff. of Variability	0.6771
Minimum	-$4,991,799
Maximum	$14,469,369
Range Width	$19,461,168
Mean Std. Error	$32,453

Forecast: PROJECT CONTINGENCY (BASELINE ESTIMATE) (cont'd) **Cell: K23**

Percentiles:	Forecast values
0%	-$4,991,799
10%	$495,692
20%	$1,797,203
30%	$2,932,909
40%	$3,882,850
50%	$4,801,148
60%	$5,721,222
70%	$6,646,522
80%	$7,724,017
90%	$9,063,378
100%	$14,469,369

End of Forecasts

Assumptions

Worksheet: [Risk Analysis (Cost)-Milepoint_3-26-11 - GRM Review.xlsx]Cost Risk Model

Assumption: Change Orders **Cell: K8**

Triangular distribution with parameters:

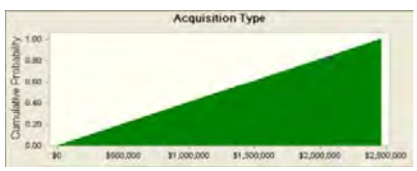
Minimum	$0	(=J8)
Likeliest	$0	(=K8)
Maximum	$1,809,705	(=L8)

Correlated with:	Coefficient
Quantity Estimates (K13)	0.50

Assumption: Acquisition Type **Cell: K11**

Uniform distribution with parameters:

Minimum	$0	(=J11)
Maximum	$2,459,301	(=L11)



Assumption: Bidding Climate **Cell: K16**

Uniform distribution with parameters:

Minimum	($4,918,602)	(=J16)
Maximum	$3,688,951	(=L16)

Correlated with:	Coefficient
Equipment Availability (K17)	0.50

Assumption: Claims **Cell: K10**

Uniform distribution with parameters:

Minimum	$0	(=J10)
Maximum	$2,201,872	(=L10)

Assumption: Contract Mark-ups **Cell: K14**

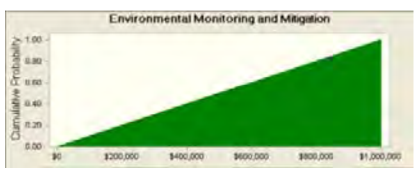
Uniform distribution with parameters:

Minimum	($621,072)	(=J14)
Maximum	$786,962	(=L14)

Assumption: Environmental Monitoring and Mitigation **Cell: K21**

Uniform distribution with parameters:

Minimum	$0	(=J21)
Maximum	$1,000,000	(=L21)



Assumption: Equipment Availability **Cell: K17**

Triangular distribution with parameters:

Minimum	$0	(=J17)
Likeliest	$0	(=K17)
Maximum	$861,135	(=L17)

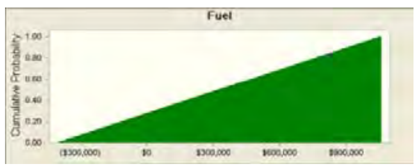
Assumption: Equipment Availability (cont'd) **Cell: K17**

Correlated with:	Coefficient
Bidding Climate (K16)	0.50

Assumption: Fuel **Cell: K19**

Uniform distribution with parameters:

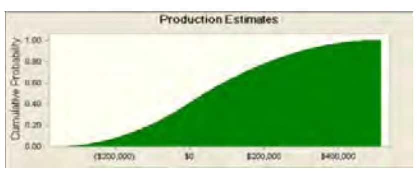
Minimum	($409,067)	(=J19)
Maximum	$1,058,101	(=L19)



Assumption: Production Estimates **Cell: K12**

Triangular distribution with parameters:

Minimum	($356,860)	(=J12)
Likeliest	$0	(=K12)
Maximum	$513,046	(=L12)

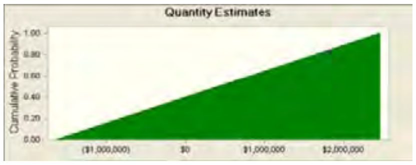


Assumption: Quantity Estimates **Cell: K13**

Uniform distribution with parameters:

Minimum	($1,642,931)	(=J13)
Maximum	$2,464,397	(=L13)

Assumption: Quantity Estimates (cont'd) **Cell: K13**

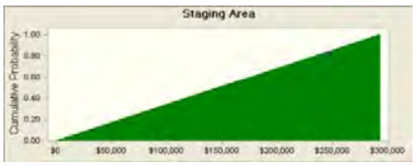


Correlated with:	Coefficient
Change Orders (K8)	0.50

Assumption: Staging Area **Cell: K9**

Uniform distribution with parameters:

Minimum	$0	(=J9)
Maximum	$293,583	(=L9)



Assumption: Stone Material Quality **Cell: K20**

Uniform distribution with parameters:

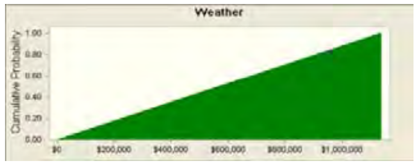
Minimum	($782,791)	(=J20)
Maximum	$929,392	(=L20)

Assumption: Weather **Cell: K18**

Uniform distribution with parameters:

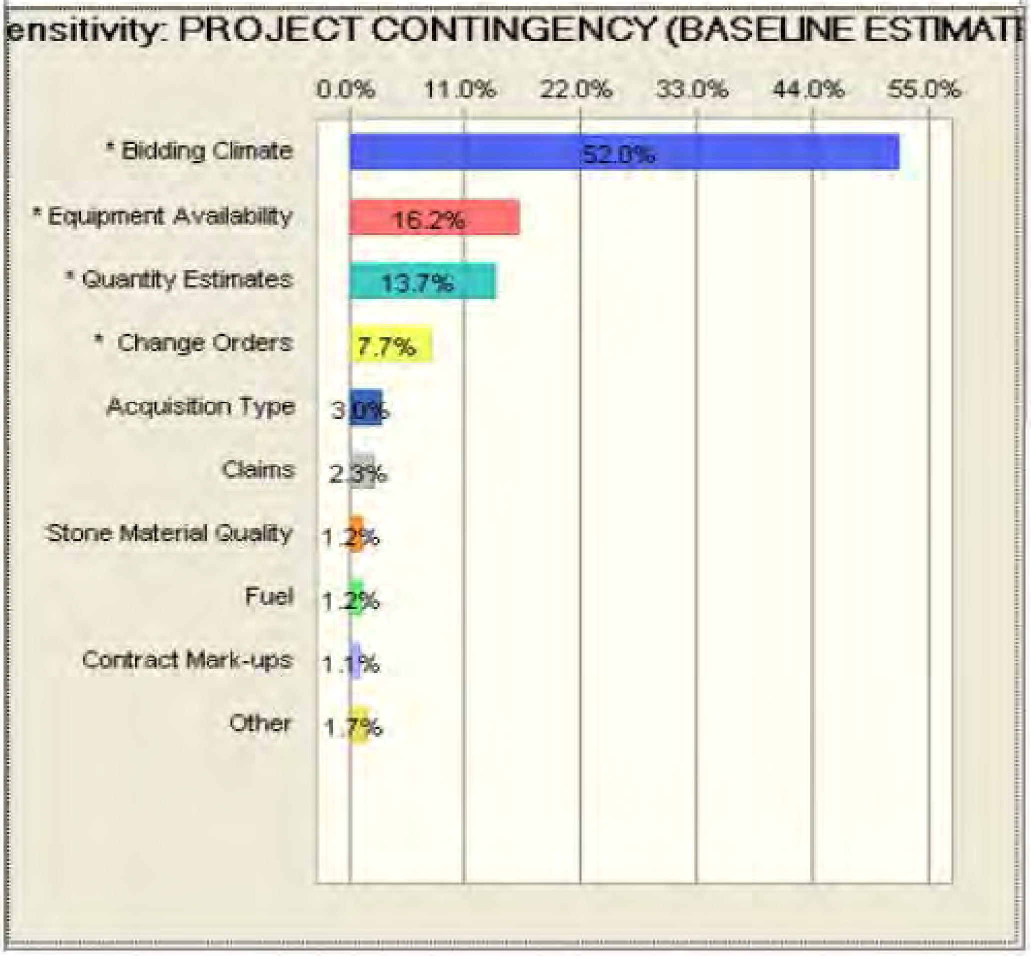
Minimum	$0	(=J18)
Maximum	$1,136,875	(=L18)

