

**Report Synopsis  
for  
Charleston Harbor, South Carolina (Post 45)  
Feasibility Study  
05-05-15**

**ABSTRACT:** The Charleston Harbor study area encompasses the offshore entrance channel, offshore and landside confined dredged material disposal sites, inner harbor channels, and any extension of the water bodies and shorelines that could be impacted by proposed improvements. Alternative plans combined multiple structural and nonstructural measures to improve the safety and efficiency of the existing navigation system. Navigation concerns include three main types of problems: insufficient Federal channel depths, difficult currents, and restrictive channel widths and turning basins.

The Recommended Plan (Locally Preferred Plan) proposes the following navigation improvements:

- Deepen the existing entrance channel from a project depth of -47 feet to -54 feet mean lower low water (MLLW) over the existing 800-foot bottom width, while reducing the existing stepped 1,000-foot width to 944 feet from an existing depth of -42 feet to a depth of -49 feet.
- Extend the entrance channel approximately three miles seaward from the existing location to a depth contour including a -54-foot MLLW project depth plus overdepths.
- Deepen the inner harbor from an existing project depth of -45 feet to -52 feet MLLW to the Wando Welch container facility on the Wando River and the new Navy Base Terminal on the Cooper River, and -48 feet MLLW for the reaches above that facility to the North Charleston container facility (over expanded bottom widths from 400 to 1,800 feet).
- Enlarge the existing turning basins to an 1800-foot diameter at the Wando Welch and new SCSPA terminals to accommodate Post Panamax Generation 2 and 3 container ships and widen selected reaches as shown in the Recommended Plan Summary: Reference Aid at the end of this document.
- Enlarge the North Charleston Terminal turning basin to a 1650-foot diameter for Post Panamax Generation 2 container ships.
- Place dredged material and raise dikes at the existing upland confined disposal facilities at Clouter Creek, Yellow House Creek, and/or Daniel Island for material from the upper harbor; and for material dredged from the lower harbor, place at the Ocean Dredged Material Disposal Site (ODMDS) and expand. Place rock to create hardbottom habitat near the entrance channel as a least cost beneficial use of dredged material.

The Recommended Plan is environmentally acceptable and economically justified. It would indirectly impact about 323.7 acres of wetlands through changes in salinity, which would require mitigation in the form of preservation of 665.6 acres of wetlands. Approximately 28.6 acres of direct impacts to hardbottom areas within the footprint of the entrance channel require mitigation. Construction of the Recommended Plan would cause temporary and minor impacts to water quality, displacement of aquatic species, and minor changes (both positive and negative) in fish habitat, potential impacts to threatened and endangered species, a decrease in dissolved oxygen, and increased salinity in the harbor and its tributaries.

Project First Cost: \$493,270,000 - Federal Cost: \$224,300,000 and Non-federal Cost: \$268,970,000; Non-Federal Local Service Facility costs of \$26,970,000; USCG Navigation Aids costs of \$620,000, which sum to Project Costs of \$520,860,000 with additional annual O&M costs of \$3,740,000/year.

## **1.0 Stage of Planning Process**

Published the integrated draft report and Environmental Impact Statement in the Federal Register on 10 Oct 14 for coordination with the public and Local, State, and Federal agencies after confirmation of the National Economic Development Plan and the Tentatively Selected Plan on 31 Jul 14 and permission to deviate from the NED plan by ASA(CW) on 1 Oct 14. USACE CECW-P granted permission to continue with preparation of the Final Report at the Agency Decision Milestone Meeting on 23 Feb 2015.

## **2.0 Study Authority (Paragraph 1.2 - Final Report)**

Section 216 of the Flood Control Act of 1970 (Public Law 91-611) allows the review of completed projects.

### 2.1 Additional Study Guidelines

The reconnaissance study, Section 905(B) (WRDA 86) Analysis, **Charleston Harbor Navigation Improvement Project, Charleston, South Carolina, July 2010** was reviewed and approved June 16, 2010. No study specific feasibility phase guidance has been provided.

### 2.2 Study Area (Paragraph 1.7 - Final Report)

As shown in Figure 1 and Existing Conditions: Section 2 Reference Aid at the end of this document, Charleston Harbor is located in a natural tidal estuary formed by the confluence of the Cooper, Ashley, and Wando Rivers that serves the Port of Charleston. The total area of the Harbor is approximately 14 square miles. The study area encompasses the Federal channels within the harbor, entrance channel, as well as any shorelines and extensions of the water bodies and disposal areas that are potentially impacted by channel enlargement alternatives as well as landside confined dredged material disposal sites.

The study also defines the routes and locations of waterborne traffic affected by study alternatives but only to the extent needed to develop transportation costs based on distribution portioned distances.

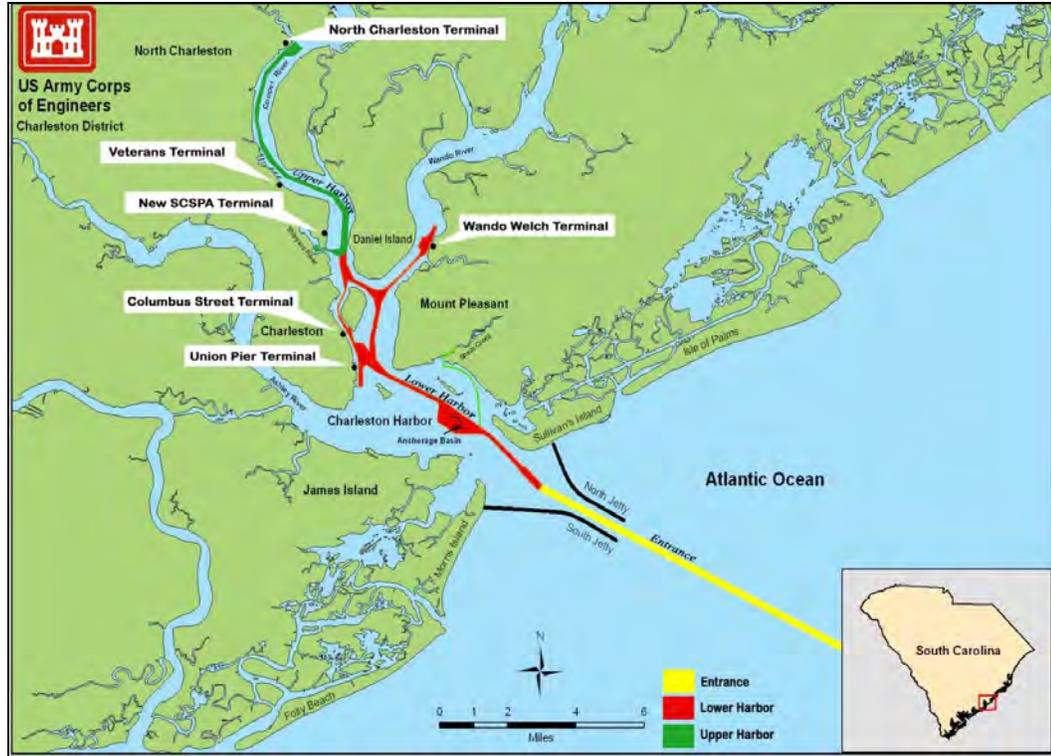


Figure 1: Location of the primary Federal channels, features and major terminals.

### 2.3 Project Area

The project area includes upland disposal sites along the Cooper River channels and the ocean dredged material disposal site just south of the entrance channel.

### 3.0 **Non-Federal Sponsor**

The non-Federal sponsor is the South Carolina State Ports Authority who requested this study.

### 4.0 **Problems (Paragraph 3.1.1 - Final Report)**

Transportation inefficiencies occur when existing channels and maneuvering areas cannot efficiently accommodate the vessels using the harbor. Currently, large vessels are constrained by channel depths, under-sized turning areas and all vessels can be constrained by strong or unpredictable currents. Meetings and coordination with the South Carolina State Ports Authority, terminal operators, the Charleston Branch (Harbor) Pilots' Association, the U.S. Coast Guard, the Charleston Harbor Navigation Safety Committee, maritime interests, environmental resource agencies, and interested individuals provided valuable information related to existing problems and opportunities for improvements. Specific problems identified include:

- (a) Navigation problems resulting from insufficient channel depths causing transportation inefficiencies

- a. Large ships (drafting more than 43') are currently experiencing delays due to insufficient channel depths, resulting in light loading, waiting for favorable tide conditions, or both.
- (b) Potential transportation delays resulting from strong and unpredictable currents
  - a. Confluence of the Intracoastal Waterway
  - b. Ebb currents at confluence of the Wando and Cooper Rivers make turns difficult in the reaches immediately north of the Ravenel Bridge.
  - c. Drum Island turn
  - d. Shipyard Creek junction
- (c) Restrictive channel widths in certain areas
  - a. Restrictive channel widths limit vessels to one way traffic in certain areas
  - b. Restrictive turning basins for larger vessels transiting Charleston Harbor
  - c. Bank suction effect in the North Charleston and Filbin Creek Reaches

***Insufficient Channel Depths***

The existing channel depths accommodate vessels drafting up to 48 feet (limited to a tide window of 2 hours per day) while maintaining the necessary underkeel clearance. Large ships currently experience delays due to insufficient channel depths. To reach port terminals, these ships must either be light loaded, wait for favorable tide conditions, or both. This requires vessel operators to forego some of the cost savings that would otherwise be realized with the use of larger ships. Table 1, below, summarizes the approximate times that are available to transit the harbor by vessels of various drafts under current conditions.

**Table 1. Tidal Limitations on Port of Charleston Vessel Draft**

Hours/Day Available for Inbound or Outbound Transit	Vessel Draft
24	38
24	39
24	40
24	41
24	42
24	43
16	44
12	45
8	46
6	47
2	48

Container ships are among the deepest drafting ships calling on Charleston Harbor. Tight schedules combined with potential delays on both the inbound and outbound voyages result in expensive delays for ships drafting more than 43-feet. According to the SCSPA, 495 ships drafting 43 feet or more called the Port of Charleston from December 2008 to December 2009.

### ***Difficult Currents***

Meetings with the Charleston Harbor Pilots, U.S. Coast Guard representatives, the Charleston Harbor Navigation Safety Committee, and other maritime interests indicate several areas of the harbor have difficult currents and crosscurrents that complicate navigation.

Strong and unpredictable ebb tide crosscurrents at the confluence of the Wando and Cooper Rivers make turns difficult in the reaches immediately north of the Ravenel Bridge. Some ships are delayed waiting on slack or flood tides to avoid ebb tide crosscurrents. Other ships reduce their speed to avoid bank suction effects in the North Charleston and Filbin Creek reaches which causes transportation delays.

The Intracoastal Waterway represents the eastern conjunction of this waterway with Rebellion Reach. Westbound vessels proceeding on the waterway into Charleston Harbor are not readily visible to vessels inbound from sea until they are clear of the northernmost part of Sullivans Island. This waterway is extensively used by tows, and its junction with the harbor of Charleston is subject to strong and unpredictable crosscurrents at various stages of the tide. Westbound tows entering Charleston Harbor from the Intracoastal Waterway should give a Security call on VHF-FM channel 13, 15 minutes prior to entry, or upon clearing the Ben Sawyer Bridge, and adjust speed so as to enter the harbor when the channel is clear. Every effort, including holding, should be made to avoid unduly restricting deep-draft vessels transiting the main ship channel, and allow them to clear this area when either inbound or outbound.

Navigation of Drum Island turn is complicated by (a) poor visibility caused by Drum Island blocking the view of vessels approaching one another, (b) close proximity, 700 yards, to the fixed bridge span over Hog Island Reach, and the vulnerability of the bridge to collision in the event vessel control is lost, and (c) crosscurrents on ebb tide from the confluence of the Cooper and Wando Rivers. Vessels should make every effort to avoid meeting at this turn, which includes Hog Island Reach above Lighted Buoy 41, north of the Ravenel Bridge. Commercial vessels should give another Security call on VHF-FM channel 13, 15 minutes prior to arriving at this turn. The vessel with the fair tide should initiate a proposal for meeting or passing and the vessel stemming the tide should hold as necessary. Any departure from this procedure should be agreed to by both vessels in a timely manner. Poor-handling vessels should not attempt to navigate this turn, except when a suitable number of tugs are immediately available for assistance, because such vessels are likely to become unmanageable, raising a substantial risk of collision with the bridge abutments and, thereby, becoming a threat to the lives of persons in the vehicles on the bridge. Local knowledge is necessary to predict current effects as they tend to set across the channel on both the flood and ebb. Navigation problems related to this reach are also noted in the United States Coast Pilot-4, Charleston Harbor, Areas of Particular Concern.

Shipyards Creek junction is complicated by the movement of vessel traffic in and out of Shipyards Creek and by ebb currents of unusually high velocity. Up-bound low-powered vessels, particularly tugs with deep-draft tows, should not attempt transit of this area, except on flood tide, as their speed over the ground will be so slow that they will effectively restrict the main channel for hours. Tankers moored at the oil terminal facing on the lower portion of Daniel Island Reach are susceptible to current surges and suction from passing deep-draft vessels. Tankers mooring at that facility should employ an array of

suitable mooring lines including wire ropes and winches with manually or hydraulically set brakes. It is recommended that a listening watch be maintained on VHF-FM channel 13 so that mooring lines can be tended during the passing of deep-draft vessels whose Security broadcasts have announced their intention to transit the upper Cooper River. In addition, vessels so moored may advise the Office of the Charleston Branch Pilots Association of their working frequencies so that such VHF communications between piloted vessels and moored vessels may be facilitated. Navigation problems related to this reach are also noted in the United States Coast Pilot-4, Charleston Harbor, Areas of Particular Concern.

