REPORT SUMMARY
LYNNHAVEN RIVER BASIN ECOSYSTEM RESTORATION STUDY
FINAL FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT

Feasibility Scoping Meeting:	09 SEP 2005
Alternative Formulation Briefing:	25 APR 2012
AFB Guidance Memorandum:	12 OCT 2012
Draft Report Guidance Memorandum	04 JUN 2013
Final Report Received at CECW-PC:	20 AUG 2013
CWRB Briefing:	24 SEP 2103
30-Day S&A Review start:	08 OCT 2013
30-Day S&A Review end:	04 DEC 2013

STUDY INFORMATION

The U.S. Army Corps of Engineers (Corps) in partnership with the City of Virgina Beach, Virginia, and in cooperation with other Federal and State agencies, has prepared this Feasibility Report (FR) and Environmental Assessment (EA) of proposed ecosystem restorationin the Lynnhavem River basin.

Study Authority. This study is authorized by Resolution of the Committee on Transportation and Infrastructure of the U.S. House of Representatives, Docket 2558, adopted May 6, 1998. The authorization states:

> *Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that the Secretary of the Army is requested to review the report of the Chief of Engineers on the Lynnhaven Inlet, Bay and connecting waters, Virginia, published as House Document 580, 80th Congress, 2nd Session, and other pertinent reports, to determine whether any modifications of the recommendations contained therein are advisable at the present time in the interest of environmental restoration and protection and other related water resources purposes for the Lynnhaven River Basin, Virginia.*

Study Sponsor. The City of Virginia Beach is the non-federal sponsor for the feasibility study, under the terms of a feasibility cost sharing agreement with the Corps executed September 22, 2004 and has indicated its willingness to sponsor project design and implementation.

Study Purpose and Scope. The purpose of this study is to evaluate ecosystem restoration within the Lynnhaven River basin and develop the most suitable plan of ecosystem restoration for the present and future conditions for a 50-year period of analysis. The study authority identifies issues to be addressed in the Feasibility Study, which are:

- Environmental Restoration and Protection;
- Other water related resource purposes.

The report presents the assessment of alternative plans that meet the purposes of the study authority and determines whether the construction of alternatives for environmental restoration, protection, and related purposes for the Lynnhaven River, Virginia, is justified and in the Federal interest. This decision is based on an appraisal of the Federal interest and the consistency of potential solutions with current policies and budgetary priorities. The scope of the study includes all existing and reasonably foreseeable future conditions that may affect the ecosystem within the Lynnhaven River Basin and its three main branches; the Eastern Branch, the Western Branch, and the Broad Bay/Linkhorn Bay complex.

The Lynnhaven River Basin Ecosystem Restoration study is considered an interim study, as the study authority will remain open after the completion of the project.

Project Location/Congressional District. The Lynnhaven River Basin is located entirely within the boundaries of the City of Virginia Beach, Virginia bounded on the northeast by First Landing State Park and on the southeast by Oceana Naval Air Station. The City of Virginia Beach is located in Southeastern Virginia, approximately 100 miles from the state capitol in Richmond, Virginia. The Lynnhaven River Basin is a 64-square-mile tidal estuary in the lower Chesapeake Bay Watershed.

The specific area addressed by this study includes the entire Lynnhaven River Basin and surrounding riparian areas. This includes its three branches, the Eastern, Western, and the Broad Bay/Linkhorn Bay. The watershed, representing one-fourth of the area of the City of Virginia Beach, performs vital functions to the City and its residents.,

The Lynnhaven River Basin study area falls entirely in the 2nd Congressional District (Scott Rigell) of the Commonwealth of Virginia.

Prior Reports and Existing Water Projects. A number of reports were completed by the Corps that assessed projects directed at the improvement of navigation within the Lynnhaven River Basin. These include:

- Annual Report of Chief of Engineers for 1880; Senate Executive Document Number 104,

46th Congress, 2nd Session, March 3, 1879.