Assumption: Weather (cont'd) **Cell: K18**



End of Assumptions

Sensitivity Charts



JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - PDT Risk Register

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

Risk No.	Risk/Opportunity Event	Discussion and Concerns	Project Cost				Project Schedule				Correlation to Other(s)	Responsibility/POC	Affected Project Component	Project Implications	
			Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)					
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
CD-1	Change Orders	Time and cost impacts vary greatly on individual issues. Changes near end of project don't impact schedule.	Very Likely	Significant	HIGH	5 - 10%	Very Likely	Significant	HIGH	3 mo.	EN-W-1	Construction Division	Construction Cost & Schedule	Cost & Schedule	
CD-2	Safety Issues	Don't usually shut project down	Likely	Negligible	LOW	Minimal	Likely	Negligible	LOW	< 10 days		Construction Division	Construction Cost & Schedule	Cost & Schedule	*Updated Schedule Impact to reflect ROI*
CD-3/ LS-2	Staging Area	Potential for problems with location; issues w/ runway; lights needed for cranes @ certain ht; aircraft- impact ht. restriction; Impacts contractor's operation	Unlikely	Siginificant	MODERATE	1 - 2%	Very Likely	Marginal	MODERATE	1 mo.		Construction Division	Project Cost & Schedule	Cost & Schedule	
CD-4	Claims	Claims are likely to occur, but not cause a drastic delay in project schedule	Likely	Significant	HIGH	5 - 15%	Very Likely	Negligible	LOW	0 mo.	DP-3	Construction Division	Project Cost & Schedule	Cost & Schedule	
CT-1	Acquisition Type	Impacts effort in award, some contract vehicles more conducive to lower cost; Prefer Best Value RFP w/ source selection plan; Increased cost/time to implement multiple awards	Unlikely	Significant	MODERATE	10%	Unlikely	Significant	MODERATE	2 mo.		Acquisition Strategy Board	Construction Cost & Schedule	Cost & Schedule	*Combined CT-6 Acquisition Strategy cost info as it was determined to be duplicated*
CT-3	Acquisition Delays	Delays in getting the contract solicited could impact the current schedule (1 month delay due to overwhelming response or other administrative procedures).	N/A	N/A	N/A	N/A	Unlikely	Significant	MODERATE	1 mo.		Acquisition Strategy Board	Construction Cost & Schedule	Cost & Schedule	*Updated to reflect only schedule impact, no cost impact; Updated Likelihood, Impact and ROI based on input provided by Beau Corbett CT on 1/31/2011*
CT-5	Acquisition Plan	Could split into multiple contracts if small business can do dredging	Very Unlikely	Significant	LOW	< 1%	N/A	N/A	N/A	N/A		Acquisition Strategy Board	Construction Cost	Cost	
CT-6/ EN-D-4	Proprietory Materials Procurement	This item is added in support of the possible sole source of the concrete structures, since there were no responses to the sources sought solicitation. If it is determined that a Sole-Source Justification and Approval (J&A) is required, the schedule may need to be increased to accomodate this effort. It could take 2-6 months to get sole sources approved through HQ.	N/A	N/A	N/A	N/A	Likely	Critical	HIGH	6 mo.		Contracting Division	Construction Cost	Cost & Schedule	*Added this risk item and assigned Likelihood, Impact and ROI based on input provided by Beau Corbett CT on 1/31/2011 and Steve Conger EN-D 2/4/2011. Removed from risk register 3/2/11 due to responses from sources sought solicitation*
CT-7/ DP-1	Project Component Sequencing	Subsequent proj. execution, if separate contracts for each phase/mult. contract (dredge/placement)	Unlikely	Marginal	LOW	$200,000	N/A	N/A	N/A	N/A		PM/Planner/Contracting	Project Schedule	Schedule	
DP-2	Funding Stream	In short term, delays based on $ amt. of contract are likely; delay in execution of proj. components	N/A	N/A	N/A	N/A	Likely	Marginal	MODERATE	Captured by DP-3	DP-3	PM	Project Schedule	Schedule	*Removed from Study -Captured by DP-3*
DP-3	Schedule Delays	Hard to fund if not in 2013 budget- automatic sched. delay; In short term, delays based on $ amt. of contract are likely; delay in execution of proj. components	Very Unlikely	Marginal	LOW	< 1%	Likely	Marginal	MODERATE	4 mo.	CT-2, EN-C-3, CD-4, EN-C-4, EN-G-1, EN-G-2, PD-E-2, PD-E-3, PD-E-4, DP-2		Project Cost & Schedule	Cost & Schedule	*Updated Notes 2/9/2011 per input from Steve Ross DP-C*
DP-4/ EN-D-2	Scope Definition/Changes	Scope is well defined; little likelihood of scope increase or changes from current docs used for estimate development; Engineering pt. of view- if the project lingers, conditions may change	Very Unlikey	Critical	LOW	$3,000,000	Unlikely	Significant	MODERATE	3 mo.	EN-C-2, EN-D-3	PM/Planner	Construction Cost & Schedule	Cost & Schedule	*Updated ROI 2/9/2011 per input from Steve Ross DP-C and Steve Conger EN-DW*
EN-C-1	Production Estimates	Unit price per cubic yard	Likely	Marginal	MODERATE	$4 M	N/A	N/A	N/A	N/A		Cost Engineering	Equipment/Production Rates	Cost	
EN-C-2	Quantity Estimates	Quantity over/under runs	Likely	Significant	HIGH	15%	N/A	N/A	N/A	N/A	EN-D-1, DP-4/ EN-D-2	Cost Engineering/Design Branch	Construction Cost	Cost	
EN-C-5	Awardable Range Increase	An additional 15% above the approximate 10% profit	Likely	Significant	HIGH	Captured by CT-4	N/A	N/A	N/A	N/A		Cost Engineering	Funding	Cost	*Risk Item covered by CT-4 Bidding Climate*
EN-C-8	Contract Mark-ups		Likely	Marginal	MODERATE	$1.7 M	N/A	N/A	N/A	N/A					
EN-D-1	Design Costs	Haven't fully calculated full PED; compared to 8%, unlikely to exceed 4 million in PED costs	Unlikely	Marginal	LOW	<10%	Unlikely	Marginal	LOW	minimal to none	EN-D-3, EN-C-2	Cost Engineering/Design Branch	Construction Cost & Schedule	Cost & Schedule	
EN-D-3	Quantity Changes	Depends on time lapse- future condition vs. current; area is dynamic & can change	Likely	Significant	HIGH	Captured by EN-C-2	N/A	N/A	N/A	N/A	EN-D-1, DP-4/ EN-D-2	Design Branch	Construction Cost	Cost	*Risk item covered by EN-C-2 Quantity Estimates*

EN-G-3	Investigation & Inspection Costs	I looked back at the JAX Harbor drilling completed in 2010. We had IGE est of ~$300,000 for the mobilization alone for the drilling jack up. We were fortunate to get a lower cost rig, but under duress of construction, we may have to take what we can find. Therefore, $300,000 isn't unreasonable. Cost per day for equipment is ~$9000 times 10 days max=$90,000, and $5,000 per day for crew times 10 days = $50,000. These are the big ticket items. Worst case would put total project costs for additional 10 holes would be less than $700,000 instead of the $1.3M shown. The risk of this happening is low.	Unlikely	Marginal	LOW	$700,000	Unlikely	Significant	MODERATE	6 mo.		Geotechnical Branch	Project Cost & Schedule	Cost & Schedule	*Updated Likelihood, Impact and ROI based on new feedback from Steve Myers EN-GG in email dated 3/1/2011*
EN-W-1	Modeling Accuracy	Pretty heavily refined model- 3D model; high level of confidence	N/A	N/A	N/A	N/A	Very Unlikely	Critical	LOW	1 mo.	CD-1; EN-W-2	H&H Branch	Construction Schedule	Schedule	*Changed Schedule Impact to reflect ROI and feedback from Brian Cornwell EN-W*
EN-W-2	Erosion Estimates	Erosion of adjacent shorelines and resultant shoaling; risk is that model is not accurate and proj. does not reduce erosion on Mile Pt. area	N/A	N/A	N/A	N/A	Very Unlikely	Significant	LOW	1 mo.	EN-W-1	H&H Branch	Construction Schedule	Schedule	
LS-1	Site Access	Has loading facility to load stone on barges- not a prob. since we own to gate on Blount Island; have rail into Tallyrand to load there as well	Unlikely	Marginal	LOW	$0	Unlikely	Marginal	LOW	0 mo.		Sponsor	Project Cost & Schedule	Cost & Schedule	
LS-3	Highway Restrictions	Will probably truck in small aggregate; not expected to tear up road; stone by rail to terminal, then use barges	Very Unlikely	Significant	LOW	$0	Unlikely	Marginal	LOW	0 mo.		Sponsor	Project Cost & Schedule	Cost & Schedule	*Downgraded Schedule Likelihood due to research*
LS-4	Cost Sharing	Prepared for it; risk may be a factor when it is time to sign agreement	N/A	N/A	N/A	N/A	Very Likely	Negligible	LOW	1 mo.		Sponsor	Project Schedule	Schedule	
LS-5	Public Support and Involvement	Currently a high level of support for project; only foresee small amt. of people having problem; people writing to Congress regularly	N/A	N/A	N/A	N/A	Likely	Negligible	LOW	1 mo.	DP-5/ PD-N-2	Sponsor	Project Schedule	Schedule	
OC-1	Project Partnership Agreement	Delay in project implementation	N/A	N/A	N/A	N/A	Very Unlikely	Critical	LOW	0.5-2 mo.		Counsel	Project Schedule	Schedule	
OD-1	Project Maintenance Requirements	50 yr. standpoint- not much maint. for training wall; dredging- area will naturally remain scoured	Very Unlikely	Marginal	LOW	1.0%	Very Unlikely	Marginal	LOW	1.0%		Operations Division	Project Cost & Schedule	Cost & Schedule	*Updated Cost and Schedule ROI 2/1/2011 per email input from John Bearce OD-N*
OD-2	Monitoring Surveys	Don't plan on monitoring anymore than what we already require	Unlikely	Marginal	LOW	1.0%	Likely	Negligible	LOW	1.5%		Operations Division	Project Cost & Schedule	Cost & Schedule	*Updated Cost and Schedule ROI 2/1/2011 per email input from John Bearce OD-N*
OD-3	O&M Funding	Already have funding for surveys, so unlikely to cause delays or additional costs to proj.	Unlikely	Negligible	LOW	1.0%	Unlikely	Negligible	LOW	1.0%		Operations Division	Project Cost & Schedule	Cost & Schedule	*Updated Cost and Schedule ROI 2/1/2011 per email input from John Bearce OD-N*
PD-N-1	Economic Changes to Benefits	Feasibilty level of study w/ high level of design; port level and administrative level; Any impacts to benefit analysis (ie, change in fleet, commodity growth rates) would affect study costs, not project construction costs. he Hanjin construction completion seems to be a moving target, and already changed from 2015 (what is says in the Milepoint draft report) to 2017 (what it will say in the Jax Harbor GRR2 report) and who knows what in the future (the original Hanjin completion was suppose to be by end of 2011). That's not to say that the traffic cannot be made up by another entity (such as MOL) -- but that would not likely occur until the MOL/TraPac terminal reaches capacity (it is less than a quarter of capacity right now).	Likely	Significant	HIGH	$0	N/A	N/A	N/A	0 mo.		Planning Economics	Project Cost	Cost	*Updated Cost Likelihood rating based on 2/22/2011 email input from Dan Abecassis*
PD-N-3	Project Approval	Already capturing cost growth. Project expected to gain approval so unlikely that it will not get approved, however if delays to project approval then significant impacts.	N/A	N/A	N/A	N/A	Unlikely	Marginal	LOW	3 mo.		Planning Economics	Project Schedule	Schedule	*Updated Schedule Impact rating 2/2/2011 per email input from Sam Borer PD-PN*
RE-1	Land Acquisition Delays	All lands belong to government entities	Very Unlikely	Negligible	LOW	< 1%	Very Unlikely	Negligible	LOW	0 mo.		Real Estate	Project Cost & Schedule	Cost & Schedule	