The main channel in North Charleston and Filbin Creek Reaches is immediately adjacent to the pier heads of a number of oil terminals which receive tank vessels. The channel in these reaches is minimally 500 feet in width, thus the passage of deep-draft vessels often occurs in close proximity to moored tank vessels transferring bulk liquid inflammable, combustible and hazardous cargoes. The presence of the Route I-526 highway bridge and its vertical structures that are surrounded by a protective fender system, further restricts navigation. When tank vessels are moored at any of these facilities, the situation becomes complicated by the wake effect and suction from passing vessels upon cargo hose and mooring lines of moored tank vessels and the possible loss of visibility of the bridge structure owing to the disbursement of large quantities of water vapor into the atmosphere from a nearby industrial plant. To provide the maximum distance between moored and passing vessels, the area encompassed by these reaches should be limited to one-way traffic with respect to the transit of deep-draft vessels past any tank vessel moored at one, or more, of the several oil terminal docks. Likewise, no deep-draft vessel should overtake and pass another vessel in these reaches in the vicinity of moored tank vessels. Deep-draft commercial vessels intending to transit these reaches should make a Security call on VHF-FM channel 13, 15 minutes prior to the intended transit and shall adjust speed so as to avoid a meeting or passing situation in the vicinity of moored tank vessels. While passing moored tank vessels, transiting deep-draft vessels shall give due regard for the wake and suction effects upon the moored vessels. Local knowledge is necessary to predict current effects as they tend to set across the channel on both flood and ebb. Poor-handling vessels should be assisted by a suitable number of assist tugs when transiting these reaches to avoid collision with tank vessels moored at the oil terminals. It is recommended that moored tank vessels maintain a listening watch on VHF-FM channel 13 to be alert to the intentions of deep-draft vessels to transit these reaches, and thereby have line handlers prepared to tend mooring lines during the transit. In addition, vessels so moored should advise the Office of the Charleston Branch Pilots Association of their working frequencies so that such VHF communications between piloted vessels and moored vessels may be facilitated. Navigation problems related to this reach are also noted in the United States Coast Pilot-4, Charleston Harbor, Areas of Particular Concern.

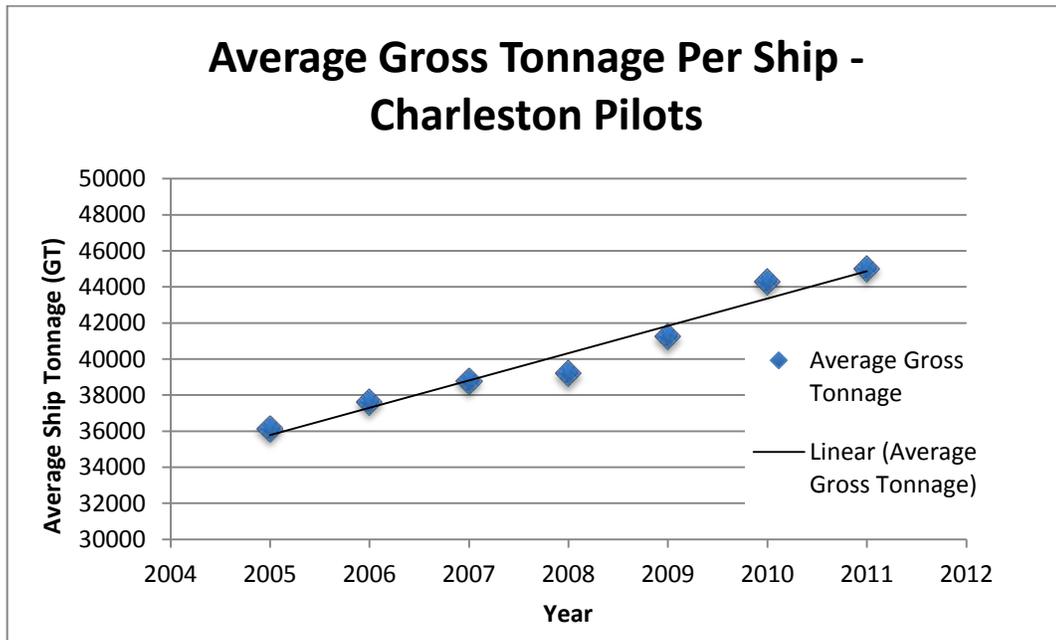
### ***Restrictive Channel Widths***

Restrictive channel widths limit ship passage to one-way traffic in some reaches and larger ships are restricted by size of the existing turning basins. Discussions with the Charleston Harbor Pilots indicate that the existing one-way traffic restrictions in the Bennis and Hog Island Reaches (and other locations) cause inefficiencies and delays. As currently constructed, the federal channel does not allow ship passages in many reaches. The usual embarking and disembarking procedures in the harbor involve

one way traffic; with outgoing ships disembarking at night and incoming ships coming in the morning. This one way flow of traffic in and out of the harbor limits the efficiency of the transport of goods.

According to data provided by the Charleston Branch (Harbor) Pilots, the “average” cargo ship size in the Port of Charleston has grown by twenty five per cent through the previous six years, from 2005 through August, 2011. As shown in Figure 2, below, in 2005 the average ship was some 36,000 Gross Tons, and in 2011, through August, the average ship had increased to some 45,000 Gross Tons. This rate of growth in the typical ship, if sustained, would indicate the “average” ship in Charleston could be Post-Panamax by 2018.

As ship tonnage grows, so does ship draft, length, beam, and height (air draft). Each of these parameters is critical to navigation safety and port capability. Turning basins are particularly critical to a port’s ship handling capabilities. Turning basins must be situated where ships can access them without air draft restrictions, and must have sufficient width and depth to safely handle longer, wider, and deeper vessels.



**Figure 2 Average Gross Tonnage Per Ship**

Charleston is already handling a significant number of Post-Panamax ships. Through August of 2011, 131 (or 15%) of the container ships calling on the port were Post-Panamax in size. Of all container ship calls in this same period, 264 inbound or outbound transits were deeper than current Panamax draft, which represents 21 percent of all container ship transits here that year.

## ***Public and Agency Concerns***

NEPA scoping was an important part in the development of study objectives and in determining the significant concerns of the public and agencies. The following main issues have generated comments and concerns from stakeholders, and are discussed in this report:

- (a) ***NEPA process related:*** It was stated that the USACE should avoid an overly restrictive statement of purpose in the Draft EIS that limits the alternatives analysis.
- (b) ***Economics:*** The general public and agencies want to understand how the project will use updated economic data, including growth trends to evaluate alternatives.
- (c) ***Salinity Impacts:*** How the proposed deepening may affect salinity levels within the Charleston Harbor has generated substantial concern and comments. Specifically, this concern relates to impacts to wetland communities, intrusion to the Bushy Park reservoir, and groundwater.
- (d) ***Sea level rise:*** Many citizens, stakeholder, and agencies were concerned about the impact of sea level rise cumulatively evaluated with the impacts of the project.
- (e) ***Dissolved oxygen:*** Many citizens, stakeholder, and agencies were concerned about the impact of the proposed project on the existing dissolved oxygen concerns in Charleston Harbor. References were made to the existing Total Maximum Daily Load (TMDL) that regulates the amount of oxygen demanding substances can be discharged into the Harbor without contravening the water quality standard.
- (f) ***Sediment quality and disposal:*** Must thoroughly review impacts related to sediment toxics and dredged material disposal.
- (g) ***Fish and wildlife habitat:*** Many comments were related to ensuring that the project won't significantly impact threatened and endangered species as well as other fish and wildlife resources, including bird habitat.
- (h) ***Shoreline Erosion:*** The general public and agencies are concerned with existing erosion problems facing many areas in Charleston Harbor and how the proposed deepening may affect this issue. Some of these stakeholders have also requested that USACE place dredged material along certain shorelines to reduce the effects of erosion. These areas include Crab Bank, Morris Island, Shutes Folly, Ft. Sumter, etc.
- (i) ***Air quality:*** The general public and agencies want to understand how the project will influence air quality in the region, including priority pollutants, toxics and greenhouse gases. Also of concern was the potential concentration of pollutants in certain areas and impacts to environmental justice communities.
- (j) ***Cultural resources:*** The general public and agencies were concerned about impacts to cultural and historic resources both in water and land-side.

## **5.0 Opportunities (Paragraph 3.1.2 – Final Report)**

Opportunities are desirable future conditions that address the specific problems. A number of opportunities were identified in the initial step of the planning process. Opportunities addressed in this study include:

- 1) The opportunity to bring the forecasted volume of goods into the Harbor on fewer ships;

- 2) The opportunity to eliminate or reduce navigational restrictions and inefficiencies (*i.e.*, channel depth limitations) to enable maritime carriers to realize the transportation economies of scale without adversely impacting their shipping operations;
- 3) The protection, restoration, and creation of environmental resources through the beneficial use of dredged material.

## **6.0 Planning Goals/Objectives (Paragraph 3.2 – Final Report)**

Planning objectives are statements that describe the desired results of the planning process by solving or alleviating the problems and taking advantage of or realizing the opportunities. Developing specific, flexible, measurable, realistic, attainable, and acceptable objectives and constraints is critical to the success of the entire planning process. The NED objective is not specific enough for direct use in plan formulation. The water and related land resource problems and opportunities identified in this study are targeted by specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect desired positive changes relative to the without project conditions.

The Primary objective for the study is to maximize, to the extent practical, Charleston Harbor's contribution to national economic development by addressing inefficiencies in the existing navigation system's ability to serve the forecasted vessel fleet and process the associated cargo.

The primary planning objective was used to identify the following goals:

- 1) Reduce navigation transportation costs of import and export trade through Charleston Harbor and contribute to increases in national economic development (NED) over the period of analysis;
- 2) Reduce navigation constraints facing harbor pilots and their operating practices including limited one-way traffic in certain reaches; and
- 3) Develop an alternative that is environmentally sustainable for the period of analysis.

The alternatives must be compared from the perspective of the NED, Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE) accounts and found to be acceptable in each case. Plans are formulated to be complete, effective, efficient and acceptable, and to reasonably maximize net benefits.

## **7.0 Planning Constraints (Paragraph 3.1.3 – Final Report)**

Constraints are restrictions that limit the planning process. Constraints are designed to avoid undesirable changes between without and with project future conditions. Specific study constraints associated with Charleston Harbor include:

- 1) Bridge horizontal clearances and air draft restrictions (A full description of the bridge constraints can be found in the Existing Conditions section of this document)
  - Ravel Bridge (Horizontal Clearance 1000'; Vertical Clearance (air draft) 186')
  - Don Holt Bridge (Horizontal Clearance 700'; Vertical Clearance 155')
- 2) Underkeel clearance of ships using the harbor

- 3) Avoid conflict with Federal and State regulation, as stated in Federal law, USACE regulations, executive orders and State of South Carolina statutes.
- 4) Avoid violating maritime safety requirements
- 5) Avoid unacceptable impacts to shallow water aquifers
- 6) Avoid unacceptable impacts to cultural resources
- 7) Avoid unacceptable impacts to landside infrastructure
- 8) Avoid unacceptable impacts to any threatened or endangered species
- 9) Avoid unacceptable impacts to dissolved oxygen within the harbor
- 10) Avoid unacceptable impacts to special aquatic resources, specifically freshwater wetlands

## **8.0 Formulating Alternative Plans (Paragraph 3.5 – Final Report)**

In accordance with 40 CFR 1502.14, USACE will “rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives eliminated from detailed study, briefly discuss the reasons for their having been eliminated.” For this report, a reasonable alternative is defined as one that meets the study objectives and is under the USACE’s congressionally authorized jurisdiction to implement.

A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Measures are grouped together and assembled to create alternative plans. They can be categorized as either nonstructural or structural measures.

The following nonstructural management measures were identified to improve navigation in Charleston Harbor: additional tugs; trucking more cargo; offshore port; light-loading of vessels to accommodate larger vessels under the existing depths; use of tide to transit larger vessels under existing conditions; lightering; and designate existing deep water areas for widening measures for accommodating ship passing.

Three basic structural measures were identified to meet the objectives/purpose and need of providing transportation cost savings in Charleston Harbor. These include: deepening channels; widening channels; and enlarging turning basins.

### ***Screening of Measures***

As outlined above, a wide variety of measures were considered, some of which were found to be infeasible due to technical, economic, or environmental considerations. Each measure was assessed and a determination made whether it should be retained in the formulation of alternative plans. The remaining measures were carried forward to assemble plans, and the plans were then evaluated based on their ability to address the study objectives.

The individual measures were evaluated considering the following technical and environmental factors:

- Cubic yards of rock & non-rock material at 1-foot increments by channel reach
- Cubic yards of shoaling material from increased dredging prism (EFDC modeling)
- Cubic yards of confined disposal area requiring replacement by new work material

- New work construction dredging and associated costs by segment
- Increased O&M dredging costs resulting from deeper/wider/extended dredging prism
- Acres of environmental resources impacted from navigation improvements, if any
- Future ERDC Ship simulation model optimizing widening/deepening measures
- Water quality/wetland impacts with changes in salinity wedge in the Cooper River.
- Water quality impacts for changes in Dissolved Oxygen levels in the Cooper River.
- Projected Import and Export Growth of Charleston Harbor.
- Potential impacts to Federally listed Threatened and Endangered Species.
- Long-term management of dredged material
- Projected future fleet calling on Port.
- Compliance with Federal Regulations/Corps Policy

Additionally, the following economic factors were used to evaluate the measures:

- Costs comparison for new work dredging to targeted depths and associated costs
- Mitigation plan incremental cost analysis - potential mitigation costs for negative impacts
- Determination of net benefits
- Potential beneficial uses of dredged material
- Post project Operations and Maintenance Costs increases over existing O&M

### ***Key Uncertainties***

Several key assumptions and were used in the evaluation process. The key uncertainties related to those assumptions include:

- The New SCSPA Terminal (Charleston Naval Base Container Terminal) will be completed and operational for the period of analysis. (Permits exist and construction is in progress.)
- The ODMDS will need to be expanded or a new ODMDS designated in order to meet the needs of new work material and 50 years of maintenance material. This will be accomplished through either an EPA ruling on the boundary of the current ODMDS or a new Section 102 (MPRSA) designation through the EPA.
- Container load factor analysis will not require revision once approved by vertical chain.
- Fleet and commodity forecast will only require a one-time review and approval.
- Salinity intrusion up the Ashley and Wando Rivers will likely be minimal. (This assumption will be confirmed by modeling and monitoring.)
- The existing Bushy Park salinity monitoring system and procedures would minimize any project impacts related to upstream salinity intrusion up the Cooper River.
- The discharge from Pinopolis Dam to the Cooper River will remain relatively constant during the period of analysis.

Some of the non structural measures discussed in the above section (which arose from internal meetings and coordination meetings with resource agencies and the sponsor), i.e., (1) the use of additional tugs, (2) trucking of goods from other areas, (3) light loading vessels to accommodate larger vessels, (4) lightering of vessels, and (5) use of tide to transit larger vessels under existing conditions do not fall within the jurisdiction of the lead agency (USACE). While NEPA requires agencies (i.e., USACE with its cooperating partners) to review “reasonable alternatives not within the jurisdiction of the lead agency” (40 CFR 1502.14(c)), these measures do not efficiently address the Study objectives. Therefore, under the evaluation criteria, they were removed from further consideration by the USACE. However, USACE will readily review any information/plans from other agencies or the public demonstrating the feasibility of these alternatives if they can be shown to meet project objectives.