- Annual Report of Chief of Engineers for 1891; House Executive Document Number 48, 51st Congress, 2nd Session, September 19, 1890.
- Annual Report of Chief of Engineers for 1892; House Executive Document Number 27, 52nd Congress, 1st Session, March 3, 1891.
- House Document Number 1244, 62nd Congress, 3rd Session, October 18, 1912.
- Unpublished USACE report December 10, 1928.
- Unpublished USACE report evaluating jetty and channel construction, November 16, 1933.
- Unpublished, March 5, 1938. This report evaluated construction of a channel.
- Lynnhaven Inlet, Bay and Connecting Waters, Virginia; House Document Number 580, 87th Congress, 2nd Session, September 25, 1962. This report evaluated channel and turning basin construction.
- Virginia Beach, Virginia, Canal Number 2, 1973; The document assessed canal construction.

More recent Corps reports and studies addressed ecosystem restoration in the vicinity of the Lynnhaven River. These are listed below:

- Lynnhaven River, Decision Document Amendment, Chesapeake Bay Oyster Recovery Phase IV of Section 704(b) as amended, November, 2005; The document recommended construction of 111 acres of oyster reefs within the Lynnhaven River Basin. Approximately 55 acres have been constructed to date.
- Identification and Assessment of Water Quality Problems in Mill Dam Creek and Dey Cove Tributaries of the Lynnhaven River, Virginia Beach, 2008; This study was conducted under Section 22 of the Water Resources Development Act of 1974 to identify and assess potential water quality problems in Mill Dam Creek, a small tributary entering the Broad Bay branch of the Lynnhaven River from the south (Sisson et al. 2009).
- A Numerical Modeling Assessment for the Implementation of a Runoff Reduction Strategy Plan for Restoration of Thalia Creek, Virginia (Sisson et al. 2010); This study identified and assessed potential water quality problems in the Thurston Branch-Thalia Creek (TB-TC) system, a small tributary at the head of the Western Branch of the Lynnhaven River.

- Assessment of Oyster Reefs in the Lynnhaven River as a Chesapeake Bay Total Maximum Daily Load Best Management Practice (Sisson et al. 2011); The purpose/scope of this project was to formally identify the ability of 2-dimensionally and 3-dimensionally constructed and naturally occurring oyster reefs to remove nitrogen, phosphorus, and sediment from the overlying water column, as a tool to meet the Chesapeake Bay TMDL requirements

Three Corps projects have been completed in the Lynnhaven River Basin. These are described below.

- **Lynnhaven Inlet** - The authorized project has been constructed and provides for an entrance channel that is 10 feet deep and 150 feet wide extending 1 mile from that depth in the Chesapeake Bay to a mooring area and turning basin that is 10 feet deep, 1,250 feet long, and 700 feet wide in Lynnhaven Bay, just upstream from the Lesner Bridge at the mouth of the inlet. A channel that is 9 feet deep and 90 feet wide extends eastward 2.0 miles from the mooring area and turning basin to Broad Bay, via the Long Creek-Broad Bay canal. There is also a channel that is 6 feet deep and 90 feet wide extending 0.5 mile through The Narrows connecting Broad and Linkhorn Bays. The project has a total length of approximately 5.2 miles. The project also includes a 0.3-mile side channel that is 8 feet deep and 100 feet wide, connecting into Long Creek.
- **Virginia Beach Canal No. 2.** The authorized project has been constructed. Significant changes have occurred in the flood plain since the completion of the last report.
- **Lynnhaven Oyster Restoration.** Approximately 55 acres of restored oyster reefs have been constructed to date out of the 111 acres recommended in the November 2005 decision document. The reefs were constructed at various locations in Linkhorn Bay, Broad Bay, the Eastern Branch, and Lynnhaven Bay as high-relief (≥ 1 foot) shell reefs.

A Reconnaissance Study was completed in January 2004, with the certification of the report entitled "Section 905(b) (WRDA 86) Analysis, Lynnhaven River Environmental Restoration, Virginia Beach, Virginia," which was completed in June 2002. The report concluded that there are environmentally sensitive solutions that can be formulated to result in substantial ecosystem restoration benefits. Further, the reort specifically recommended that the Corps conduct a feasibility study with the city of Virginia Beach to address ecosystem restoration within the Lynnhaven River Basin.

Federal Interest. The Federal objective of water and related land resources project planning is to contribute to national ecosystem restoration in a manner consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable EOs, and other Federal planning requirements. If the projected benefits of ecosystem restoration measures exceed their estimated costs and are judged acceptable, their construction as a Federal project would contribute to this objective and be in the Federal interest.