External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)

CT-2	Protests	Delay in project execution; Sole source- can't get approved or if there is a protest it can kill contract- high risk	N/A	N/A	N/A	N/A	Likely	Significant	HIGH	6 mo.	DP-3	Contracting Division	Project Schedule	Schedule	
CT-4	Bidding Climate	Severe economic swings can increase / decrease number of potential bidders.	Likely	Marginal	MODERATE	-20% to +15%	Likely	Marginal	MODERATE	1 mo.	EN-C-7, EN-C-3				*Updated Impact and ROI based on input provided by Beau Corbett CT on 1/31/2011*
DP-5/ PD-N-2	Project Review and Authorization Delays	Likely b/c of public comment; review policy to adhere to; not a huge sched. impact; Delay in execution of project components. Uncertainties with IEPR may impact schedule.	N/A	N/A	N/A	N/A	Unlikely	Marginal	LOW	1 mo.	LS-5	PM/Planning	Project Schedule	Schedule	*Updated Schedule Impact rating 2/2/2011 per email input from Sam Borer PD-PN*
EN-C-3	Equipment Availability	Dredge may have to come from further away, increasing mobilization costs or size / type of equipment available.	Likely	Significant	HIGH	$4.8 M	Likely	Marginal	MODERATE	1 mo.	DP-3, CT-4	Cost Engineering	Equipment	Cost & Schedule	*Updated Schedule Likelihood and ROI*
EN-C-4	Weather	Severe weather causing damage to project during construction.	Likely	Marginal	MODERATE	$1.8 M	Likely	Negligible	LOW	1 mo.	DP-3	Cost Engineering	Labor/Production Rates	Cost & Schedule	*Updated Schedule Impact since weather days already accounted for*
EN-C-6	Fuel	$x.xx per gallon was used in the Sep 08 MII, increases will effect equipment operating costs.	Very Likely	Significant	HIGH	$446,000	N/A	N/A	N/A	N/A		Cost Engineering	Equipment	Cost	
EN-C-7	Labor	Labor Prices are fixed by Davis Bacon wage rates. Labor availability is subject to bidding climate.	Unlikely	Marginal	LOW	< 1%	N/A	N/A	N/A	N/A	CT-4	Cost Engineering	Labor/Production Rates	Cost	
EN-G-1	Stone Material Quality	Salvage stone- if quality of intended reusable stone is bad then need to purchase additional stone- slip in sched and increase to cost; EN-D feels the estimated 14,600CY of recoverable stone is conservative estimate of what is out there; don't know gradation of stone;	Unlikely	Significant	MODERATE	3.33%	Very Unlikely	Negligible	LOW	1 mo.	DP-3	Geotechnical	Project Cost & Schedule	Cost & Schedule	*Updated ROI 2/3/2011 per email input from Steven Myers EN-GG; $850,000 from EN-GG changed to 3.33% (~$830,000) based on assumption that potentially as much as 20% of estimated quantity of reusable stone is not suitable- would increase current construction cost by about 3.33%*
EN-G-2	Stone Material Availability	Have lots of nearby sources readily available	Very Unlikely	Significant	LOW	5%	Unlikely	Marginal	LOW	1 mo.	DP-3	Geotechnical	Construction Cost & Schedule	Cost & Schedule	*Updated ROI 2/3/2011 per email input from Steven Myers EN-GG; $850,000 from EN-GG changed to 5% of Construction Cost since item listed as significant impact and quick analysis showed increase in shipping costs from $60 to $100/ton yields about 5% increase*
OC-2	Court Injunctions	If we should receive a court injunction, all work on the project will come to a complete halt, an external factor that we cannot control	N/A	N/A	N/A	N/A	Very Unlikely	Critical	LOW	Years		Counsel	Project Schedule	Schedule	
PD-E-1	Environmental Monitoring and Mitigation	Predicting final marsh elevations difficult, may require future funding for long term monitoring	Unlikely	Significant	MODERATE	$1,000,000	Unlikely	Critical	MODERATE	12 mo.		Planning Environmental	Project Cost & Schedule	Cost & Schedule	
PD-E-2	Endangered Species Impact	Manatee takes, although unlikely, could create a slip in schedule during construction	Unlikely	Negligible	LOW	$240,000	Unlikely	Negligible	LOW	3 days	DP-3	Planning Environmental	Project Cost & Schedule	Cost & Schedule	*Updated Cost Impact rating to reflect $240,000 magnitude and Schedule Likelihood and Impact based on 2/10/2011 email input from Grady Caulk PD-EP*
PD-E-3	Environmental Restrictions	A potentially significant submerged prehistoric site has been identified in the proposed Great Marsh Island restoration area. The prefered alternative (restore marsh in Great Marsh Island) will have a "no adverse effect". Resulting in no mitigation cost. Other alternatives, which are very unlikely to be used, may result in an adverse effect determination requiring mitigation. If needed additional evaluation and mitigation activities may take at least 36 months.	Very Unlikely	Critical	LOW	$5,000,000+	Very Unlikely	Critical	LOW	36 mo.	DP-3	Planning Environmental	Project Schedule	Schedule	*Updated Cost and Schedule Likelihood & Impact rating to reflect feedback in 2/10/2011 email input from Grady Caulk PD-EP*
PD-E-4	Permit Delays	Anticipate time to get permit and meet that- not significant	Likely	Negligible	LOW	$20,000	Unlikely	Critical	MODERATE	12 mo.	DP-3	Planning Environmental	Project Schedule	Schedule	*Updated Schedule Impact Rating based on 2/10/2011 email input from Grady Caulk PD-EP*
RE-2	Property Values	Administrative costs only	Very Unlikely	Negligible	LOW	< 1%	Very Unlikely	Negligible	LOW	0 mo.		Real Estate	Project Cost & Schedule	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.

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Cost & Schedule Risk Analysis Model

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$27,660,467**
Baseline Estimate Cost Contingency Amount ->	$7,724,017
Baseline Estimate Construction Cost (80% Confidence) ->	**$35,384,484**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**68.2 Months**
Schedule Contingency Duration ->	29.9 Months
Project Schedule Duration (80% Confidence) ->	**98.1 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$419,968**

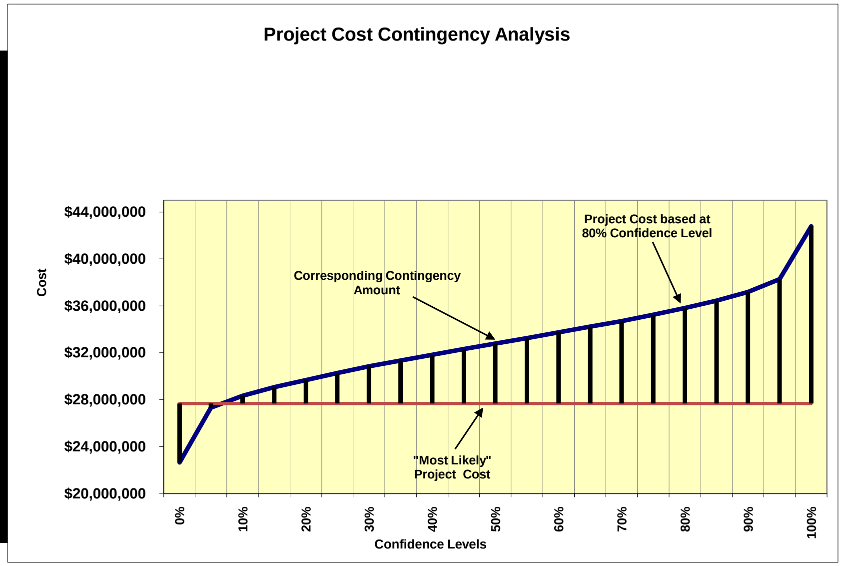
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$8,143,985**
Project Contingency Percentage (80% Confidence) ->	**29%**

Project Cost (80% Confidence) ->	**$35,804,452**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