The remaining measures were carried forward to assemble a range of alternatives. These measures include:

- Non-structural Widener (Designating naturally deep water areas for widening measures)
- Deepening
- Widening
- Enlarging Turning basins

To assist in the development of alternatives, the existing federal channels were divided into five planning segments based primarily on which terminals would be served (ships and cargo that would be served), and physical factors such as air draft constraints and wave and current conditions that affect underkeel clearance requirements and vessel maneuverability. These segments are illustrated in Figure 3, below, and include:

**Segment 1:** Entrance Channel to Wando Turning Basin/Wando Welch Terminal

**Segment 2:** Drum Island to Daniel Island Reach/ New SCSPA Terminal

**Segment 3:** Daniel Island Bend to Ordnance Reach/N. Charleston Terminal

**Segment 4\*:** Custom House to Town Creek Lower Reach/Columbus Terminal

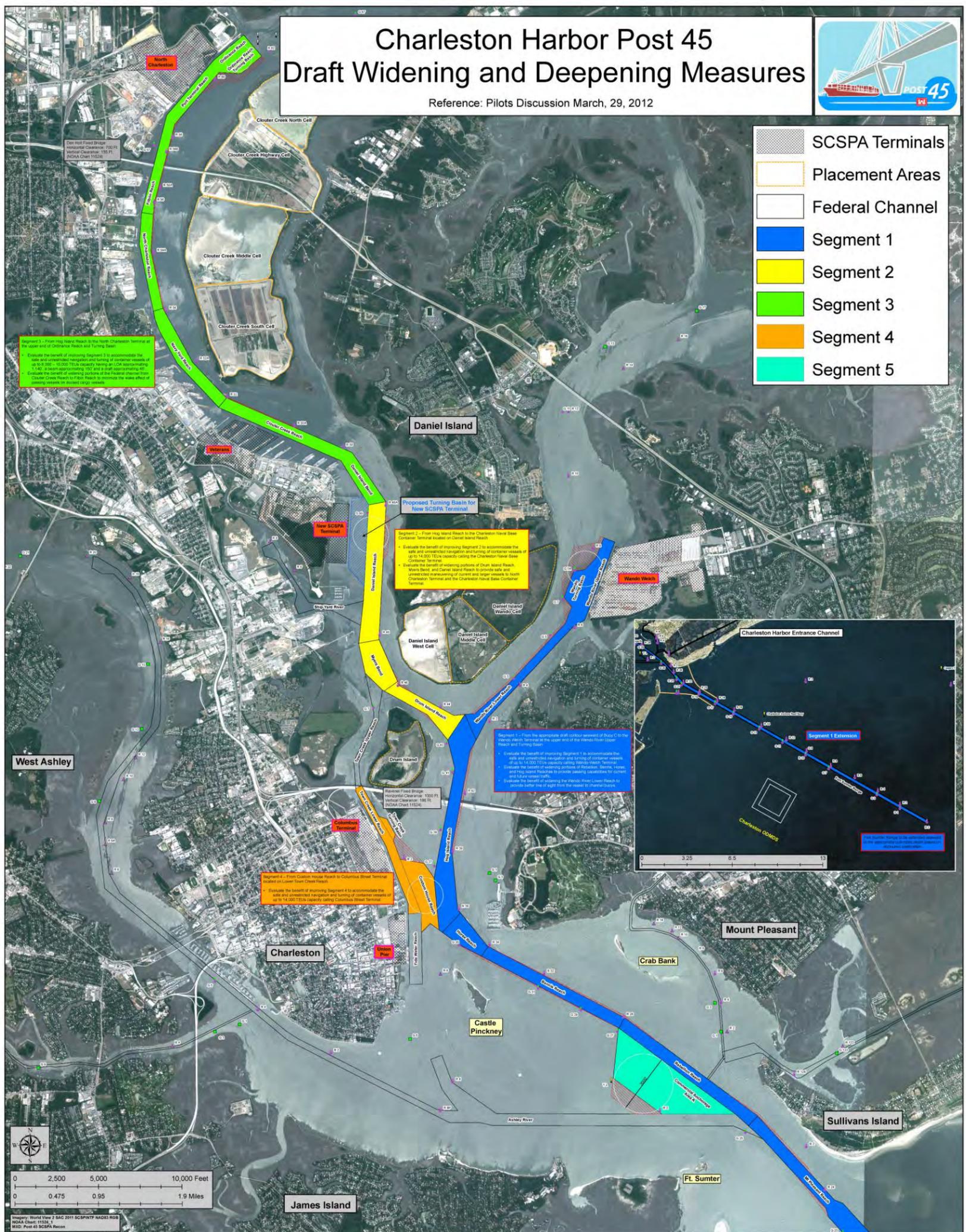
**Segment 5\*:** Anchorage Area A

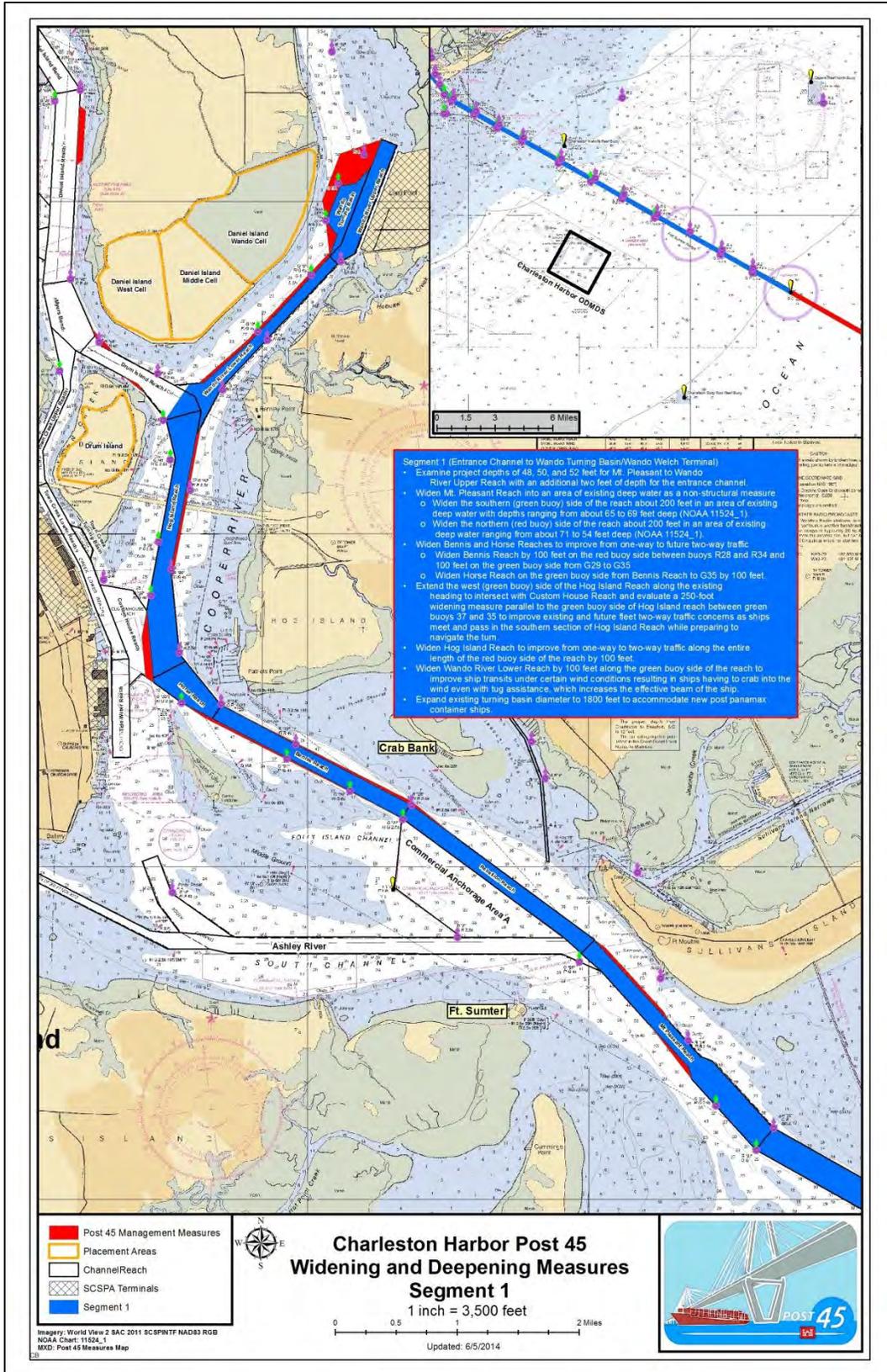
Two of the five segments initially considered for modification were eliminated early in the screening process. The eliminated segments include Segment 4 (channel leading from the main lower harbor channel to the Columbus Terminal) and Segment 5, ( Anchorage Area A). In a letter dated July 13, 2012, the non-Federal sponsor indicated that no future business plans existed to expand areas serviced by those segments. The Columbus Terminal serves as a roll-on/roll-off terminal and the ships using that facility do not have draft restriction in the present authorized depth of 45 feet. Segment 5 is the anchorage area just inside the entrance channel. The authorized depths have not been maintained due to lack of funding and minimal usage in the past. While conversations with maritime interests and the U.S. Coast Guard indicate commercial interest exists to reactivate this facility, estimated costs of deepening the anchorage area precludes this action from being within the federal interest at this time.

In summary, these segments have been eliminated due to lack of need and associated lack of economic justification.

The measures considered in Segments 1, 2 and 3 are illustrated in Figures 4, 5 and 6, respectively and the Plan Formulation: Section 3 Reference Aid at the end of this document.