STUDY OBJECTIVES

Problems and Opportunities. The inventory of existing conditions identified the following ecosystem restoration problems/issues within the study area:

- Loss of submereged aquatic vegetation (SAV) habitat
- Loss of reef habitat
- Reduced water quality
- Siltation
- Loss of tidal wetlands
- Invasive wetlands species
- Loss of bay scallops

The following opportunities were developed as means to address those problems in the study area:

- Restore SAV habitat
- Restore hard reef habitat
- Restore the bay scallop population
- Restore benthic habitat
- Create wetland habitat
- Increase tidal connectivity though dam removal
- Improve wetland function through removal of invasive species and planting of native salt marsh plants
- Improve wetland function through diversification of habitat features

Planning Objectives. The following specific objectives have been identified:

1. Restore a self-sustaining population of bay scallops by reintroducing bay scallops to the Lynnhaven River Basin where SAV has been successfully re-established and maintain a bay scallop population of 1,000,000 individuals in the system five years after the completion of project. The population goal is based on work done in sub-estuaries and embayments in other regions, including the Northeast, Southeast and Gulf Coasts, and the nearby lower Eastern Shore, Virginia, where most stocking efforts have aimed for establishing approximately 500,000 animals (Tettlebach and Smith 2009).

2. Reduce the acreage of invasive marsh plants by 75% for at least three wetland sites throughout the basin ten years after the completion of construction.

3. Preserve marsh function through increased habitat and species diversity and sustainability by restoring 20 to 25 acres of native marsh five years after the completion of construction.

4. Restore and maintain up to 100 acres of self-sustaining population of SAV in the Lynnhaven River System by five years after the completion of construction. These acreages reflect the ecologically viable and reasonably available restoration area. SAV may spread to any areas in the system that have suitable parameters for supporting SAV.

5. Increase the diversity, productivity, and sustainability of reef habitat within the Lynnhaven River Basin by constructing 25 to 35 acres of three-dimensional reef habitat by five years after the completion of construction. This acreage reflects the area suitable for reef habitat and provides varied location of reef habitat in each of the main Bays.

Planning Constraints. The following planning constraints have been identified for this study:

- Adverse impacts to existing fisheries should be avoided;
- Adverse effects to navigation channels, navigational aids, and existing infrastructure must be avoided; and
- Restoration measures cannot be built on private oyster leases or private property.

ALTERNATIVES

Plan Formulation. Plans to address the problems and opportunities for ecosystem restoration in the Lynnhaven River basin were developed consistent with the planning guidance, and objectives and constraints outlined above. Environmental restoration measures and alternatives were carried through to the plan formulation process.

Management Measures and Alternative Plans. Ecosystem restoration management measures are identified and evaluated individually on the basis of their suitability, applicability, and merit in meeting the planning objectives and constraints for the study. For this study, measures formulated include tidal wetland habitat construction/restoration, planting of SAV beds in optimal locations, placement of reef habitat in optimal locations, removal of dams blocking off areas previously connected to the tidal estuarine environment, restoration of bay scallops, removal of accumulated silts in choked areas to create improved subaqueous habitat for oysters and fish, and various nonstructural measures. The management measures were narrowed down to the following scales and sites for each restoration measure carried forward for consideration:

Environmental benefits assessment was conducted on each site/scale for each of the 5 measures under consideration. Cost-Effectiveness/Incremental Cost Analysis (CE/ICA) was performed on 1632 Alternatives (all combinations of measures except Wetland restoration/diversification). Separate CE/ICA was performed on wetland restoration/diversification sites considered individually and combined.