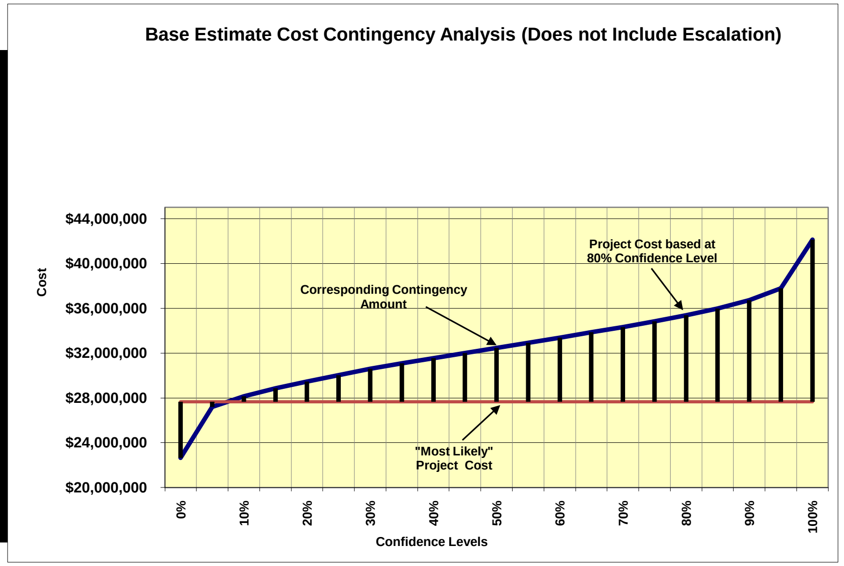
Most Likely Cost Estimate	$27,660,467		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	$22,656,136	($5,004,330)	-18.09%
5%	$27,319,884	($340,583)	-1.23%
10%	$28,323,970	$663,504	2.40%
15%	$29,061,427	$1,400,960	5.06%
20%	$29,672,679	$2,012,212	7.27%
25%	$30,270,680	$2,610,214	9.44%
30%	$30,843,997	$3,183,531	11.51%
35%	$31,341,319	$3,680,852	13.31%
40%	$31,826,234	$4,165,767	15.06%
45%	$32,311,775	$4,651,308	16.82%
50%	$32,776,924	$5,116,457	18.50%
55%	$33,240,512	$5,580,045	20.17%
60%	$33,728,730	$6,068,264	21.94%
65%	$34,216,760	$6,556,294	23.70%
70%	$34,689,217	$7,028,750	25.41%
75%	$35,237,230	$7,576,764	27.39%
80%	$35,804,452	$8,143,985	29.44%
85%	$36,427,500	$8,767,033	31.70%
90%	$37,189,845	$9,529,378	34.45%
95%	$38,270,714	$10,610,247	38.36%
100%	$42,766,335	$15,105,868	54.61%



- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

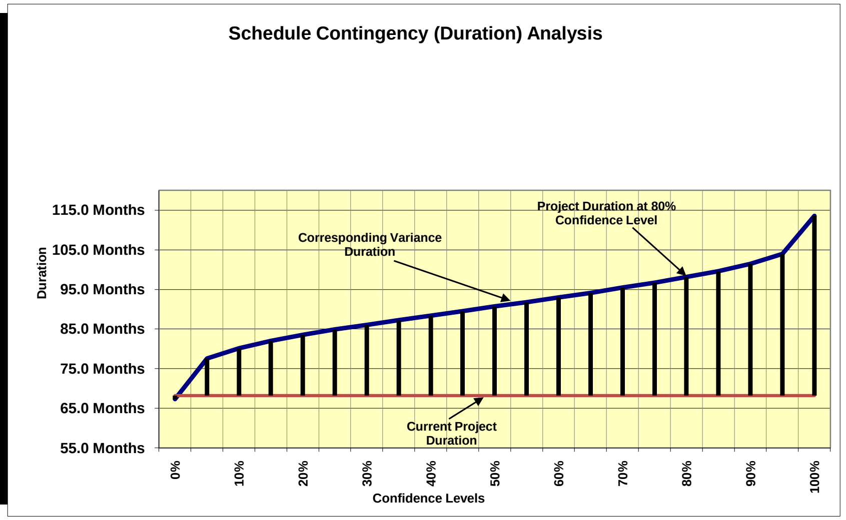
Most Likely Cost Estimate	$27,660,467		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$22,668,667	($4,991,799.40)	-18.05%
5%	$27,188,411	($472,055.28)	-1.71%
10%	$28,156,158	$495,691.57	1.79%
15%	$28,868,149	$1,207,682.35	4.37%
20%	$29,457,670	$1,797,202.95	6.50%
25%	$30,036,870	$2,376,403.41	8.59%
30%	$30,593,376	$2,932,909.36	10.60%
35%	$31,074,521	$3,414,054.54	12.34%
40%	$31,543,316	$3,882,849.87	14.04%
45%	$32,013,001	$4,352,534.47	15.74%
50%	$32,461,615	$4,801,147.91	17.36%
55%	$32,909,844	$5,249,377.37	18.98%
60%	$33,381,688	$5,721,221.52	20.68%
65%	$33,853,108	$6,192,641.37	22.39%
70%	$34,306,988	$6,646,521.56	24.03%
75%	$34,837,110	$7,176,643.86	25.95%
80%	**$35,384,484**	**$7,724,017.34**	**27.92%**
85%	$35,986,877	$8,326,410.06	30.10%
90%	$36,723,845	$9,063,378.12	32.77%
95%	$37,769,640	$10,109,173.57	36.55%
100%	$42,129,836	$14,469,369.01	52.31%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

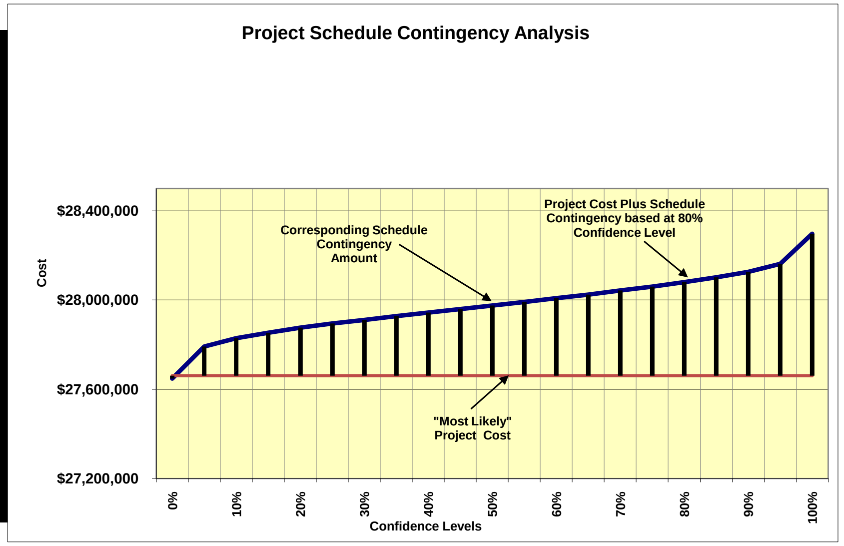
Most Likely Schedule Duration	68.2 Months		
Confidence Level	Project Duration	Contingency	Contingency %
0%	67.3 Months	-0.9 Months	-1.31%
5%	77.6 Months	9.4 Months	13.74%
10%	80.2 Months	12.0 Months	17.53%
15%	82.0 Months	13.8 Months	20.20%
20%	83.5 Months	15.3 Months	22.47%
25%	84.9 Months	16.7 Months	24.43%
30%	86.1 Months	17.9 Months	26.19%
35%	87.2 Months	19.0 Months	27.88%
40%	88.4 Months	20.2 Months	29.56%
45%	89.5 Months	21.3 Months	31.22%
50%	90.7 Months	22.5 Months	32.95%
55%	91.8 Months	23.6 Months	34.55%
60%	92.9 Months	24.7 Months	36.26%
65%	94.1 Months	25.9 Months	38.00%
70%	95.5 Months	27.2 Months	39.94%
75%	96.7 Months	28.5 Months	41.81%
80%	98.1 Months	29.9 Months	43.88%
85%	99.6 Months	31.4 Months	46.04%
90%	101.4 Months	33.2 Months	48.69%
95%	103.9 Months	35.7 Months	52.36%
100%	113.6 Months	45.4 Months	66.51%