Figure 3: Planning Segments





Figures 4. Segment 1 deepening and widening measures carried forward

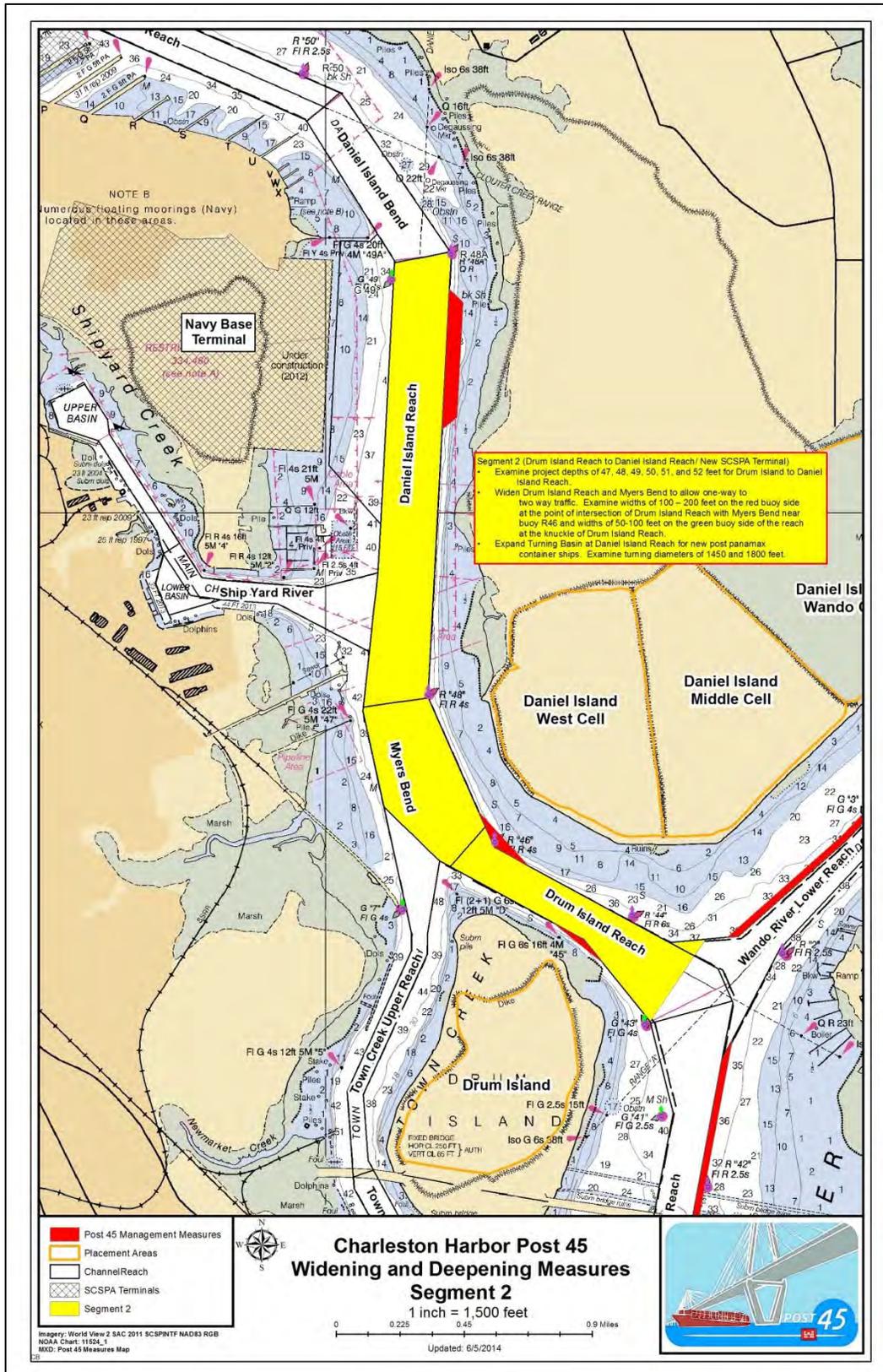


Figure 5. Segment 2 deepening and widening measures carried forward

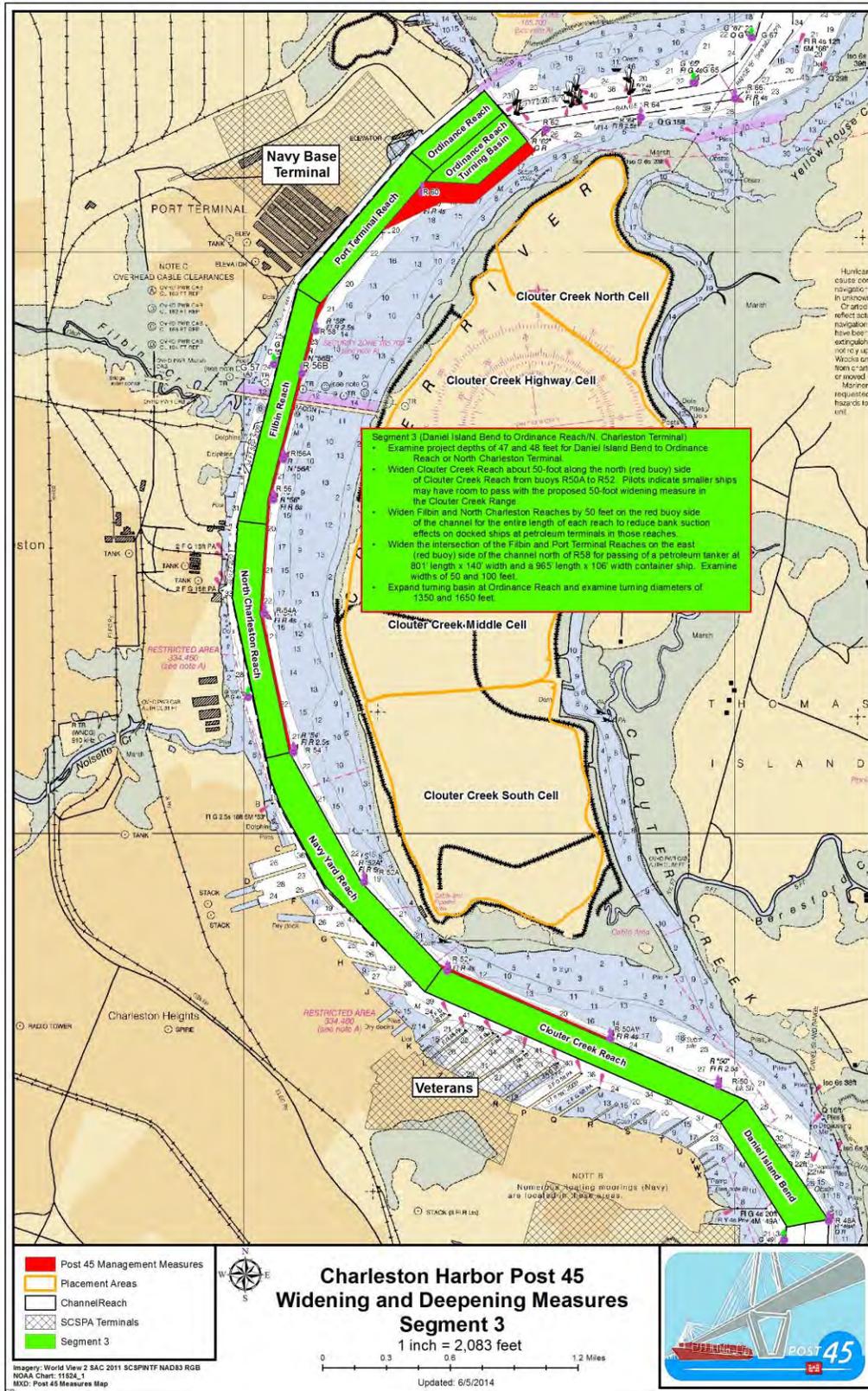


Figure 6. Segment 3 deepening and widening measures carried forward

### ***Initial Array of Alternative Plans***

Alternative plans include combinations of screened management measures. Meetings and coordination with the Sponsor (South Carolina State Ports Authority), terminal operators, the Charleston Branch (Harbor) Pilots' Association, the U.S. Coast Guard, the Charleston Harbor Navigation Safety Committee, maritime interests, environmental resource agencies, and interested individuals attending a public workshop held on December 13, 2011, helped identify/screen widening and turning basin measures to solve navigation problems. The Project Delivery Team (PDT) combined proposed widening and turning basin measures into structural and nonstructural alternatives based on terminal locations for ships providing benefits. USACE policy considers measures that generate benefits interdependently as inseparable and recommends including those measures collectively in the formulation of alternative plans.

Initially, the deepening measures included incremental depths of 47, 48, 49, 50, 51, and 52 feet within the inner harbor segments with the entrance channel at +2 feet. When these measures were combined to assemble alternatives, the large number of possible combinations resulted in a very large number (294 ) of alternatives, which includes 98 deepening only plus 196 widening and turning basin expansion options. The Table Top (Desktop exercise) involving ERDC ship simulation representatives and the Charleston Harbor and Docking Pilots helped reduce the 294 alternatives to a proposed ship simulation test matrix (scheduled for the Planning, Engineering, and Design [PED] phase of the study) consisting of 128 ship simulation runs (84 runs involving no channel widening, 50-foot, and 100-foot widening increments plus 44 runs including 1350-foot, 1450-foot, 1650-foot, and 1800-foot turning basin diameters). With the exception of the Entrance Channel and Drum Island Reach, the widening alternatives were developed to examine incremental 50-foot widening measures. For example, if simulator-run Alternate 1 was deepening with no widening, simulator-run Alternate 2 would be 50 ft widening, and simulator-run Alternate 3 would be 100 ft widening. Preliminary cost and benefit analysis with the Transportation Cost Savings Model reduced the number of alternatives to 54 then 44.

A decision to analyze alternative depths at 2-foot increments instead of 1-foot increments further decreased the number of alternatives. Additional decisions related to entrance channel width requirements (based on professional judgment) and screening of alternatives based on preliminary cost and benefit estimates, operational considerations, and environmental acceptability reduced the number of alternatives to six to be evaluated in greater detail and later to three which were more thoroughly evaluated. The Initial Alternative screening process is summarized in Table 2, below. Additional details about specific decisions can be found in the decision log.

**Table 2: Summary of Initial Alternative Screening**

Screening Date	Number of Alternatives Considered	Estimated Net NED Benefits	Apparent NED Plan	Benefit to Cost Ratio	Comments
May-12	294	\$0	N/A	N/A	Initially identified alternatives with all reasonable measures in all segments at 1-foot increments from 47'-52' depths, which resulted in 98 deepening only plus 196 widening and turning basin options for 294 total.
Sep-12	54	\$25,900,000	50'-48'	4.7	Determined Entrance Channel width requirements based on design vessels from the fleet forecast; Eliminated Segment 4 (Columbus Terminal) & Segment 5 (Anchorage Area) based on lack of cost effectiveness of measures in those segments. Transportation Cost Savings Model was used to screen preliminary measures and alternatives based on cost effectiveness.
Nov-12	44	\$85,200,000	50'-48'	6.8	Several alternatives were eliminated based on lack of cost effectiveness. Briefly considered subdividing Segments 1 and 2 and evaluating a 48' depth to the Wando Terminal/50' depth to the Navy Base Terminal and 50' depth to the Wando Terminal/48' depth to the Navy Base Terminal. However, those alternatives were eliminated based on practical operational considerations.
Oct-13	6	\$81,300,000	52'-48'	5.6	Limited the range of depth alternatives being considered to 48-52 feet based on economic benefit results generated by the HarborSym Model and made decision to use 2-foot increments instead of 1-foot increments based on considerations associated with the time and costs to run the models and potential variation from forecasted vessel fleet and cargo volume data. The alternatives carried forward for detailed evaluation included: 48'-48', 50'-48', 52'-48', 48'-47', 50'-47', and 52'-47'. All of these alternatives assumed maximum widening measures based on safety and operational considerations. The size of these measures will be reconsidered based on ship simulation which will be conducted during the PED phase.

***Focused Array of Alternative Plans***

Once the focused array of alternatives was identified, a naming convention was developed. The alternatives are identified using a combination of two numbers separated by a “/” such as 48/48, 50/47 or 52/48. The numbers represent alternative depths in Segments 1 and 2 (Lower Harbor) and in Segment 3 (Upper Harbor), respectively. For example, the 50/48 alternative proposes authorized depths of 50 feet in the Lower Harbor and 48 feet in the Upper Harbor. In all cases, the entrance channel depths are 2 feet greater than the lower harbor depths to account for ship movement and wave conditions in the Atlantic Ocean

More detailed analysis of the costs and economic benefits associated with the six remaining alternatives was performed. The results are summarized in Table 3.

**Table 3 Economic Summary of Focused Array of Alternatives**

Preliminary Benefits Analysis (HarborSym - Origin to Destination) as of 8 Aug 2013 Preliminary Costs at FY14 (10-01-13 Price Levels) Federal Discount Rate FY14 = 3.5%					
Alternative	Project Costs	AAEQ Benefits	AAEQ Costs	Net Benefits	Screening Result
52/48	\$411,214,367	\$98,820,000	\$17,531,594	\$81,288,406	Continue to Evaluate
50/48	\$341,174,783	\$94,150,000	\$14,545,547	\$79,604,453	Continue to Evaluate
48/48	\$247,816,309	\$81,540,000	\$10,565,329	\$70,974,671	Continue to Evaluate
52/47	\$399,895,545	\$84,410,000	\$17,049,031	\$67,360,969	Eliminated due to low net benefits
50/47	\$330,287,683	\$80,320,000	\$14,081,389	\$66,238,611	Eliminated due to low net benefits
48/47	\$240,183,716	\$67,140,000	\$10,239,923	\$56,900,077	Eliminated due to low net benefits

Based on the relatively low difference in average annual costs (less than \$500,000) and large difference in average annual net benefits (about \$14,000,000) associated with the dredging Segment 3 to 48 feet compared to 47 feet, the alternatives that included a 47 foot depth in Segment 3 were eliminated from further consideration.

In addition to screening out the alternatives with 47 foot depths in Segment 3, the analysis shows that the alternatives with depths of 48 feet and greater in Segments 1 and 2 generate the majority of the total benefits and are incrementally justified based on increased net benefits for each increment.

## **8.0 Evaluation of Final Array of Alternative Plans**

Throughout the screening process, non-economic factors are considered with the intent to identify factors that would significantly influence the decision. These include environmental and social factors that could exhibit meaningful differences between alternatives. In this case, no such factors were identified within the range of alternatives that were evaluated. Table 4 provides a comprehensive comparison of the three alternatives still being evaluated as well as the existing condition and no action alternatives. Table 5 presents a more concise set of economic information and the results of the screening effort.