Final Array of Measures Combined into Alternatives
Wetland Construction (Fish House Island) – 1 site, 3 scales
Large Island
Medium Island
Small Island
Construction of Reef Habitat – 2 sites, 5 scales
Lynnhaven Bay and Broad Bay (normal and soft bottom)
Lynnhaven Bay and Broad Bay (normal bottom)
Broad Bay (normal and soft bottom)
Lynnhaven Bay
Broad Bay (normal bottom)
Restoration of Submerged Aquatic Vegetation – 2 sites, 6 scales
Suitable Areas Main Stem/Suitable Areas Broad Bay
Key Areas Main Stem/Suitable Areas Broad Bay
Suitable Areas Main Stem/Key Areas Broad Bay
Suitable Areas Broad Bay
Key Areas Main Stem/Key Areas Broad Bay
Key Areas Broad Bay
Restoration of Bay Scallops – 2 sites, 10 scales
Suitable Areas Main Stem/Suitable Areas Broad Bay
Key Areas Main Stem (with Suitable Areas SAV in Main Stem)/ Key Areas Broad Bay (with Suitable Areas SAV in Broad Bay)
Key Areas Main Stem/Suitable Areas Broad Bay
Key Areas Main Stem/Key Areas Broad Bay (with Suitable Areas SAV in Broad Bay)
Suitable Areas Main Stem/Key Areas Broad Bay
Key Areas Main Stem (with Suitable Areas SAV)/Key Areas Broad Bay
Suitable Areas Broad Bay
Key Areas Broad Bay (with Suitable Areas SAV in Broad Bay)
Key Areas Main Stem/Key Areas Broad Bay
Key Areas Broad Bay
Wetland Construction – 2 sites
Narrows to Rainy Gut
Lake Windsor
Wetlands Restoration/Diversification – 4 sites
Princess Anne High School (wetland restoration)
South Great Neck (wetland restoration/diversification)
Mill Dam Neck (wetland restoration/diversification)
North Great Neck (wetland restoration)

Final Array of Alternatives. The final array of Alternatives for SAV, Scallops, Reef Habitat, and Wetland Construction is listed below.

Alternative	SAV	Scallops	Reef Habitat	Wetland Construction
A	Suitable Areas in Main Stem and Broad Bay	Key Areas in Main Stem and Broad Bay	None	None
B	Suitable Areas in Main Stem and Broad ay	Key areas in Main Stem and Broad Bay	Broad Bay on normal foundation	None
C	Suitable Area SAV in Main Stem and Broad Bay	Key Areas Scallops in Main Stem and Broad Bay	Lynnhaven Bay and Broad Bay on normal foundation	None
D	Suitable Area SAV in Main Stem and Broad Bay	Key Areas Scallops in Main Stem and Broad Bay	Lynnhaven Bay and Broad Bay on normal and soft foundation	None
E	Suitable Area SAV in Main Stem and Broad Bay	Key Areas Scallops in Main Stem and Broad Bay	Lynnhaven Bay and Broad Bay on normal and soft foundation	Fish House Island (Large Design)
F	Suitable Area SAV in Main Stem and Broad Bay	Sustainable Areas Scallops in Main Stem and Broad Bay	Lynnhaven Bay and Broad Bay on normal and soft foundation	Fish House Island (Large Design)
G	Suitable Area SAV in Main Stem and Broad Bay	Sustainable Areas Scallops in Main Stem and Broad Bay	Lynnhaven Bay and Broad Bay on normal and soft foundation	Fish House Island (Large Design), and Lake Windsor
H	Suitable Area SAV in Main Stem and Broad Bay	Sustainable Areas Scallops in Main Stem and Broad Bay	Lynnhaven Bay and Broad Bay on normal and soft foundation	Fish House Island (Large Design), Lake Windsor, Narrows to Rainy Gut

The final array of Alternatives for Wetland Restoration/Diversification is listed below.

Alternative	Wetland Restoration/Diversification Site
1	Mill Dam Creek
2	South Great Neck and Mill Dam Creek
3	South Great Neck, Mill Dam Creek, and North Great Neck
4	Princess Anne High School, South Great Neck, Mill Dam Creek, and North Great Neck

Comparison of Alternatives. Alternative A includes only measures of SAV and scallops, and while efficient and effective, it is not complete in terms of fully meeting the objectives of the project. The incremental cost per output is considerably high for Plans E, F, G, and H, which include the island wetland construction measure that carries significant challenges to construction and maintenance along with a high risk reagrding success.

Alternatives B, C, and D are similar other than the scale and sites of reef habitat. The average annual incremental cost per unit of output for Alternative D is approximately $540,000 more than Alternative C. However, this plan includes both the normal and soft foundation sites for the reef habitat, rather than just the normal foundation sites. Inclusion of these soft foundation sites increases secondary production by 45,000 kg more on average annually. While the average cost per acre to construct the reef habitat sites with soft foundations is higher as compared to the reef habitat sites with normal foundations, it is still worth it to produce this additional level of output when considered along with all the other components of the restoration project. In addition to the quantified benefits of the reef habitat sites, there are additional benefits that would be realized by the reef habitat sites with soft foundations. These particular sites would require geotextile matting with small stone to stabilize the bottom in order to prevent subsidence of the reefs. These mats essentially function as a thin riprap layer and increase the size of the footprint of reefs placed on top of them. This underlying structure provided by the mats creates hard bottom habitat in an area currently lacking it which is expected to improve secondary production.