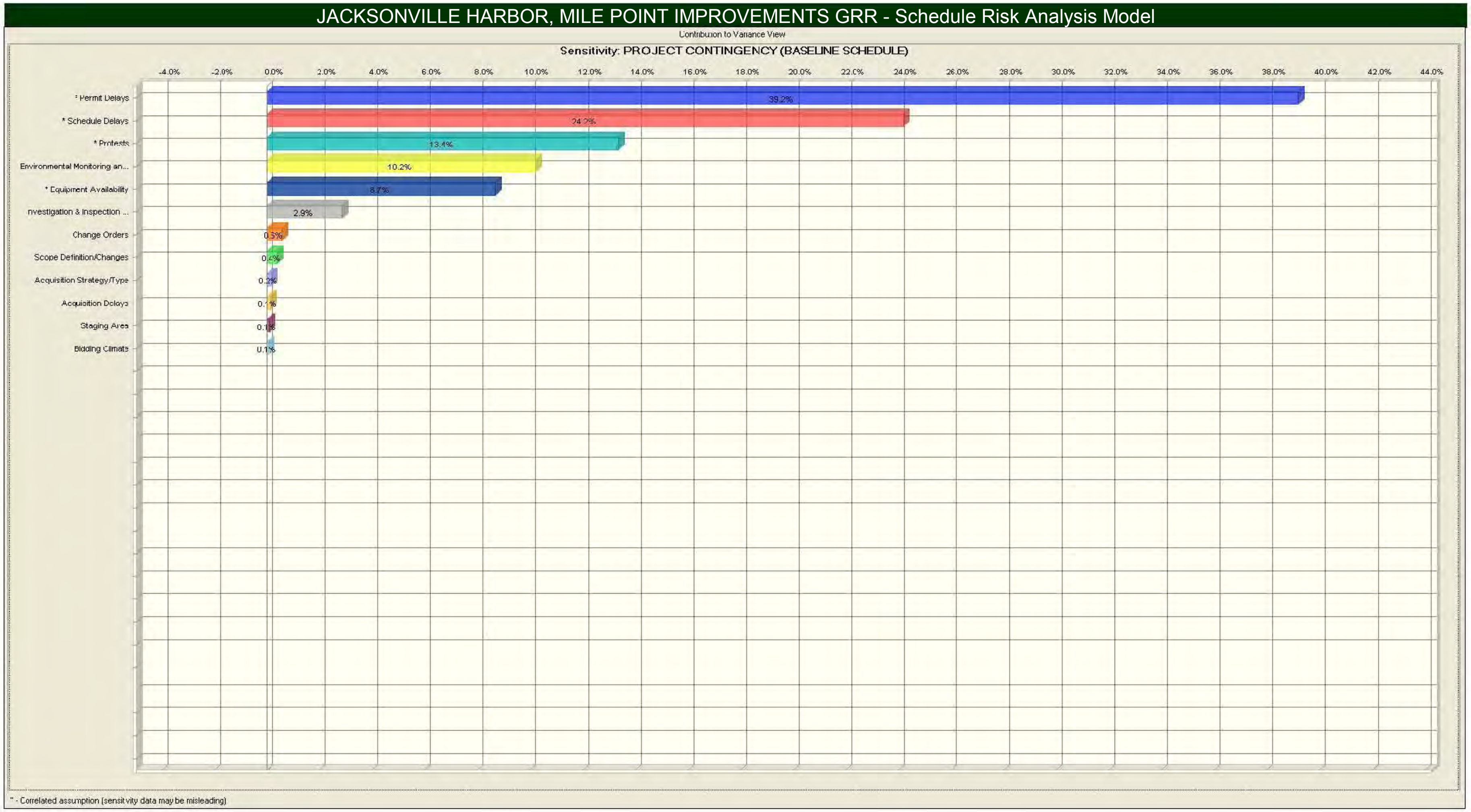


- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$27,660,467		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	$27,647,936	($12,531)	-0.05%
5%	$27,791,939	$131,473	0.48%
10%	$27,828,279	$167,812	0.61%
15%	$27,853,744	$193,278	0.70%
20%	$27,875,476	$215,009	0.78%
25%	$27,894,277	$233,810	0.85%
30%	$27,911,088	$250,621	0.91%
35%	$27,927,264	$266,798	0.96%
40%	$27,943,384	$282,917	1.02%
45%	$27,959,240	$298,774	1.08%
50%	$27,975,776	$315,309	1.14%
55%	$27,991,134	$330,668	1.20%
60%	$28,007,509	$347,042	1.25%
65%	$28,024,119	$363,652	1.31%
70%	$28,042,695	$382,229	1.38%
75%	$28,060,586	$400,120	1.45%
80%	$28,080,434	$419,968	1.52%
85%	$28,101,090	$440,623	1.59%
90%	$28,126,466	$466,000	1.68%
95%	$28,161,541	$501,074	1.81%
100%	$28,296,966	$636,499	2.30%




JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model
Contribution to Variance View
Sensitivity: PROJECT CONTINGENCY (BASELINE SCHEDULE)
-4.0%
-2.0%
0.0%
2.0%
4.0%
6.0%
8.0%
10.0%
12.0%
14.0%
16.0%
18.0%
20.0%
22.0%
24.0%
26.0%
28.0%
30.0%
32.0%
34.0%
36.0%
38.0%
40.0%
42.0%
44.0%
* Permit Delays
39.2%
* Schedule Delays
24.2%
* Protests
13.4%
Environmental Monitoring an...
10.2%
* Equipment Availability
8.7%
nvestigation & Inspection ...
2.9%
Change Orders
0.5%
Scope Definition/Changes
0.4%
Acquisition Strategy/Type
0.2%
Acquisition Delays
0.1%
Staging Area
0.1%
Bidding Climate
0.1%
* - Correlated assumption (sensitivity data may be misleading)

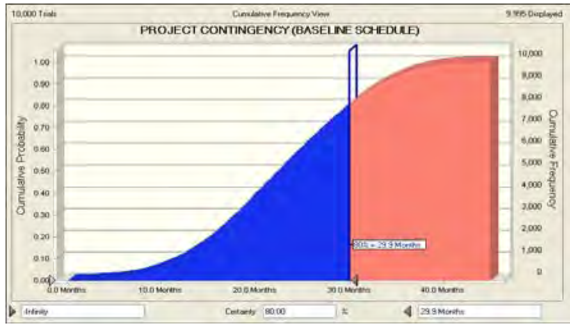
JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

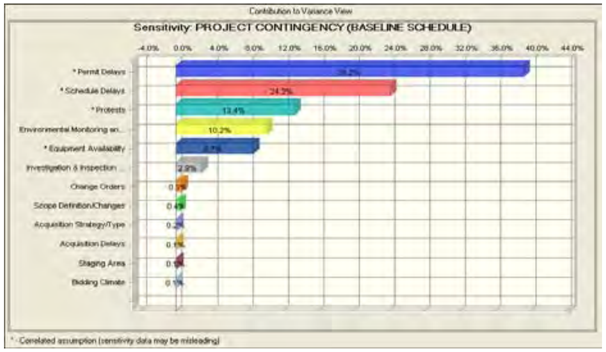
Risk No.	Risk/Opportunity Event	Discussion and Concerns	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Variance Distribution	Correlation to Other(s)	Crystal Ball Simulation Expected Values ($$$): Low	Crystal Ball Simulation Expected Values ($$$): Most Likely	Crystal Ball Simulation Expected Values ($$$): High		Crystal Ball Simulation Expected Values (%s): Low	Crystal Ball Simulation Expected Values (%s): Most Likely	Crystal Ball Simulation Expected Values (%s): High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)														
CD-1	Change Orders	Time and cost impacts vary greatly on individual issues. Changes near end of project don't impact schedule.	Very Likely	Significant	HIGH	Uniform	EN-W-1	0.0 Months	0.0 Months	3.0 Months		0.0%	0.0%	4.4%
CD-3/ LS-2	Staging Area	Potential for problems with location; issues w/ runway; lights needed for cranes @ certain ht; aircraft- impact ht. restriction; Impacts contractor's operation	Very Likely	Marginal	MODERATE	Uniform		0.0 Months	0.0 Months	1.0 Months		0.0%	0.0%	1.5%
CT-1	Acquisition Strategy/Type	Impacts effort in award, some contract vehicles more conducive to lower cost; Prefer Best Value RFP w/ source selection plan; Increased cost/time to implement multiple awards	Unlikely	Significant	MODERATE	Uniform		0.0 Months	0.0 Months	2.0 Months		0.0%	0.0%	2.9%
CT-3	Acquisition Delays	If the Sole-Source J&A does not get approved, could impact the schedule by up to 12 months while the PDT comes up with another alternative.	Unlikely	Significant	MODERATE	Uniform		0.0 Months	0.0 Months	1.0 Months		0.0%	0.0%	1.5%
DP-3	Schedule Delays	Hard to fund if not in 2013 budget- automatic sched. delay; In short term, delays based on $ amt. of contract are likely; delay in execution of proj. components	Likely	Marginal	MODERATE	Uniform	CD-4, EN-C-4, EN-G-1, EN-G-2, PD-E-2, PD-E-3,	0.0 Months	0.0 Months	4.0 Months		0.0%	0.0%	5.9%
DP-4/ EN-D-2	Scope Definition/Changes	Scope is well defined; little likelihood of scope increase or changes from current docs used for estimate development; Engineering pt. of view- if the project lingers, conditions may change	Unlikely	Significant	MODERATE	Uniform		0.0 Months	0.0 Months	3.0 Months		0.0%	0.0%	4.4%
EN-G-3	Investigation & Inspection Costs	Good quality stone readily avail; won't need further investigation	Unlikely	Significant	MODERATE	Uniform		0.0 Months	0.0 Months	6.0 Months		0.0%	0.0%	8.8%
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
CT-2	Protests	Delay in project execution	Likely	Significant	HIGH	Uniform	DP-3	0.0 Months	0.0 Months	6.0 Months		0.0%	0.0%	8.8%
CT-4	Bidding Climate	Severe economic swings can increase / decrease number of potential bidders.	Likely	Marginal	MODERATE	Uniform		0.0 Months	0.0 Months	1.0 Months		0.0%	0.0%	1.5%
EN-C-3	Equipment Availability	Dredge may have to come from further away, increasing mobilization costs or size / type of equipment available.	Likely	Marginal	MODERATE	Uniform	DP-3, CT-4	-1.0 Months	0.0 Months	1.0 Months		-1.5%	0.0%	1.5%
PD-E-1	Environmental Monitoring and Mitigation	Predicting final marsh elevations difficult, may require future funding for long term monitoring	Unlikely	Critical	MODERATE	Uniform		0.0 Months	0.0 Months	12.0 Months		0.0%	0.0%	17.6%
PD-E-4	Permit Delays	Anticipate time to get permit and meet that- not significant	Unlikely	Critical	MODERATE	Uniform	DP-3	-6.0 Months	0.0 Months	12.0 Months		-8.8%	0.0%	17.6%
											Not Part of Study - Placeholder for Project Summation Purposes Only			
									0.0 Months					

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

Contingency Summary Table - Schedule

PROJECT CONTINGENCY (BASELINE SCHEDULE)	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
	0%	68.2 Months	-0.9 Months	**67.3 Months**	**-1.31%**
	5%	68.2 Months	9.4 Months	**77.6 Months**	**13.74%**
	10%	68.2 Months	12.0 Months	**80.2 Months**	**17.53%**
	15%	68.2 Months	13.8 Months	**82.0 Months**	**20.20%**
	20%	68.2 Months	15.3 Months	**83.5 Months**	**22.47%**
	25%	68.2 Months	16.7 Months	**84.9 Months**	**24.43%**
	30%	68.2 Months	17.9 Months	**86.1 Months**	**26.19%**
	35%	68.2 Months	19.0 Months	**87.2 Months**	**27.88%**
	40%	68.2 Months	20.2 Months	**88.4 Months**	**29.56%**
	45%	68.2 Months	21.3 Months	**89.5 Months**	**31.22%**
	50%	68.2 Months	22.5 Months	**90.7 Months**	**32.95%**
	55%	68.2 Months	23.6 Months	**91.8 Months**	**34.55%**
	60%	68.2 Months	24.7 Months	**92.9 Months**	**36.26%**
	65%	68.2 Months	25.9 Months	**94.1 Months**	**38.00%**
	70%	68.2 Months	27.2 Months	**95.5 Months**	**39.94%**
	75%	68.2 Months	28.5 Months	**96.7 Months**	**41.81%**
	80%	68.2 Months	29.9 Months	**98.1 Months**	**43.88%**
	85%	68.2 Months	31.4 Months	**99.6 Months**	**46.04%**
	90%	68.2 Months	33.2 Months	**101.4 Months**	**48.69%**
	95%	68.2 Months	35.7 Months	**103.9 Months**	**52.36%**
	100%	68.2 Months	45.4 Months	**113.6 Months**	**66.51%**





JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - SCHEDULE RISK ANALYSIS

Enter Estimated Total Project Cost (Price Level)	**$27,660,467**
Max. Anticipated Annual Amount	**$4,868,909**
Enter Current OMB Escalation Rate	**1.80%**
Enter Current Project Location Escalation Rate	**1.80%**
Enter Assumed Hotel Rate	**3.46%**

	Date	Escalation Delta Amount	Hotel Amount	Total Schedule Contingency
Enter Current Project Start	16-Mar-09			
Enter Baseline Project Completion	20-Nov-14			
Project Completion at 0% Confidence	23-Oct-14		($12,531.09)	($12,531.09)
Project Completion at 5% Confidence	1-Sep-15		$131,472.77	$131,472.77
Project Completion at 10% Confidence	18-Nov-15		$167,811.93	$167,811.93
Project Completion at 15% Confidence	13-Jan-16		$193,277.74	$193,277.74
Project Completion at 20% Confidence	29-Feb-16		$215,008.95	$215,008.95
Project Completion at 25% Confidence	9-Apr-16		$233,810.28	$233,810.28
Project Completion at 30% Confidence	16-May-16		$250,621.35	$250,621.35
Project Completion at 35% Confidence	20-Jun-16		$266,797.67	$266,797.67
Project Completion at 40% Confidence	25-Jul-16		$282,917.36	$282,917.36
Project Completion at 45% Confidence	28-Aug-16		$298,773.56	$298,773.56
Project Completion at 50% Confidence	3-Oct-16		$315,309.48	$315,309.48
Project Completion at 55% Confidence	5-Nov-16		$330,667.79	$330,667.79
Project Completion at 60% Confidence	11-Dec-16		$347,042.25	$347,042.25
Project Completion at 65% Confidence	16-Jan-17		$363,652.44	$363,652.44
Project Completion at 70% Confidence	25-Feb-17		$382,228.83	$382,228.83
Project Completion at 75% Confidence	5-Apr-17		$400,119.77	$400,119.77
Project Completion at 80% Confidence	18-May-17		$419,967.76	$419,967.76
Project Completion at 85% Confidence	2-Jul-17		$440,623.11	$440,623.11
Project Completion at 90% Confidence	26-Aug-17		$465,999.77	$465,999.77
Project Completion at 95% Confidence	10-Nov-17		$501,073.90	$501,073.90
Project Completion at 100% Confidence	31-Aug-18		$636,499.29	$636,499.29

Entry Required

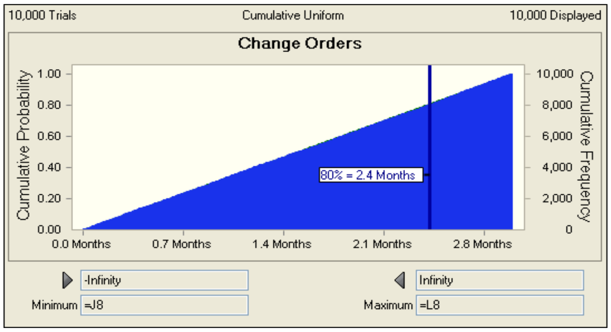
Do Not Overwrite

Summary Data -- Do Not Overwrite

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CD-1	Change Orders	0.0 Months	0.0 Months	3.0 Months

Notes: This item captures the risk of schedule delay due to change orders.
Likely Most likely assumes no schedule growth due to change orders.
Low Low assumes no schedule growth due to change orders.
High High assumes up to 3 months delay, based on input from Construction Division.



Assumption: Change Orders

Percentile	Assumption values
0%	0.0 Months
10%	0.3 Months
20%	0.6 Months
30%	0.9 Months
40%	1.2 Months
50%	1.5 Months
60%	1.8 Months
70%	2.1 Months
80%	2.4 Months
90%	2.7 Months
100%	3.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

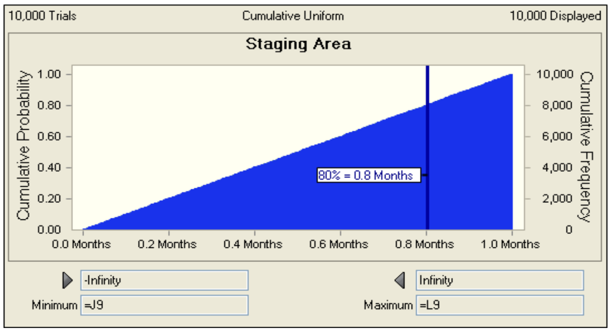
Risk Refer No.	Risk Event	Low	Most Likely	High
CD-3/ LS-2	Staging Area	0.0 Months	0.0 Months	1.0 Months

Notes: This item captures the risk that there will be schedule impact to the stone placement for the jetty work due to the unavailability of staging areas. The sponsor and the Corps is confident in the availability of the staging areas currently contemplated.

Likely Most likely assumes no change to the baseline schedule.

Low The baseline schedule was made on the most optimum conditions.

High High assumes that the availability of staging areas for cranes is less favorable, creating a total schedule impact of up to one month.



Assumption: Staging Area

Percentile	Assumption values
0%	0.0 Months
10%	0.1 Months
20%	0.2 Months
30%	0.3 Months
40%	0.4 Months
50%	0.5 Months
60%	0.6 Months
70%	0.7 Months
80%	0.8 Months
90%	0.9 Months
100%	1.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

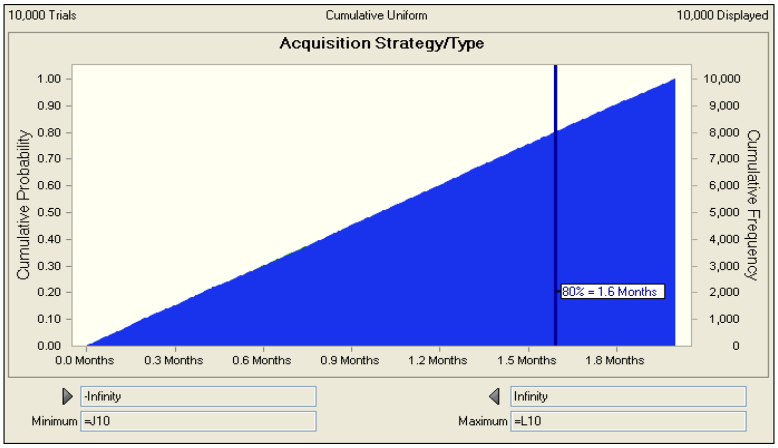
Risk Refer No.	Risk Event	Low	Most Likely	High
CT-1	Acquisition Strategy/Type	0.0 Months	0.0 Months	2.0 Months

Notes: This item captures the risk of total project schedule delay due to the selected acquisition strategy.

Likely Most likely assumes no change to baseline schedule.

Low Low assumes no change to baseline schedule.

High High assumes that acquisition strategy could delay the schedule by up to 2 months.



Assumption: Acquisition Strategy/Type

Percentile	Assumption values
0%	0.0 Months
10%	0.2 Months
20%	0.4 Months
30%	0.6 Months
40%	0.8 Months
50%	1.0 Months
60%	1.2 Months
70%	1.4 Months
80%	1.6 Months
90%	1.8 Months
100%	2.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CT-3	Acquisition Delays	0.0 Months	0.0 Months	1.0 Months

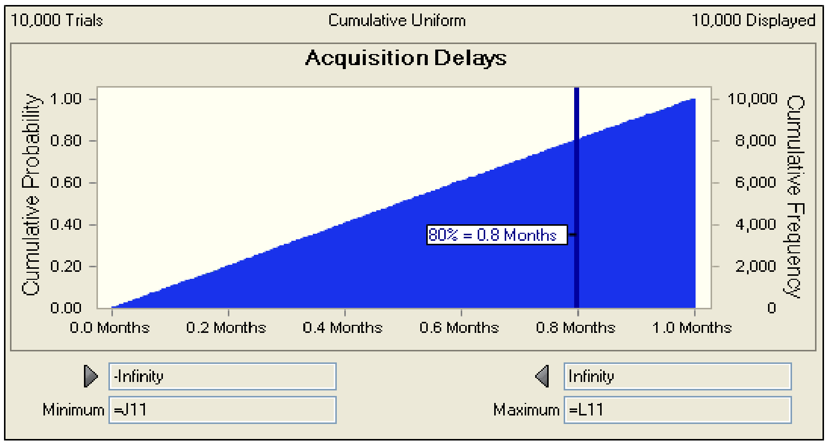
Notes: This item captures the risk that delays in getting the contract solicited could impact the current schedule (1 month delay due to overwhelming response or other administrative procedures).

Likely Most likely assumes no change to the baseline schedule.

Low Low assumes no change to the baseline schedule.

High

High assumes that delays in the soliciitation could delay the schedule by up to one month.