Table 4: Summary Comparison of Final Alternatives (Report Synopsis 9.0)					
* Denotes Items Specified in Section 122 of Public Law 91-611					
CONDITION WITH ALTERNATIVE PLANS					
SEGMENTS 1 + 2 + 3 (ALTERNATIVE 5)					
ITEM	EXISTING CONDITION	WITHOUT (NO ACTION) CONDITION	48-FOOT DEPTH Segments 1 & 2 / 48- FOOT DEPTH Segment 3	50-FOOT DEPTH Segments 1 & 2 / 48-FOOT DEPTH Segment 3	52-FOOT DEPTH Segments 1 & 2 / 48-FOOT DEPTH Segment 3
A. PLAN DESCRIPTION	Conditions that existed during navigation study from 2011 - 2015 based on field data, published information and data collected from the public	Most probable future with no navigation improvements in the study area	• Deepen the entrance channel from 47 feet to 50 feet over the existing 800-foot bottom width. • Extend the entrance channel approximately 1.5 miles seaward from to the 50-foot project depth contour. • Deepen the inner harbor from 45 feet to 48 feet over varying bottom widths from 400 to 1,800 feet • Enlarge the existing turning basins at the Wando Welch , the new SCSPA terminal, and the North Charleston Terminal • Place dredged material from the upper harbor reaches at the existing upland confined disposal facilities at Clouter Creek, Yellow House Creek, and/or Daniel Island; and for material dredged from the lower harbor, place at the Ocean Dredged Material Disposal Site (ODMDS). See Figures _ and _ in the Executive Summary.	Deepen the entrance channel from 47 feet to 52 feet over the existing 800-foot bottom width. • Extend the entrance channel approximately 3 miles seaward to the 52-foot project depth contour. • Deepen the inner harbor from 45 feet to 50 feet and 48 feet over varying bottom widths from 400 to 1,800 feet • Enlarge the existing turning basins at the Wando Welch , the new SCSPA terminal, and the North Charleston Terminal • Place dredged material from the upper harbor reaches at the existing upland confined disposal facilities at Clouter Creek, Yellow House Creek, and/or Daniel Island; and for material dredged from the lower harbor, place at the Ocean Dredged Material Disposal Site (ODMDS). See Figures _ and _ in the Executive Summary.	Deepen the entrance channel from 47 feet to 54 feet over the existing 800-foot bottom width. • Extend the entrance channel approximately 3 miles seaward to the 54-foot project depth contour. • Deepen the inner harbor from 45 feet to 52 feet and 48 feet over varying bottom widths from 400 to 1,800 feet • Enlarge the existing turning basins at the Wando Welch , the new SCSPA terminal, and the North Charleston Terminal • Place dredged material from the upper harbor reaches at the existing upland confined disposal facilities at Clouter Creek, Yellow House Creek, and/or Daniel Island; and for material dredged from the lower harbor, place at the Ocean Dredged Material Disposal Site (ODMDS). See Figures _ and _ in the Executive Summary.
B. SIGNIFICANT IMPACTS					
1. National Economic Development					
a. Beneficial Effects					
(1) Commercial (Annualized)	None	None	\$87,614,201	\$101,621,011	\$107,492,499
(2) Recreational	None	None	None	None	None
b. Adverse Effects					
(1) Commercial	Causes inefficient operations of vessels and terminal facilities resulting in a waste of the nation's economic resources	No significant change from EXISTING CONDITION	Some inefficient operations of deeper draft commercial vessels but an overall improvement over existing conditions	Improvement over conditions with 48-foot/48-foot project depths	A very minor adverse effect on commercial vessel usage, continued improvement over 48-foot/50-foot project depth
(2) Recreational	None	None	None	None	None
(3) Alternative First Costs	None	None	\$379,017,326	\$457,055,248	\$528,458,301
(4) Altern' Plan Annual Cost	None	None	\$21,257,060	\$25,408,984	\$29,380,678
(5) Altern' Plan Net Annual Benefits	None	None	\$66,357,141	\$76,212,027	\$78,111,821
(6) Benefit/Cost Ratio	None	None	4.12	4.00	3.66
2. NEPA Environmental Quality*					
a. Manmade Resources (Adverse & Beneficial Effects)	Results in inefficient use of fuels, labor, and other manmade products in the operatio of commercial vessels.	Same as existing condition	A manmade channel does not totally eliminate inefficiency as described under existing conditions, but greatly reduces the impact and provides a valuable resource for the area	Same as 48-foot/48-foot project depth but with more efficient operations as a result of more depth	Same as 48-foot/48-foot project depth but with even higher level of efficient operations as a result of more depth
b. Natural Resources					
(1) Air	Stack exhaust gases from vessel propulsion plant add to pollution in the air while ships wait for favorable tides	No significant change from existing condition	Reduction in emissions compared to FWOP.	Reduction in emissions compared to the 48/48	Reduction in emissions compared to the 50/48
(2) Water/DO	Storms and vessel traffic suspend bottom material in waters causing turbidity	No significant change from existing condition. Saturation of dissolved oxygen will continue to be reduced due to increased salinity.	Less probability of material suspension from vessel traffic. Periodic and temporary suspension of materials from construction and maintenance dredging causing localized turbidity and decreased oxygen levels similar to some storm conditions. The alternative will generally result in reduced oxygen concentration and saturation potential within the harbor. The average delta DO is -0.019mg/L throughout the harbor. If TMDL analysis doesn't show no impact to the DO standard, the impacts are institutionally significant and could require mitigation. DO injection has been determined to be most likely option.	Less probability of material suspension from vessel traffic. Periodic and temporary suspension of materials from construction and maintenance dredging causing localized turbidity and decreased oxygen levels similar to some storm conditions. The alternative will generally result in reduced oxygen concentration and saturation potential within the harbor. The average delta DO is -0.023mg/L throughout the harbor. If TMDL analysis doesn't show no impact to the DO standard, the impacts are institutionally significant. If TMDL analysis doesn't show no impact to the DO standard, the impacts are institutionally significant and could require mitigation. DO injection has been determined to be most likely option and would require more O2 than 48/48.	Less probability of material suspension from vessel traffic. Periodic and temporary suspension of materials from construction and maintenance dredging causing localized turbidity and decreased oxygen levels similar to some storm conditions. The alternative will generally result in reduced oxygen concentration and saturation potential within the harbor. The average delta DO is -0.027mg/L. If TMDL analysis doesn't show no impact to the DO standard, the impacts are institutionally significant. If TMDL analysis doesn't show no impact to the DO standard, the impacts are institutionally significant. If TMDL analysis doesn't show no impact to the DO standard, the impacts are institutionally significant and could require mitigation. DO injection has been determined to be most likely option and would require more O2 than 48/48.
c. Fish H S I Models			Decrease in fish habitat. Within range of confidence/error of EFDC model.	Slightly greater decrease in fish habitat. Within range of confidence/error of EFDC model.	Slightly greater decrease in fish habitat. Within range of confidence/error of EFDC model.
d. Threatened and Endangered Species	Animals live in a dynamic environment and face extreme conditions throughout much of their lifecycle. They have adapted to these changes through evolution.	No significant change from existing condition	Likely to adversely affect sea turtles, sturgeon sp during the dredging. May affect, but not likely to adversely affect sturgeon sp habitat as a result of channel modifications (negative change in habitat units).	Likely to adversely affect sea turtles, sturgeon sp during the dredging. Greater likelihood of take due to more required dredging. May affect, but not likely to adversely affect sturgeon sp habitat as a result of channel modifications. (slightly greater negative change in habitat units)	Likely to adversely affect sea turtles, sturgeon sp during the dredging. Greater likelihood of take due to more required dredging. May affect, but not likely to adversely affect sturgeon sp habitat as a result of channel modifications. (slightly greater negative change in habitat units)
e. Hardbottoms	N/A	No impacts to hardbottom habitat unless shoaling rates and locations change causing the need for maintenance dredging.	Will result in the potential removal of hardbottom habitat within previously undredged portions of the entrance channel to support the new depth. The impacts will be from direct removal as well as a 5% injury to habitat resulting from turbidity and 28.6 acres	Will result in the potential removal of hardbottom habitat along the slope of the entrance channel to support the new depth. The impacts will be from direct removal as well as a 5% injury to habitat resulting from turbidity and sedimentation from dredging operations. No additional impact from 48/48	Will result in the potential removal of hardbottom habitat along the slope of the entrance channel to support the new depth. The impacts will be from direct removal as well as a 5% injury to habitat resulting from turbidity and sedimentation from dredging operations. No additional impact from 48/48
f. Wetlands	N/A	No direct effects. Predicted sea level rise will cause salinity increases and freshwater wetland plants would transition to more salt tolerant species	Dredging operations would not directly affect wetlands. Predicted indirect effects due to salinity increases and freshwater wetlands species transitioning to more salt tolerant species would impact an estimated 253 acres of herbaceous and forested wetlands.	Dredging operations would not directly affect wetlands. Predicted indirect effects due to salinity increases and freshwater wetlands species transitioning to more salt tolerant species would impact an estimated 288 acres of herbaceous and forested wetlands. (35 more acres than the 48/48 plan)	Dredging operations would not directly affect wetlands. Predicted indirect effects due to salinity increases and freshwater wetlands species transitioning to more salt tolerant species would impact an estimated 493 acres of herbaceous and forested wetlands. (205 more acres than the 50/48 plan). The incremental increase of wetland impacts from 50 to 52 feet is significantly greater than the increase from 48 to 50 feet.
3. Social Well-being					
a. Leisure Opportunities	N/A	N/A	N/A	N/A	N/A
b. Noise	N/A	A greater number of ships of the same approximate size are predicted to call on the port without a project. Underwater noise from maintenance dredging will still occur	Minor adverse impacts to aquatic species due to displacement. Temporary and minor impact to human populations due to the construction of project. Noise from maintenance dredging will take longer due to increased quantities from the no action alternative.	Minor adverse impacts to aquatic species due to displacement. Temporary and minor impact to human populations due to the construction of project. Slightly longer than 48/48. Noise from maintenance dredging will take longer than the 48/48 alternative due to increased quantities.	Minor adverse impacts to aquatic species due to displacement. Temporary and minor impact to human populations due to the construction of project. Slightly longer than 50/48. Noise from maintenance dredging will take longer than the 50/48 alternative due to increased quantities.
c. Aesthetic Values	N/A	No effect to area wide aesthetics. A greater number of ships of the same approximate size are predicted to call on the port without a project.	No effect to area wide aesthetics. Larger ships will transit through the port. Not out of character for the Charleston area. Fewer ships projected to call than the no action alternative.	No effect to area wide aesthetics. Larger ships will transit through the port. Not out of character for the Charleston area. Fewer ships projected to call than the 48/48 alternative.	No effect to area wide aesthetics. Larger ships will transit through the port. Not out of character for the Charleston area. Fewer ships projected to call than the 50/48 alternative.

**Table 5 Preliminary Economic Summary of Final Array of Alternatives**

Preliminary Benefits (HarborSym - Origin to Destination, widening & Tide Delay) as of 30 May 2014 Costs at FY14 (10-01-13 Price Levels) Federal Discount Rate FY14 = 3.5%					
Alternatives	Project Costs	AAEQ Benefits	AAEQ Costs	Net Benefits	Screening Result
52/48	\$528,458,301	\$107,492,499	\$29,380,678	\$78,111,821	Continue to Evaluate
50/48	\$457,055,248	\$101,621,011	\$25,408,984	\$76,212,027	Continue to Evaluate
48/48	\$379,017,326	\$87,614,201	\$21,257,060	\$66,357,141	Eliminated based on low net benefits

Based on significantly lower average annual net benefits of about \$10,000,000/year and the lack of non-economic considerations that should influence plan selection, the 48/48 alternative was dropped from further consideration. Since the average annual net benefits of the 50/48 and 52/48 alternatives were within about \$2,000,000/year, those alternatives were both carried forward for more detailed analysis based on updated cost estimates.

**9.0 Comparison of Final Array of Alternative Plans / Decision Criteria (Table 3.7 Final Report)**

Table 6 below presents the economic data available as of April 2015.

**Table 6 Economic Summary of Final Alternatives**

Benefits (HarborSym - Origin to Destination, widening & Tide Delay) Costs at FY15 (10-01-14 Price Levels) as of April 2015 Federal Discount Rate FY15 = 3.375%					
Alternatives	Project Costs	AAEQ Benefits	AAEQ Costs	Net Benefits	Benefit to Cost Ratio
52/48	\$520,860,000	\$108,900,000	\$27,990,000	<b>\$80,910,000</b>	3.89
50/48	\$476,050,000	\$103,100,000	\$25,700,000	<b>\$77,400,000</b>	4.01

## 10.0 Identifying a Recommended Plan (Paragraph 3.7 [Table 3-7] in the Final Report)

**Table 7.** Summary of final cost and benefits analysis as of April 15

Item	50/48	52/48	Difference
Project Cost	\$476,050,000	\$520,860,000	\$44,810,000
Average Annual Costs	\$25,700,000	\$27,990,000	\$2,290,000
Average Annual Benefits	\$103,100,000	\$108,900,000	\$5,800,000
Net Benefits	\$77,400,000	\$80,910,000	\$3,510,000
Benefit Cost Ratio	4.01	3.89	-0.12

Table 7 above provides the total average annual equivalent (AAEQ) benefits, the AAEQ costs, and the net benefits for the 50/48 and 52/48 alternatives. ER 1105-2-100 (Appendix G, Exhibit G-1) states the following: “Identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the National Economic Development (NED) plan, even though the level of outputs may be less.” While the 52/48 plan in Table 7 absolutely maximizes AAEQ net benefits at \$80,910,000, the 50/48 plan provides AAEQ net benefits of \$77,400,000 or an AAEQ difference of approximately \$3,510,000.

The difference in net benefits is small enough to become subject to the interpretation of the meanings of “reasonably maximizing” and “significantly different” and closer consideration of the differences in the environmental impacts of each alternative. As presented, the cost estimate for each alternative includes the costs to mitigate for environmental impacts and the costs to monitor those impacts and ensure the performance of the mitigation actions during and after construction. Additionally, no unacceptable environmental impacts were identified for either alternative, and the environmental impacts are similar in nature and are not out of proportion in magnitude when compared with each other and the No Action Alternative. After careful consideration, the USACE decided to identify the 50/48 alternative as the tentative NED Plan in the draft report, and then finalize the identification of the NED Plan in the Final Integrated Feasibility Report and EIS. The NED Plan presented in the final document could be the 50/48 alternative, 52/48 alternative, or an alternative between or outside those depths if justified by additional analysis.

In accordance with ER-1105-2-100, study recommendations may deviate from the NED plan if requested by the non-Federal Sponsor and approved by the ASA (CW). If the sponsor prefers a plan more costly than the NED plan and the increased scope of the plan is not sufficient to warrant full Federal participation, the ASA (CW) may grant a waiver from the requirement to recommend the NED Plan as long as the sponsor pays the difference in cost between the NED Plan and what is known as the Locally Preferred Plan (LPP). In this case, the LPP must have outputs similar in kind, and equal to or greater than the outputs of the NED Plan. It may also have other outputs. The incremental benefits, impacts, and costs of the LPP, beyond the NED Plan, must be analyzed and documented in the Feasibility Report.

## **10.1 Deviation from the NED Plan-Reasons for the LPP [Para. 3.7.1 - Final Report]**

Following the USACE decision to tentatively identify the 50/48 alternative as the NED Plan in the draft report and to reassess that decision for the final report, the SCSPA submitted a letter dated August 20, 2014, formally requesting that the 52/48 plan be considered as an LPP. Accordingly, the SCSPA acknowledged a willingness to pay for the incremental cost of the project (\$45 Million – Table 7 above) to achieve the LPP if the USACE does not identify the 52/48 alternative as the NED Plan when it reassesses its decision.

The Charleston District submitted a request for a waiver from the requirement to recommend the NED Plan on 22 August 2014, which the ASA(CW) approved on 1 Oct 14. The SCSPA believes that modern containerships requiring 48 feet of draft and appropriate under keel clearance will be the dominant vessels calling within the next 5 years. The port wants the ability to handle this class of Generation II and III containerships without tidal restrictions. Additionally, the SCSPA has expressed a desire to avoid the need for, and costs associated with additional studies, separate construction, and environmental impacts that would result if a follow-up feasibility study would be needed within the foreseeable future.

## **10.2 LPP Economic Considerations [Para. 3.7.1.1 – Final Report]**

The SCSPA has elected to pay for the additional 2 feet of project depth in Segments 1 and 2 based on its own assessment of the future utilization of Post-Panamax (Generation II and III) container vessels at Charleston Harbor. The SCSPA strongly believes that modern container vessels requiring 48-feet of draft with appropriate allowable under keel clearance will be the dominant service vessel calling at their facilities within the next 5 years. The SCSPA wants the ability to handle this class of Generation II and III container vessels without tidal restriction in order to serve one of the fastest growing regions in the country, which has experienced a resurgence of manufacturing and continued agricultural success.

The benefits are derived from the container vessel portion of the fleet. The LPP has more net benefits than the NED plan and the benefits of the LPP are similar in kind (i.e., transportation cost savings). The 52/48 alternative derives its higher net benefits from the Post-Panamax Generation III container vessel that is a portion of the future vessel fleet calling on the Port of Charleston, with a slight shift to a deeper draft depth compared with a 50-foot channel.

## **10.3 LPP Environmental Considerations (Para. 3.7.1.2 – Final Report)**

The LPP (323.7 acres) and NED (231.6 acres) plans have similar mitigation requirements, with the LPP requiring an additional 92.1 acres more wetland mitigation than the NED Plan. Adverse environmental impacts have been avoided and minimized as described in Section 3.6.3.1 of the final report. Mitigation requirements for the unavoidable adverse environmental impacts related to the NED plan and the LPP are included in Table 8 below, which contains required acreages for the preservation of wetlands. Mitigation for impacts to approximately 28.6 acres of hardbottom habitat within the channel would be the same for both the NED plan and LPP. The least cost plan for placement of rock involves constructing eight new 33-acre reef sites to mitigate for hardbottom impacts within the navigation

channel. The project includes other potential beneficial uses of dredged material, which will be examined during the PED phase.

**Table 8. Wetland impacts and wetland mitigation**

<b>Wetland Impacts</b>	<b>50/48</b>	<b>52/48</b>
Ashley River forested wetlands	3.52 acres	4.36 acres
Ashley River marsh wetlands	10.86 acres	13.16 acres
Cooper River forested wetlands	89.65 acres	126.37 acres
Cooper River marsh wetlands	127.57 acres	179.83 acres
<b>Total</b>	<b>231.60 acres</b>	<b>323.72 acres</b>
<b>Total Acres of Wetland Mitigation Required <sup>2</sup></b>	<b>476</b>	<b>665.6</b>

<sup>2</sup> Estimated value based on functions within example area

#### **10.4 Description of the Recommended Plan (RP) (Para. 4.1 - Final Report)**

The Section 4 Reference Aid, located at the end of this section, provides a summary of the proposed changes and illustrates the general locations of the RP’s major features. Figures 3, 4, 5, and 6 provide more detailed descriptions and locations of the RP’s features.

#### **10.5 RP General Navigation Features (Para. 4.1.1 – Final Report)**

General navigation features include channels, jetties or breakwaters, locks and dams, basins or water areas for vessel maneuvering, turning, passing, mooring or anchoring incidental to transit of the channels and locks. Also included are dredged material disposal areas (except those for the inland navigation system, the Atlantic Intracoastal Waterway and the Gulf Intracoastal Waterway) and sediment basins. See the Recommended Plan Reference Aid at the end of this document.