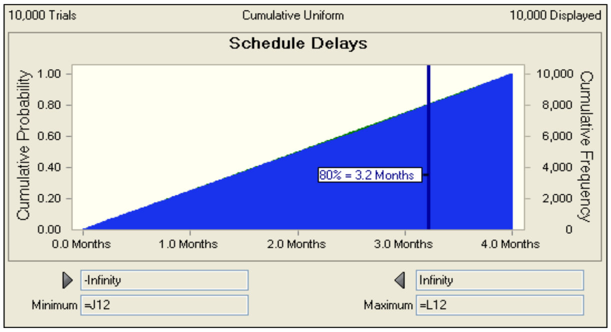
Assumption: Acquisition Delays

Percentile	Assumption values
0%	0.0 Months
10%	0.1 Months
20%	0.2 Months
30%	0.3 Months
40%	0.4 Months
50%	0.5 Months
60%	0.6 Months
70%	0.7 Months
80%	0.8 Months
90%	0.9 Months
100%	1.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
DP-3	Schedule Delays	0.0 Months	0.0 Months	4.0 Months

Notes: This item captures the risk that the project could experience delay if it is not in the 2010 budget.
Likely Most likely assumes no change to the baseline schedule.
Low Low assumes no change to the baseline schedule.
High High assumes that funding constraints could delay the project by up to 4 months.



Assumption: Schedule Delays

Percentile	Assumption values
0%	0.0 Months
10%	0.4 Months
20%	0.8 Months
30%	1.2 Months
40%	1.6 Months
50%	2.0 Months
60%	2.4 Months
70%	2.8 Months
80%	3.2 Months
90%	3.6 Months
100%	4.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
DP-4/ EN-D-2	Scope Definition/Changes	0.0 Months	0.0 Months	3.0 Months

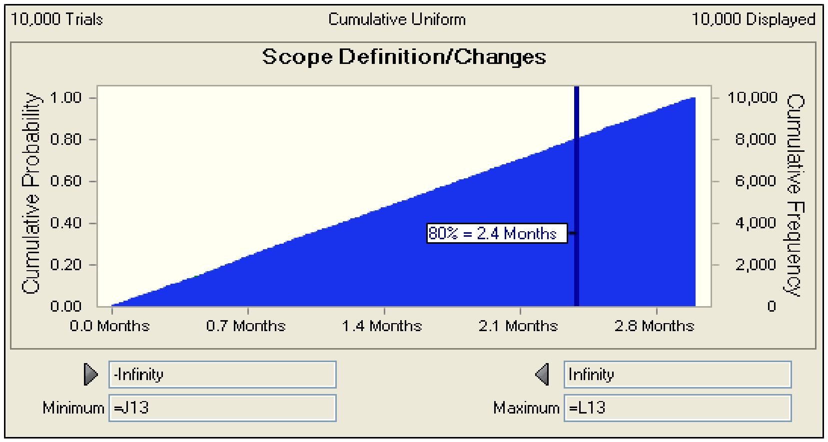
Notes: This item captures the risk that there could be some conditions that changes that affect project scope, particularly if the project languishes.

Likely Most likely assumes no change to the baseline schedule.

Low Low assumes no change to the baseline schedule.

High

High assumes that changes in site conditions could delay the project by up to 3 months.



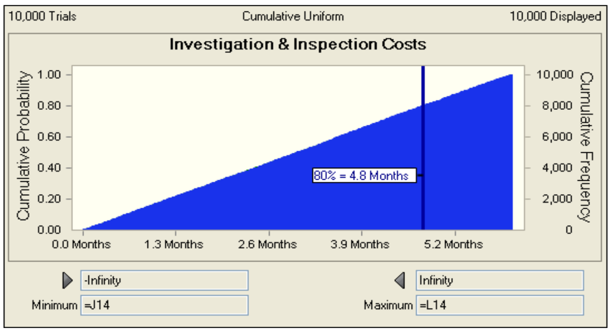
Assumption: Scope Definition/Changes

Percentile	Assumption values
0%	0.0 Months
10%	0.3 Months
20%	0.6 Months
30%	0.9 Months
40%	1.2 Months
50%	1.5 Months
60%	1.8 Months
70%	2.1 Months
80%	2.4 Months
90%	2.7 Months
100%	3.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EN-G-3	Investigation & Inspection Costs	0.0 Months	0.0 Months	6.0 Months

Notes: This captures the risk that more investigation and inspection is actually required than currently contemplated.
Likely Most likely assumes no change to the baseline schedule.
Low Low assumes no change to the baseline schedule.
High High assumes that increased investigation and inspection could delay the schedule by up to 6 months.



Assumption: Investigation & Inspection Costs

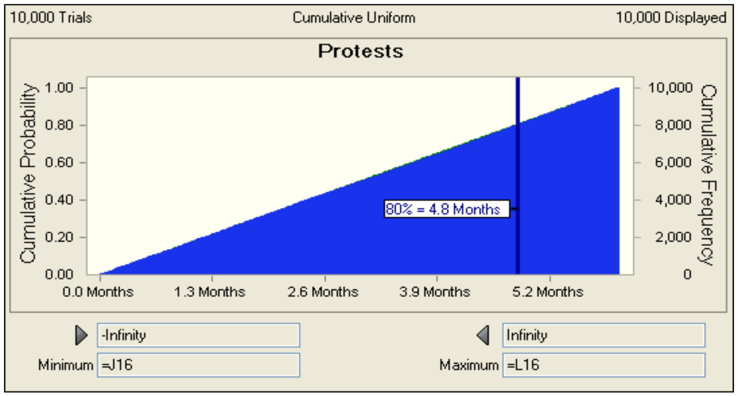
Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.2 Months
30%	1.8 Months
40%	2.4 Months
50%	3.0 Months
60%	3.6 Months
70%	4.2 Months
80%	4.8 Months
90%	5.4 Months
100%	6.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CT-2	Protests	0.0 Months	0.0 Months	6.0 Months

Notes:

	This item captures the risk that there could be schedule delays due to contractor protests.
Likely	Most likely assumes no change from the current schedule.
Low	Low assumes no change from the current schedule.
High	High assumes that contractor protests could cause up to 6 months of delay.



Assumption: Protests

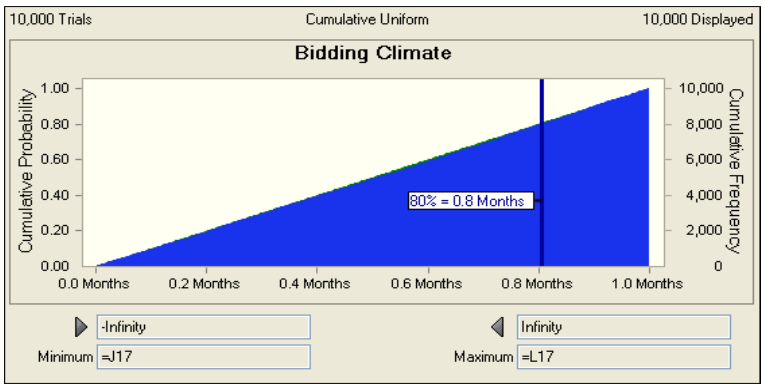
Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.2 Months
30%	1.8 Months
40%	2.4 Months
50%	3.0 Months
60%	3.6 Months
70%	4.2 Months
80%	4.8 Months
90%	5.4 Months
100%	6.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CT-4	Bidding Climate	0.0 Months	0.0 Months	1.0 Months

Notes: This item captures the risk of total project schedule delay due to the selected acquisition strategy.

Likely Most likely assumes no change to baseline schedule.
Low Low assumes no change to baseline schedule.
High High assumes that acquisition strategy could delay the schedule by up to 1 month.



Assumption: Bidding Climate

Percentile	Assumption values
0%	0.0 Months
10%	0.1 Months
20%	0.2 Months
30%	0.3 Months
40%	0.4 Months
50%	0.5 Months
60%	0.6 Months
70%	0.7 Months
80%	0.8 Months
90%	0.9 Months
100%	1.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

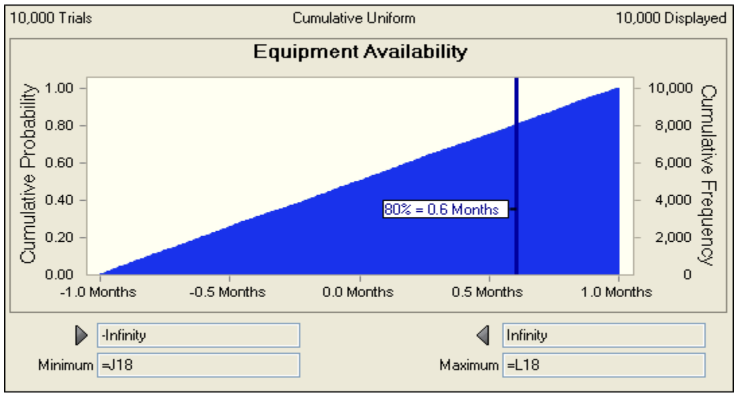
Risk Refer No.	Risk Event	Low	Most Likely	High
EN-C-3	Equipment Availability	-1.0 Months	0.0 Months	1.0 Months

Notes: This item captures the risk that limited availability of equipment in the dredging industry and regional market could cause schedule delays.

Likely Most likely assumes no change to the current schedule (using 16" pipeline).

Low Low assumes that schedule could improve by up to 1 month if dredge mobilizes from local area.

High High assumes that limited equipment availability could create up to 1 month of delay.



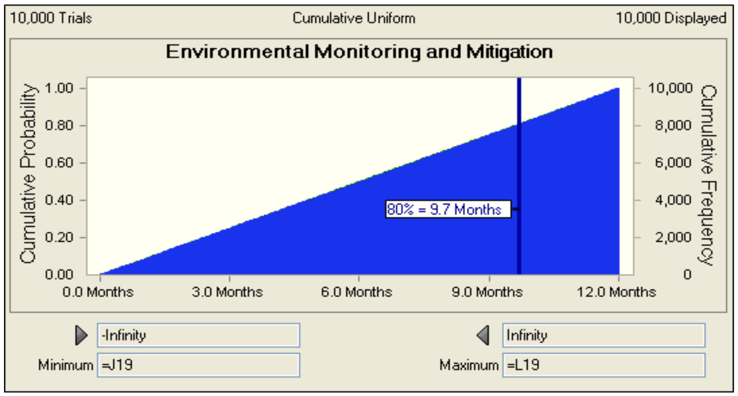
Assumption: Equipment Availability

Percentile	Assumption values
0%	'-1.0 Months
10%	'-0.8 Months
20%	'-0.6 Months
30%	'-0.4 Months
40%	'-0.2 Months
50%	0.0 Months
60%	0.2 Months
70%	0.4 Months
80%	0.6 Months
90%	0.8 Months
100%	1.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PD-E-1	Environmental Monitoring and Mitigation	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that there will be more moniotring and mitigation required due to changing conditions in the marsh elevations.
Likely Most likely assumes no change to the baseline schedule.
Low Low assumes no change to the baseline schedule.
High High assumes that monitoring and mitigation efforts could cause delays up to one year.