The RP proposes to extend and deepen the entrance channel in combination with deepening and widening the inner harbor channels that primarily serve containerships. The proposed navigation improvements are described in more detail in the bullets and text that follow:

- Deepen the existing entrance channel from a project depth of -47 feet to -54 feet MLLW over the existing 800-foot bottom width, while reducing the existing stepped 1,000-foot width to 944 feet from an existing depth of -42 feet to a depth of -49 feet MLLW. The proposed deepening of the entrance channel also includes 1 to 2 feet of required overdepth dredging and up to 2 feet of allowable overdepth dredging as shown on Section 5 Reference Aid at the end of the document.
- Extend the entrance channel approximately three miles seaward to match to about the -57 foot MLLW contour.
- Deepen the inner harbor from an existing project depth of -45 feet to -52 feet MLLW to the Wando Welch Terminal on the Wando River and the new SCSPA Navy Base Terminal on the Cooper River, and from -45 feet to -48 feet MLLW for the reaches above that facility to the North Charleston Terminal (over varying expanded bottom widths ranging from 400 to 1,800

feet). The proposed deepening of the inner harbor also includes overdepth dredging and advance maintenance dredging as outlined in Appendix A (Engineering).

- Enlarge the existing turning basins to a 1,800-foot diameter at the Wando Welch and new Navy Base Terminals to accommodate Post Panamax Generation 2 and 3 containerships.
- Enlarge the North Charleston Terminal turning basin to a 1,650-foot diameter to accommodate Post Panamax Generation II and Generation III containerships. A turning basin at the new Navy Base Terminal will be part of the existing condition prior to the base year of the study (2022).
- Raise dikes and place dredged material from the upper harbor at the existing upland confined disposal facilities at Clouter Creek, Yellow House Creek, and/or Daniel Island; place material dredged from the lower harbor and sediment from the entrance channel at the expanded Ocean Dredged Material Disposal Site (ODMDS). Place some of the rock dredged from the entrance channel along the outside of the entrance channel and along the edges of the ODMDS to create hardbottom habitat.

## **11.0 Key Social and Environmental Factors (Para. 4.1.2 Mitigation – Final Report)**

This paragraph outlines the general compensatory mitigation requirements associated with the Recommended Plan. More detailed information about the impacts and the mitigation are provided in Section 4.3 of the final report and several supporting appendices (primarily Appendix P). The RECOMMENDED PLAN would indirectly impact about 281 acres of freshwater wetlands (emergent and forested) through changes in salinity, which could require compensatory mitigation in the form of preservation and conveyance of an estimated 831 acres to the US Forest Service (See Appendix P). Additionally, direct impacts to about 29 acres of hardbottom habitat within the footprint of the entrance channel extension footprint require mitigation. To compensate for impacts to hardbottom habitat, rock dredged from the entrance channel would be used to construct artificial reefs. Two reefs would be constructed specifically to compensate for lost habitat in the channel and 6 reefs would be constructed as a beneficial use of dredged material. In total, 8 new 33-acre artificial reefs would be created along the margins of the entrance channel. Additionally, at the request of the South Carolina Department of Natural Resources (SCDNR), approximately 240,000 cy of rock material would also be placed at SCDNR's existing 25 acre Charleston Nearshore Reef. The total quantity of reef habitat created far exceeds the required mitigation. However, construction of the reefs near the entrance channel is less expensive than transporting the material to the ODMDS. The total amount of reef habitat created was limited based on conversations with SCDNR biologists in order to maintain an appropriate and productive balance of habitat types in the area.

### **11.1 Stateholders Perspectives and Differences (Para. 7.2 – Final Report)**

The NEPA Scoping meeting was held on December 13, 2011, at Mark Clark Hall, the Citadel. The purpose of the meeting was to solicit for views and comments regarding environmental and cultural resources, study objectives, and other important features/concerns in the study area. The following list

identifies the main issues have generated comments and concerns from stakeholders, and are discussed thoroughly within the Final EIS:

- (a) **NEPA process related:** It was stated that the USACE should avoid an overly restrictive statement of purpose in the Final EIS that limits the alternatives analysis.
- (b) **Economics:** The general public and agencies want to understand how the project would use updated economic data, including growth trends to evaluate alternatives.
- (c) **Salinity Impacts:** How the proposed deepening may affect salinity levels within the Charleston Harbor has generated substantial concern and comments. Specifically, this concern relates to impacts to wetland communities, intrusion to the Bushy Park reservoir, and groundwater.
- (d) **Sea level rise:** Many citizens, stakeholder, and agencies were concerned about the impact of sea level rise cumulatively evaluated with the impacts of the project.
- (e) **Dissolved oxygen:** Many citizens, stakeholder, and agencies were concerned about the impact of the proposed project on the existing dissolved oxygen concerns in Charleston Harbor. References were made to the existing Total Maximum Daily Load (TMDL) that regulates the amount of oxygen demanding substances can be discharged into the Harbor without contravening the water quality standard.
- (f) **Sediment quality and disposal:** Must thoroughly review impacts related to sediment toxics and dredged material disposal.
- (g) **Fish and wildlife habitat:** Many comments were related to ensuring that the project won't significantly impact threatened and endangered species as well as other fish and wildlife resources, including bird habitat.
- (h) **Shoreline Erosion:** The general public and agencies are concerned with existing erosion problems facing many areas in Charleston Harbor and how the proposed deepening may affect this issue. Some of these stakeholders have also requested that USACE place dredged material along certain shorelines to reduce the effects of erosion. These areas include Crab Bank, Morris Island, Shutes Folly, Ft. Sumter, etc.
- (i) **Air quality:** The general public and agencies want to understand how the project would influence air quality in the region, including priority pollutants, toxics and greenhouse gases. Also of concern was the potential concentration of pollutants in certain areas and impacts to environmental justice communities.
- (j) **Cultural resources:** The general public and agencies were concerned about impacts to cultural and historic resources both in water and land-side.

## **11.2 Environmental Compliance (Para. 6.0 – Final Report)**

The NEPA document for this report is an Environmental Impact Statement (EIS). The District submitted the integrated draft report and EIS to the EPA website on October 2, 2014 for publishing in the Federal Register on October 10, 2014. Items identified in paragraph 6.1 Table of Compliance of the draft report as being in "Full Compliance" assumes their compliance status upon completion of the NEPA

process; Items identified as being in "Partial Compliance" indicates that concurrence is needed from another Agency, and will be completed prior to the Final EIS.

## **12.0 Costs and Benefits (Tables 4-6, 4-7, & 4-8 – Final Report)**

Project costs by category including construction elements by project purpose, LERRD, PED, construction management (E&D and S&A), and associated non-Federal costs are identified in the following tables. Table 9 provides a cost summary and cost sharing apportionment between the Federal government and the non-Federal sponsor for the NED plan (50-foot/48-foot). Table 10 provides a cost summary and cost sharing apportionment between the Federal government and the non-Federal sponsor for the Recommended Plan or the Locally Preferred Plan. Table 11 contains Average Annual Equivalent (AAEQ) benefits and costs for the 52-foot/48-foot LPP.

**Table 9.** Cost summary for the 50-foot/48-foot tentative NED Plan – Charleston Post 45 Navigation Study

<b>Federal/Non-Federal Cost Apportionment - NED Plan</b>			
<b>(October 2014 Price Levels -13 Apr 2015)</b>			
<b>Segment 1 @ 50' + Segment 2 @50' + Segment 3 @ 48'</b>			
Maximum Widening and Turning Basin Expansion Measures with 800-foot Entrance Channel with 944-foot Wings			
Cost sharing for > 45 feet	<b>Total Cost</b>		
	<b>Allocated</b>	<b>Federal Share</b>	<b>Non-Fed</b>
<b>General Navigation Features (GNF) [50% Fed / 50% Non-Fed]</b>	<b>50'+50'+48'</b>	<b>GNF</b>	<b>GNF</b>
Dredging --			
Mob & Demob (included in segment costs)			
Segment 1 @ 50' Inner Harbor / 52' Entrance Channel	\$336,740,000	\$168,370,000	\$168,370,000
Segment 2 @ 50' Inner Harbor	\$21,370,000	\$10,685,000	\$10,685,000
Segment 3 @ 48' Inner Harbor	\$30,690,000	\$15,345,000	\$15,345,000
Environmental Mitigation (Hardbottom- Clamshell w/rock bucket)*	\$13,130,000	\$6,565,000	\$6,565,000
Disposal Area Dike Improvements	\$16,780,000	\$8,390,000	\$8,390,000
Environmental Mitigation Monitoring-9 Yrs (shoreline erosion)	\$5,310,000	\$2,655,000	\$2,655,000
Environmental Mitigation Monitoring-9 Yrs (wetlands/hardbottom)	\$10,620,000	\$5,310,000	\$5,310,000
Real Estate, Administrative (Federal Review of NFS Acquisition)	\$6,000	\$6,000	\$0
Real Estate, Administrative (Non-Federal Acquisition by NFS)	\$31,000	\$0	\$31,000
Real Estate Land Payments by NFS - 476 Acres Wetland Mitigation	\$2,140,000	\$1,070,000	\$1,070,000
Preconstruction, Engineering, Design, & Planning	\$5,570,000	\$2,785,000	\$2,785,000
Construction Management (S&I)	\$6,280,000	\$3,140,000	\$3,140,000
<b>Total GNF</b>	<b>\$448,667,000</b>	<b>\$224,321,000</b>	<b>\$224,346,000</b>
<b>Subtotal - Project First Costs (rounded)</b>	<b>\$448,700,000</b>	<b>\$224,300,000</b>	<b>\$224,400,000</b>
Additional 10% of (NED) GNF	<b>\$0</b>	-\$44,870,000	\$44,870,000
LERRD Adjustment	<b>\$0</b>	\$0	\$0
<b>Non-Federal Sponsor's Amount for Payment over 30 years</b>	<b>\$0</b>	-\$44,870,000	<b>\$44,870,000</b>
<b>Non-Federal Local Service Facilities [100% Non-Federal]</b>			
Berthing Area Dredging (Segments 1, 2, & 3)	\$4,760,000	\$0	\$4,760,000
Port Bulkhead Const. (Segment 1 - Wando Terminal)	\$22,000,000	\$0	\$22,000,000
<b>Total Non-Federal Local Service Facilities</b>	<b>\$26,760,000</b>	<b>\$0</b>	<b>\$26,760,000</b>
<b>USCG Aids to Navigation (100% USCG Federal Cost)</b>	<b>\$620,000</b>	<b>\$620,000</b>	<b>\$0</b>
<b>Project Costs (rounded)</b>	<b>\$476,000,000</b>	<b>\$180,100,000</b>	<b>\$295,900,000</b>

\* The rock dredging operations to place material on the hardbottom mitigation areas are less efficient for the 50/48 plan than the 52/48 plan. Thus, the cost of the mitigation is higher for the NED plan even though the quantity of material is the same. Dredge efficiency increases with greater material bank heights.

**Table 10.** Cost summary for the 52-foot/48-foot Recommended Plan or LPP – Charleston Post 45 Navigation Study

<b>Federal/Non-Federal Cost Apportionment – Locally Preferred Plan</b>			
<b>(October 2014 Price Levels -13 Apr 2015)</b>			
<b>Segment 1 @ 52' + Segment 2 @52' + Segment 3 @ 48'</b>			
Maximum Widening and Turning Basin Expansion Measures with 800-foot Entrance Channel with 944-foot Wings			
Cost sharing for > 45 feet	Total Cost	Federal Share	Non-Fed
	Allocated	GNF	GNF
<b>General Navigation Features (GNF) [Sponsor pays 52'-50'</b>	<b>52' Project</b>	<b>50' Project</b>	<b>52' minus 50'</b>
Dredging --			
Mob & Demob (included in segment costs)			
Segment 1 @ 52' Inner / 54' Entrance Channel	\$381,600,000	\$168,370,000	\$213,230,000
Segment 2 @ 52' Inner	\$23,630,000	\$10,680,000	\$12,950,000
Segment 3 @ 48' Inner Harbor	\$30,690,000	\$15,340,000	\$15,350,000
Environmental Mitigation (Hardbottom - Clamshell w/rock bucket)*	\$9,110,000	\$6,560,000	\$2,550,000
Disposal Area Dike Improvements	\$16,780,000	\$8,390,000	\$8,390,000
Environmental Mitigation Monitoring-9 Yrs (shoreline erosion)	\$5,310,000	\$2,655,000	\$2,655,000
Environmental Mitigation Monitoring-9 Yrs (wetlands/hardbottom)	\$10,620,000	\$5,310,000	\$5,310,000
Real Estate, Administrative (Federal Review of NFS Acquisition)	\$6,000	\$6,000	\$0
Real Estate, Administrative (Non-Federal Acquisition by NFS)	\$30,000	\$0	\$30,000
Real Estate Land Payments by NFS - 665.6 Acres Wetland Mitigation	\$2,995,000	\$1,070,000	\$1,925,000
Preconstruction, Engineering, Design, & Planning	\$5,570,000	\$2,780,000	\$2,790,000
Construction Management (S&I)	\$6,930,000	\$3,140,000	\$3,790,000
<b>Total GNF</b>	<b>\$493,270,000</b>	<b>\$224,300,000</b>	<b>\$268,970,000</b>
<b>Subtotal – Project First Costs (rounded)</b>	<b>\$493,300,000</b>	<b>\$224,300,000</b>	<b>\$269,000,000</b>
Additional 10% of (NED) GNF	\$0	-\$44,870,000	\$44,870,000
LERRD Adjustment - Non-Federal Sponsor's LERRD Credit	\$0	\$0	\$0
<b>Non-Federal Sponsor's Amount for Payment over 30 years</b>	<b>\$0</b>	<b>-\$44,870,000</b>	<b>\$44,870,000</b>
<b>Non-Federal Local Service Facilities [100% Non-Federal]</b>			
Berthing Area Dredging (Segments 1, 2, & 3)	\$4,970,000	\$0	\$4,970,000
Port Bulkhead Const. (Segment 1 - Wando Terminal)	\$22,000,000	\$0	\$22,000,000
<b>Total Non-Federal Local Service Facilities</b>	<b>\$26,970,000</b>	<b>\$0</b>	<b>\$26,970,000</b>
<b>USCG Aids to Navigation (100% USCG Federal Cost)</b>	<b>\$620,000</b>	<b>\$620,000</b>	<b>\$0</b>
<b>Project Costs 52/48 Plan (rounded)</b>	<b>\$520,900,000</b>	<b>\$180,100,000</b>	<b>\$340,800,000</b>

\* The rock dredging operations to place material on the hardbottom mitigation areas are less efficient for the 50/48 plan than the 52/48 plan. Thus, the cost of the mitigation is higher for the NED plan even though the quantity of material is the same. Dredge efficiency increases with greater material bank heights.