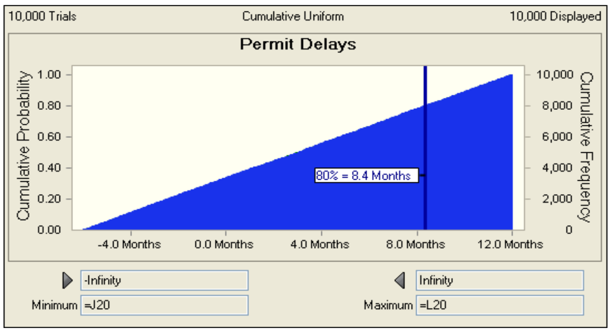
Assumption: Environmental Monitoring and Mitigation

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.6 Months
40%	4.8 Months
50%	6.1 Months
60%	7.3 Months
70%	8.5 Months
80%	9.7 Months
90%	10.8 Months
100%	12.0 Months

JACKSONVILLE HARBOR, MILE POINT IMPROVEMENTS GRR - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PD-E-4	Permit Delays	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that inability to obtain permits in a timely manner could significantly impact the project schedule.
Likely Most likely assumes no change to baseline schedule.
Low Low assumes that permits could be obtained much sooner than contemplated, allowing for up to 6 months of improvement on the total project schedule.
High High assumes that issues in obtaining permits could cause up to one year in delay.



Assumption: Permit Delays

Percentile	Assumption values
0%	'-6.0 Months
10%	'-4.2 Months
20%	'-2.5 Months
30%	'-0.7 Months
40%	1.2 Months
50%	3.1 Months
60%	4.8 Months
70%	6.6 Months
80%	8.4 Months
90%	10.2 Months
100%	12.0 Months

Crystal Ball Report - Full

Simulation started on 3/26/2011 at 5:28 PM
Simulation stopped on 3/26/2011 at 5:29 PM

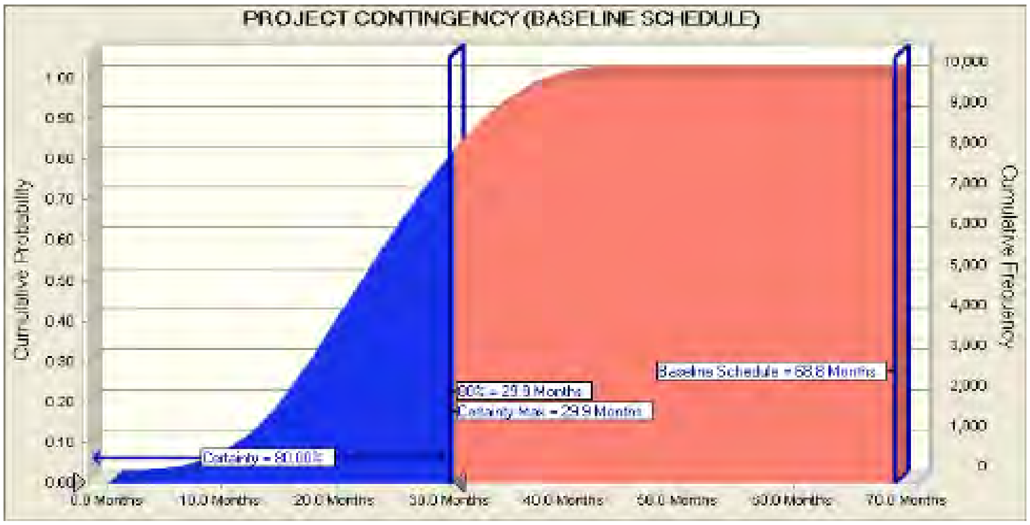
Run preferences:	
Number of trials run	10,000
Monte Carlo	
Seed	999
Precision control on	
Confidence level	95.00%
Run statistics:	
Total running time (sec)	12.16
Trials/second (average)	822
Random numbers per sec	9,868
Crystal Ball data:	
Assumptions	12
Correlations	3
Correlated groups	1
Decision variables	0
Forecasts	1

Forecasts

Worksheet: [Risk Analysis (Schedule)-Milepoint_3-2-11.xlsx]Schedule Risk Model

Forecast: PROJECT CONTINGENCY (BASELINE SCHEDULE) **Cell: K22**

Summary:
  Certainty level is 80.00%
  Certainty range is from -Infinity to 29.9 Months
  Entire range is from -0.9 Months to 45.4 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
Base Case	0.0 Months
Mean	22.5 Months
Median	22.5 Months
Mode	---
Standard Deviation	8.1 Months
Variance	65.0 Months
Skewness	0.0238
Kurtosis	2.44
Coeff. of Variability	0.3576
Minimum	-0.9 Months
Maximum	45.4 Months
Range Width	46.3 Months
Mean Std. Error	0.1 Months

Forecast: PROJECT CONTINGENCY (BASELINE SCHEDULE) (cont'd) **Cell: K22**

Percentiles:	Forecast values
0%	-0.9 Months
10%	12.0 Months
20%	15.3 Months
30%	17.9 Months
40%	20.2 Months
50%	22.5 Months
60%	24.7 Months
70%	27.2 Months
80%	29.9 Months
90%	33.2 Months
100%	45.4 Months

End of Forecasts

Assumptions

Worksheet: [Risk Analysis (Schedule)-Milepoint_3-2-11.xlsx]Schedule Risk Model

Assumption: Acquisition Delays **Cell: K11**

Uniform distribution with parameters:

Minimum	0.0 Months	(=J11)
Maximum	1.0 Months	(=L11)

Assumption: Change Orders **Cell: K8**

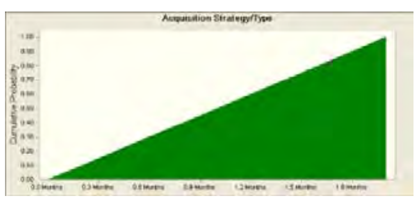
Uniform distribution with parameters:

Minimum	0.0 Months	(=J8)
Maximum	3.0 Months	(=L8)

Assumption: Acquisition Strategy/Type **Cell: K10**

Uniform distribution with parameters:

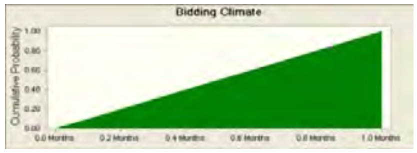
Minimum	0.0 Months	(=J10)
Maximum	2.0 Months	(=L10)



Assumption: Bidding Climate **Cell: K17**

Uniform distribution with parameters:

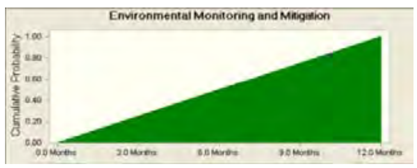
Minimum	0.0 Months	(=J17)
Maximum	1.0 Months	(=L17)



Assumption: Environmental Monitoring and Mitigation **Cell: K19**

Uniform distribution with parameters:

Minimum	0.0 Months	(=J19)
Maximum	12.0 Months	(=L19)



Assumption: Equipment Availability **Cell: K18**

Uniform distribution with parameters:

Minimum	-1.0 Months	(=J18)
Maximum	1.0 Months	(=L18)

Correlated with:	Coefficient
Schedule Delays (K12)	0.50

Assumption: Investigation & Inspection Costs **Cell: K14**

Uniform distribution with parameters:

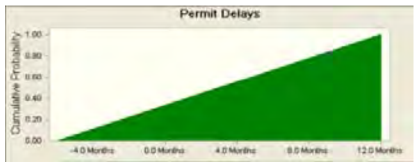
Minimum	0.0 Months	(=J14)
Maximum	6.0 Months	(=L14)

Assumption: Investigation & Inspection Costs (cont'd) **Cell: K14**

Assumption: Permit Delays **Cell: K20**

Uniform distribution with parameters:

Minimum	-6.0 Months	(=J20)
Maximum	12.0 Months	(=L20)

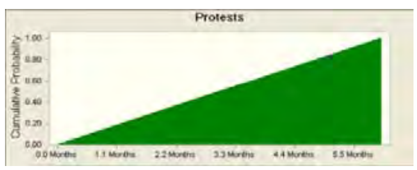


Correlated with:	Coefficient
Schedule Delays (K12)	0.50

Assumption: Protests **Cell: K16**

Uniform distribution with parameters:

Minimum	0.0 Months	(=J16)
Maximum	6.0 Months	(=L16)



Correlated with:	Coefficient
Schedule Delays (K12)	0.50

Assumption: Schedule Delays **Cell: K12**

Uniform distribution with parameters:

Minimum	0.0 Months	(=J12)
Maximum	4.0 Months	(=L12)

Assumption: Schedule Delays (cont'd) **Cell: K12**

Correlated with:	Coefficient
Permit Delays (K20)	0.50
Equipment Availability (K18)	0.50
Protests (K16)	0.50

Assumption: Scope Definition/Changes **Cell: K13**

Uniform distribution with parameters:

Minimum	0.0 Months	(=J13)
Maximum	3.0 Months	(=L13)

Assumption: Staging Area **Cell: K9**

Uniform distribution with parameters:

Minimum	0.0 Months	(=J9)
Maximum	1.0 Months	(=L9)

End of Assumptions

Sensitivity Charts