Table 11. Average Annual Equivalent (AAEQ) benefits and costs for the 52-foot/48-foot Recommended Plan or LPP - Charleston Harbor Post 45 Navigation Study

Federal Discount Rate FY15 = 3.375%	October 2014 (FY15) Price Levels
Capital Recovery Factor = 0.041677	50-Year Period of Analysis
Project Costs	\$520,900,000
Interest During Construction	59,800,000
Economic Investment (rounded)	580,700,000
AAEQ Costs	
Economic Investment	24,200,000
Increased O&M Dredging	3,740,000
Increased O&M for Navigation Aids	\$50,000
Total AAEQ Costs (rounded)	28,000,000
Benefits (Transportation Cost Savings)	
Origin to Destination Deepening	\$105,300,000
Channel Widening & Tidal Delay	\$3,600,000
Total AAEQ Benefits (rounded)	\$108,900,000
<b>AAEQ Net Benefits (rounded)</b>	<b>80,900,000</b>
Benefit to Cost Ratio (computed at 3.375%)	3.89

### 13.0 Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) – [Paragraph 4.5.3 - Final Report]

Increased Operation and Maintenance (O&M) costs over the existing project O&M costs result from deepening and widening of the Federal navigation channel. Appendix A (Engineering) describes the use of the sediment transport module of EFDC to assess potential changes to suspended sediment concentration in the water column and deposition rates in the Federal navigation channel. The greatest increase in sedimentation caused by the project alternatives would occur in the Wando River Upper Reach, Turning Basin and Terminal. The next largest predicted increase in sedimentation occurs in the Ordnance Reach & Turning Basin. Sedimentation is also predicted to increase along Hog Island Reach, Drum Island Reach, Meyers Bend Reach and Daniel Island Reach. Note there are four areas in which the model estimated shoaling that historical records do not support. These are Rebellion Reach, Bennis Reach, Clouter Creek Reach and North Charleston reach. For these reaches the model predicted sedimentation rates were used in estimating dredging quantities. It is estimated that the Wando TB increases 89 percent over its existing size, Ordnance TB increase 76 percent over its existing size. Thus the majority of increased shoaling is due to the increase in footprint. The increased annual cost for O&M dredging between the existing condition and the future with project condition for the 52/48 plan amounts to \$3,740,000. Increased annual O&M costs for maintenance to U.S. Coast Guard Aids to Navigation include \$50,000.

## **14.0 Review**

District Quality Control (DQC) reviews occurred throughout the study process by the Project Delivery Team followed with peer reviewers from other Districts selected and approved by the Deep Draft Navigation Planning Center of Expertise. Project Management kept a detailed log of those DQC and peer reviews to identify and document resolution of concerns throughout the study process.

The review of the Tentatively Selected Plan involved two Pre-TSP meetings with the USACE South Atlantic Division on June 2, 2014, and June 12, 2014, prior to the Vertical Team TSP Milestone Meeting on 8 Jul 14, and subsequent identification of the National Economic Development Plan and Tentatively Selected Plan as documented in the CECW-SAD memorandum dated 31 Jul 2014.

Concurrent Agency Technical Review (ATR), Independent External Peer Review (IEPR), and Policy Reviews are scheduled to occur from 10 Oct – 24 Nov 14 with publication of the draft integrated feasibility report and environmental impact statement in the Federal Register on 10 Oct 2014.

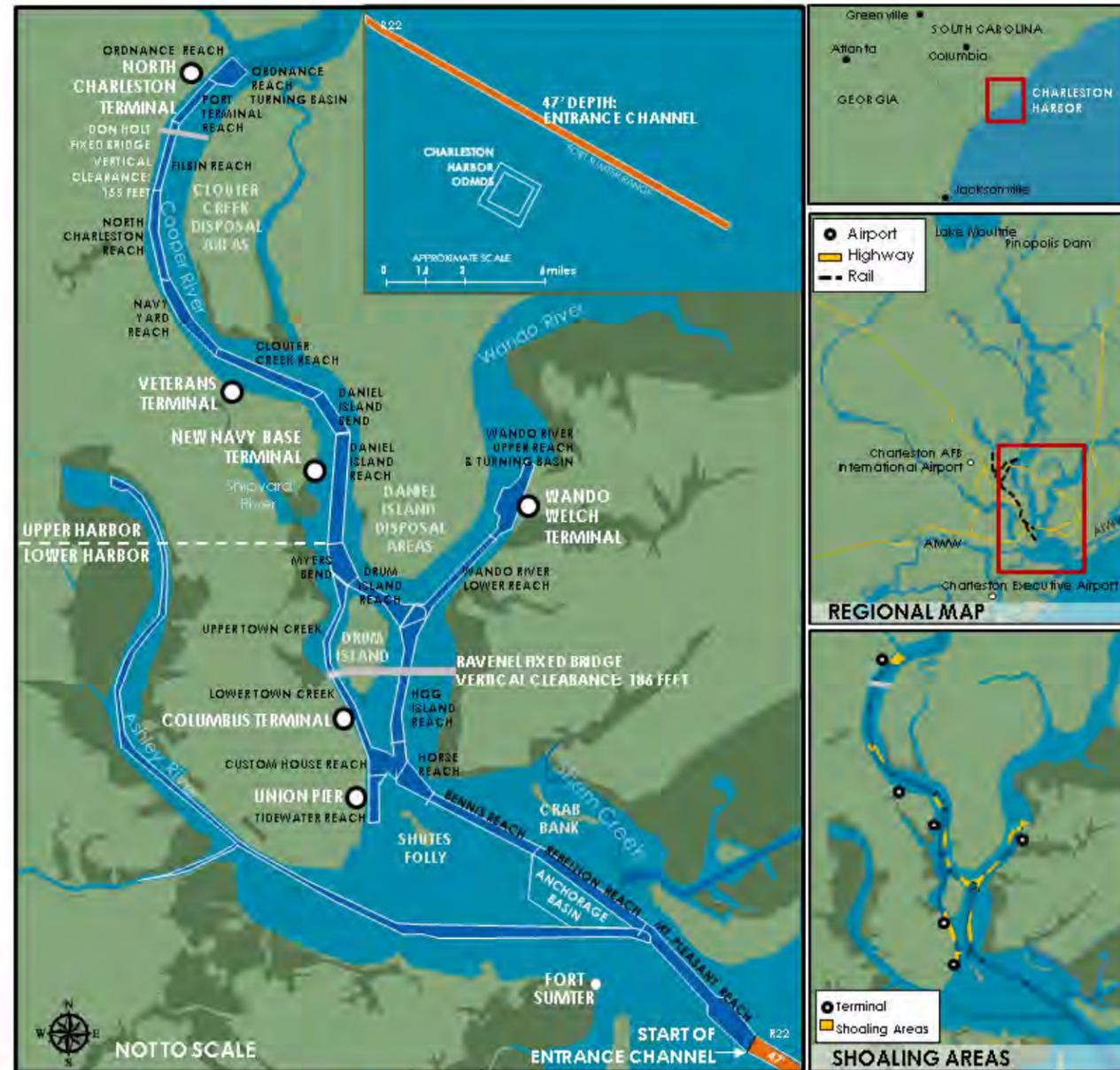
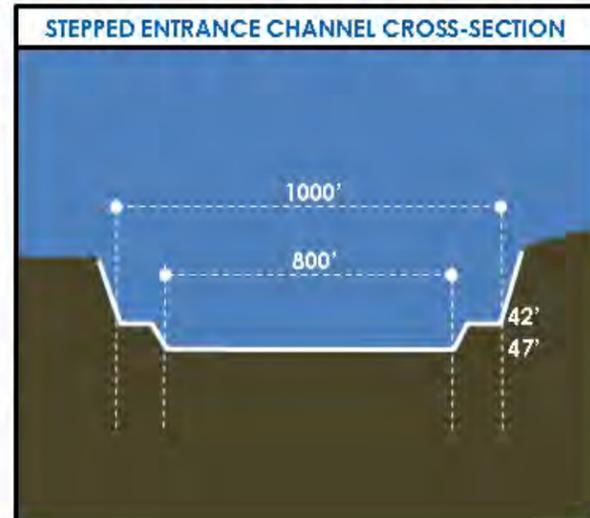
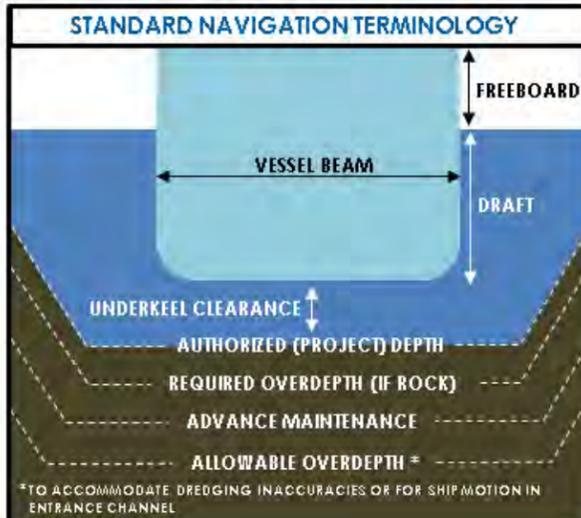
The schedule for revision of the draft report and submission of the final report through receipt of the Chief of Engineers Report follows on the next page.

## Overall Schedule Summary

Post 45 from ADM to Chief's Report	2/23/2015	9/14/2015
ADM Milestone Meeting	2/23/2015	2/23/2015
PDT Revise Report - Draft FINAL	2/24/2015	3/31/2015
DQC/ATR	4/1/2015	5/5/2015
SAD/OWPR Review	4/15/2015	5/12/2015
District Commander Approval	5/13/2015	5/18/2015
Division Engineer's Transmittal	5/19/2015	5/25/2015
OWPR Prep & Briefing to MG Peabody/Stockton	5/26/2015	6/8/2015
CWRB Prep	6/9/2015	6/22/2015
CWRB Meeting	6/22/2015	6/22/2015
Chief's Report Prep	6/23/2015	9/14/2015
Chief's Report Complete	9/14/2015	9/14/2015

**REFERENCE TABLE 1: CHARLESTON HARBOR EXISTING SEGMENT DIMENSIONS**

REACH/SEGMENT	NOMINAL DEPTH		NOMINAL WIDTH		MAX SAILING DRAFT (WITH 5 TO 6-FOOT FLOOD TIDE CONDITION)
	MAINTENANCE	AUTHORIZED	MAINTENANCE	AUTHORIZED	
Entrance Channel	47/42	47/42	42' at 1000'	42' at 1000'	47
Entrance Channel	47/42	47/42	47' at 800'	47' at 800'	47
<b>ENTRANCE CHANNEL TO WANDO WELCH TERMINAL (LOWER HARBOR)</b>					
Mount Pleasant Range	45	45	600-1000	600-1000	45
Rebellion Reach	45	45	600	600	45
Bennis Reach	45	45	600	600	45
Horse Reach	45	45	800	800	45
Hog Island Reach	45	45	600	600	45
Wando Channel	45	45	400	400	45
Wando Turning Basin	45	45	1400	1400	45
<b>DRUM ISLAND TO NORTH CHARLESTON TERMINAL (UPPER HARBOR)</b>					
Drum Island Reach	45	45	600	600	45
Myers Bend	45	45	V.A.R.I.E.S	V.A.R.I.E.S	45
Daniel Island Reach	45	45	880	880	45
Daniel Island Bend	45	45	700-780	700-780	45
Clouter Creek Reach	45	45	600	600	45
Navy Yard Reach	45	45	600-675	600-675	45
North Charleston Reach	45	45	500	500	45
Filbin Creek Reach	45	45	500	500	45
Port Terminal Reach	45	45	600	600	45
Ordnance Reach	45	45	1400	1400	45
<b>UNION PIER TO WEST OF DRUM ISLAND</b>					
Custom House Reach	45	45	Varies	Varies	45
Upper Town Creek	16	16	500	500	16
Lower Town Creek	45	45	400	400	45
Town Creek Turning Basin	35	35	300	300	35
Tidewater Reach	40	40	650	650	40
<b>OTHER FEDERAL CHANNELS</b>					
Anchorage Basin	35	35	2250	2250	35
Shem Creek Channel	12	12	110	110	12
<b>SHIPYARD RIVER</b>					
Entrance Channel	45	45	300	300	45
Basin A	45	45	700	700	45
Connector Channel	45	45	200	200	45
Basin B	30	30	600	600	30



**FEDERAL CHANNEL DEPTHS**

**LOWER HARBOR:** 45 feet  
Downstream of Shipyard River to Entrance Channel

**UPPER HARBOR:** 45 feet  
North of Shipyard River

**ENTRANCE CHANNEL:** 42-47 feet

Wetlands (Generalized)

**SEGMENT WIDTHS**

Refer to Reference Table 1

**TERMINALS AND INFRASTRUCTURE**

**North Charleston Terminal (NCT):** primarily containers, but can process break-bulk and roll-on/roll-off cargoes

**Wando Welch Terminal (WWT):** containers

**Columbus Street Terminal (CST):** roll-on/roll-off and project cargoes/heavy lift (transitioned from a container terminal, but retained container capabilities)

**Veterans Terminal:** break-bulk, roll-on/roll-off, and project cargoes

**New Navy Base Terminal:** containers

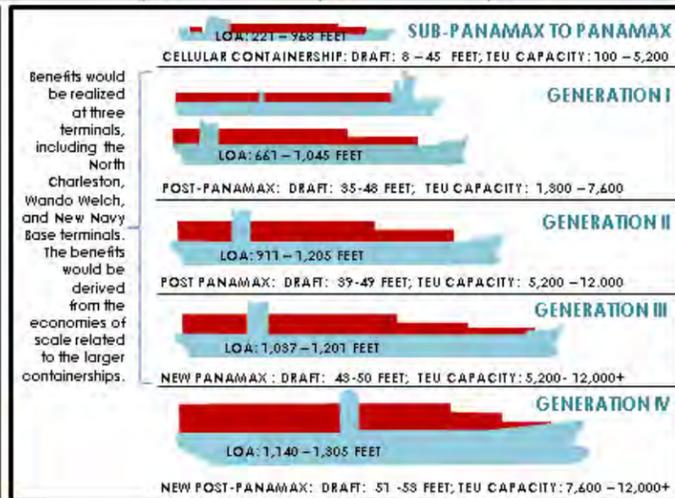
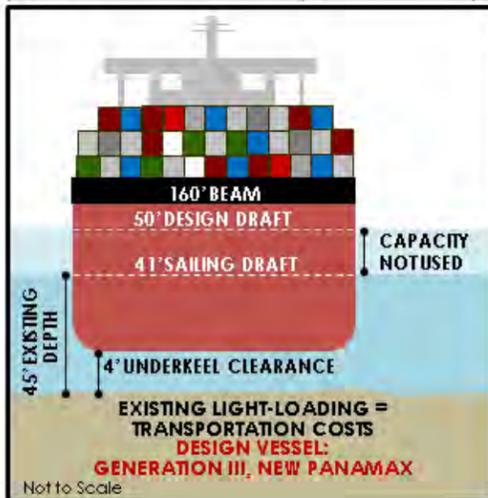
**Union Pier Terminal:** conventional break-bulk, roll-on/roll-off, and project cargoes

**MAXIMUM VESSEL (CONTAINER) SIZE TRANSITING PORT:**

Generation III, New Panamax vessel but vastly light-loaded

**REFERENCE TABLE 1: CHARLESTON HARBOR EXISTING SEGMENT DIMENSIONS**

REACH OR SEGMENT	NOMINAL DEPTH		NOMINAL CHANNEL WIDTH		MAXIMUM SAILING DRAFT (with a 5 to 6-foot flood tide condition)
	MAINTENANCE	AUTHORIZED	MAINTENANCE	AUTHORIZED	
Entrance Channel	47/42	47/42	42' at 1000'	42' at 1000'	47
Entrance Channel	47/42	47/42	47' at 800'	47' at 800'	47
<b>ENTRANCE CHANNEL TO WANDO WELCH TERMINAL (LOWER HARBOR)</b>					
Mount Pleasant Range	45	45	600-1000	600-1000	45
Rebellion Reach	45	45	600	600	45
Bennis Reach	45	45	600	600	45
Horse Reach	45	45	800	800	45
Hog Island Reach	45	45	600	600	45
Wando Channel	45	45	400	400	45
Wando Turning Basin	45	45	1400	1400	45
<b>DRUM ISLAND TO NORTH CHARLESTON TERMINAL (UPPER HARBOR)</b>					
Drum Island Reach	45	45	600	600	45
Myers Bend	45	45	VARIES	VARIES	45
Daniel Island Reach	45	45	880	880	45
Daniel Island Bend	45	45	700-780	700-780	45
Clouter Creek Reach	45	45	600	600	45
Navy Yard Reach	45	45	600-675	600-675	45
North Charleston Reach	45	45	500	500	45
Filbin Creek Reach	45	45	500	500	45
Port Terminal Reach	45	45	600	600	45
Ordnance Reach	45	45	1400	1400	45
<b>UNION PIER TO WEST OF DRUM ISLAND</b>					
Custom House Reach	45	45	Varies	Varies	45
Upper Town Creek	16	16	500	500	16
Lower Town Creek	45	45	400	400	45
Town Creek Turning Basin	35	35	300	300	35
Tidewater Reach	40	40	650	650	40
<b>OTHER FEDERAL CHANNELS</b>					
Anchorage Basin	35	35	2250	2250	35
Shem Creek Channel	12	12	110	110	12
<b>SHIPYARD RIVER</b>					
Entrance Channel	45	45	300	300	45
Basin A	45	45	700	700	45
Connector Channel	45	45	200	200	45
Basin B	30	30	600	600	30



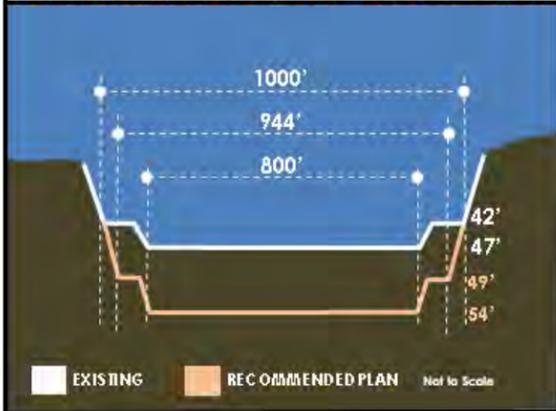
REFERENCES & APPENDIX C



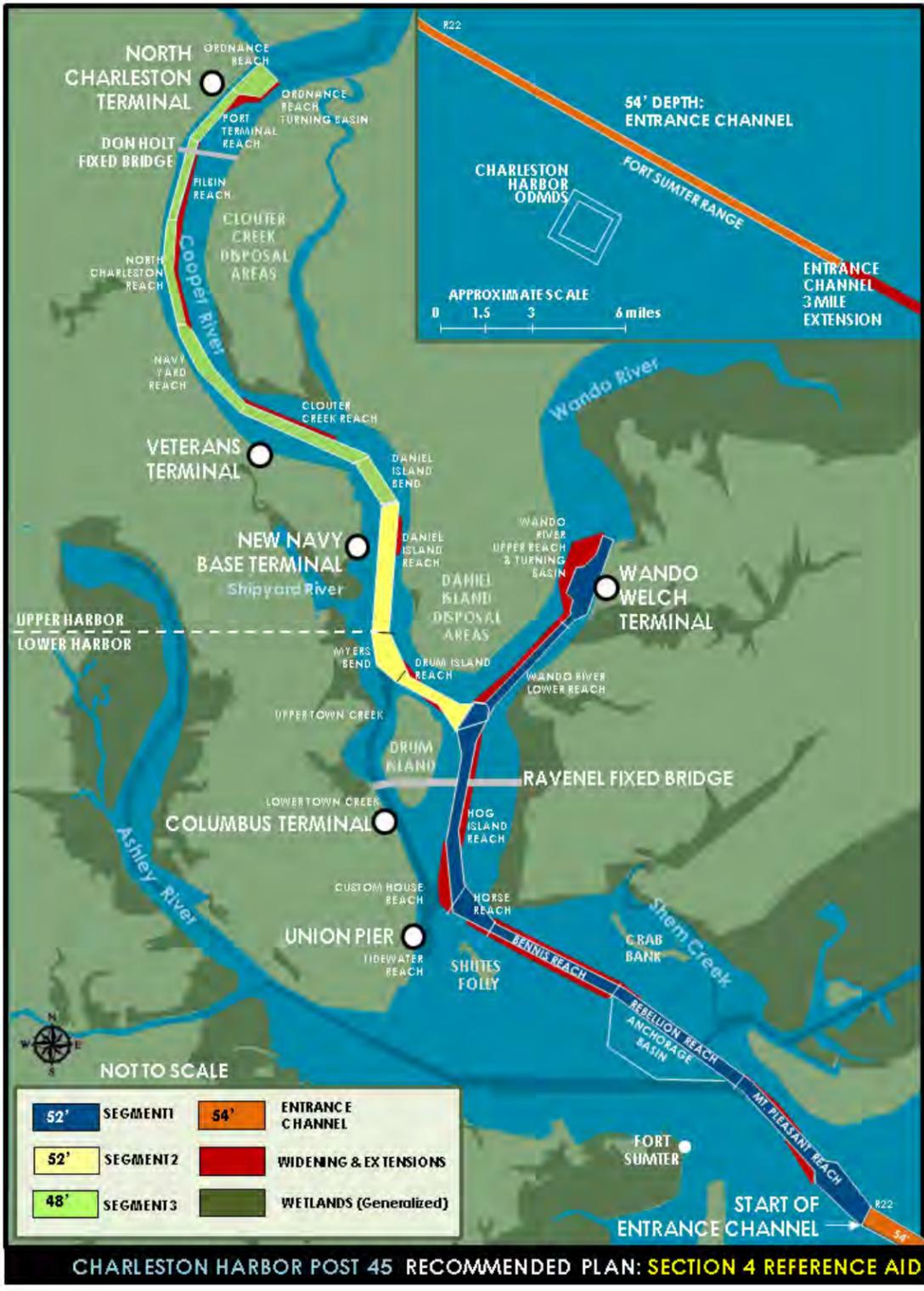
**REFERENCE TABLE 1: CHARLESTON HARBOR EXISTING COMPARED TO RECOMMENDED PLAN SEGMENT DIMENSIONS**

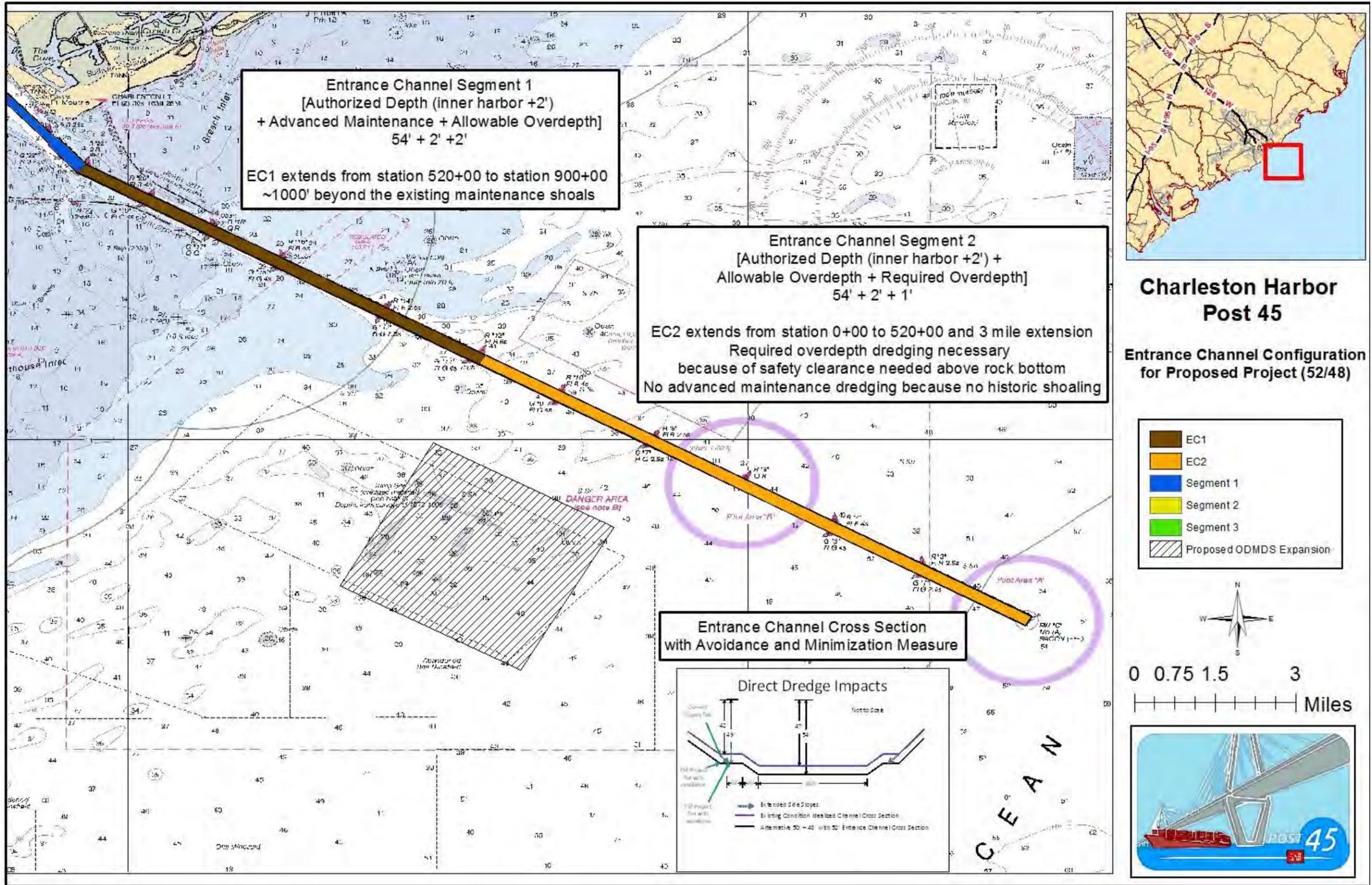
REACH OR SEGMENT	NOMINAL DEPTH		NOMINAL CHANNEL WIDTH		RECOMMENDED PLAN
	MAINTENANCE	AUTHORIZED	MAINTENANCE	AUTHORIZED	
Entrance Channel	47/42	47/42	42' at 1000'	42' at 1000'	49' at 944' width
Entrance Channel	47/42	47/42	47' at 800'	47' at 800'	54' at 800' width
<b>ENTRANCE CHANNEL TO WANDO WELCH TERMINAL (LOWER HARBOR)</b>					
Mount Pleasant Range	45	45	600-1000	600-1000	52
Rebellion Reach	45	45	600	600	52
Bennis Reach	45	45	600	600	52
Horse Reach	45	45	800	800	52
Hog Island Reach	45	45	600	600	52
Wando Channel	45	45	400	400	52
Wando Turning Basin	45	45	1400	1400	52
<b>DRUM ISLAND TO NORTH CHARLESTON TERMINAL (UPPER HARBOR)</b>					
Drum Island Reach	45	45	600	600	52
Myers Bend	45	45	VARIES	VARIES	52
Daniel Island Reach	45	45	880	880	52
Daniel Island Bend	45	45	700-780	700-780	48
Clouter Creek Reach	45	45	600	600	48
Navy Yard Reach	45	45	600-675	600-675	48
North Charleston Reach	45	45	500	500	48
Filbin Creek Reach	45	45	500	500	48
Port Terminal Reach	45	45	600	600	48
Ordnance Reach	45	45	1400	1400	48
<b>UNION PIER TO WEST OF DRUM ISLAND</b>					
Custom House Reach	45	45	Varies	Varies	45
Upper Town Creek	16	16	500	500	16
Lower Town Creek	45	45	400	400	45
Town Creek Turning Basin	35	35	300	300	35
Tidewater Reach	40	40	650	650	40
<b>OTHER FEDERAL CHANNELS</b>					
Anchorage Basin	35	35	2250	2250	35
Shem Creek Channel	12	12	110	110	12
<b>SHIPYARD RIVER</b>					
Entrance Channel	45	45	300	300	45
Basin A	45	45	700	700	45
Connector Channel	45	45	200	200	45
Basin B	30	30	600	600	30

**STEPPED ENTRANCE CHANNEL CROSS-SECTION**



ITEM	NED (50/48)	LPP (52/48)	DIFFERENCE (LPP - NED)
Project Cost	\$476,040,000	\$520,860,000	+\$44,820,000
Average Annual Costs	\$25,700,000	\$27,990,000	+\$2,290,000
Average Annual Benefits	\$103,100,000	\$108,900,000	+\$5,800,000
<b>Net Benefits</b>	<b>\$77,400,000</b>	<b>\$80,910,000</b>	<b>+3,510,000</b>
Benefit Cost Ratio	4.01	3.89	-0.12





CHARLESTON HARBOR POST 45 ENTRANCE CHANNEL: SECTION 5 REFERENCE AID