For the wetland restoration/diversification alternatives, Alternative 4, with construction of all four wetlands with *P. australis* eradication sites, best meets the planning objectives while reasonably maximizing the environmental benefits. There is a significant difference in incremental cost per output between the alternative with construction of just Mill Dam Creek and the other alternatives. However, the Mill Dam Creek site is limited to less than one acre. While the Princess Anne site is more expensive compared to the other sites considered, it carries the additional non-monetary benefit of allowing for an educational component, since connected to a school.

Key Assumptions. Assumptions made during plan formulation include:

- The future without-project condition is the projection and forecast of what is "most likely" to occur in the study area over the 50-year planning horizon.
- Models used in the study have the ability to predict ecosystem changes.
- Bay scallop restoration is dependent on the success of SAV habitat restoration.
- Natural recruitment at oyster spat will occur if adequate substrate is provided in the Lynnhaven River estuary.
- River bottom necessary for the project will be procured by the Non-Federal Sponsor.
- Accelerated sea level rise is expected to impact only two measures of the recommended plan, wetlands restoration/diversification and SAV, and the both types of habitat will

likely be able to adjust to the environmental changes caused by sea level rise.

Recommended Plan.

Wetland Restoration/Diversification. Four sites within the Lynnhaven River Basin have been identified for restoration or diversification of wetlands in the Lynnhaven Restoration Project. Each site currently contains established stands of the nonnative, invasive, emergent plant, *Phragmites australis*. Two sites were selected for restoration of the indigenous salt marsh community and reduction of the population of invasive plant species, *P. australis,* growing on site. Habitat restoration will involve both physical alteration of the site and herbicide application. Ecological function at two other sites will be established by increasing habitat diversity. It was determined that the replacement of *P. australis* with the native marsh community would not be successful due to tidal restriction and reestablishing the full tidal range was prohibitively expensive. Instead, ecological function will be increased through the construction of habitat features, including islands, channels, and pools, in order to break up the homogeneous *P. australis* stands.

Submerged Aquatic Vegetation (SAV). The twelve selected sites are in Broad Bay (42 acres) and the Lynnhaven Mainstem (52 acres). The sites will be planted with SAV seeds of two species, *Ruppia maritima,* widgeongrass, and *Zostera marina,* eelgrass.

Reintroduction of Bay Scallops. The 12 sites selected for reintroduction of the bay scallop are located within the SAV restoration sites and total approximately 22 acres. The SAV beds would be restored first, as bay scallops are known to prefer SAV to other substrates. No scallop restoration would commence until a minimum of one year after SAV restoration begins. Two main techniques are used in restoring bay scallops, direct stocking of juveniles or adults within SAV beds or use of broodstock adults, which are kept in cages at high densities to protect them from predators and aggregate them for increased spawning efficiency. A combination of both techniques, broodstock adults kept in cages as well as direct stocking of juveniles and adults, within restored SAV beds would increase the chances for successful re-introduction of the bay scallop to the Lynnhaven River.

Reef Habitat. The nine sites selected are located in the Lynnhaven Mainstem and the Broad Bay/Linkhorn complex. The sites in the Lynnhaven would restore approximately 10.5 total acres through the placement of small artificial reef structures approximately two feet in height and three feet in width at density of approximately 2,000 hard reef structures per acre. The sites in the Broad Bay/Linkhorn complex would restore approximately 21 total acres of reef habitat. Larger artificial reef structures ranging in size from four feet four inches in height and five and half feet in width to five feet in height and six feet wide, would be placed at a density of 500 hard reef structures per acre.

The ecological benefits estimated for the recommended plan include an average annual increase

in secondary production (aquatic biomass) of 285,000 kg and an average annual increase in the biological index of benthic integrity (BIBI) per acre of approximately two index points (on a scale of 1-5). The wetland restoration component of the recommended plan is expected to increase the USEPA Marsh Assessment Score by an average of approximately 70 for each site restored.

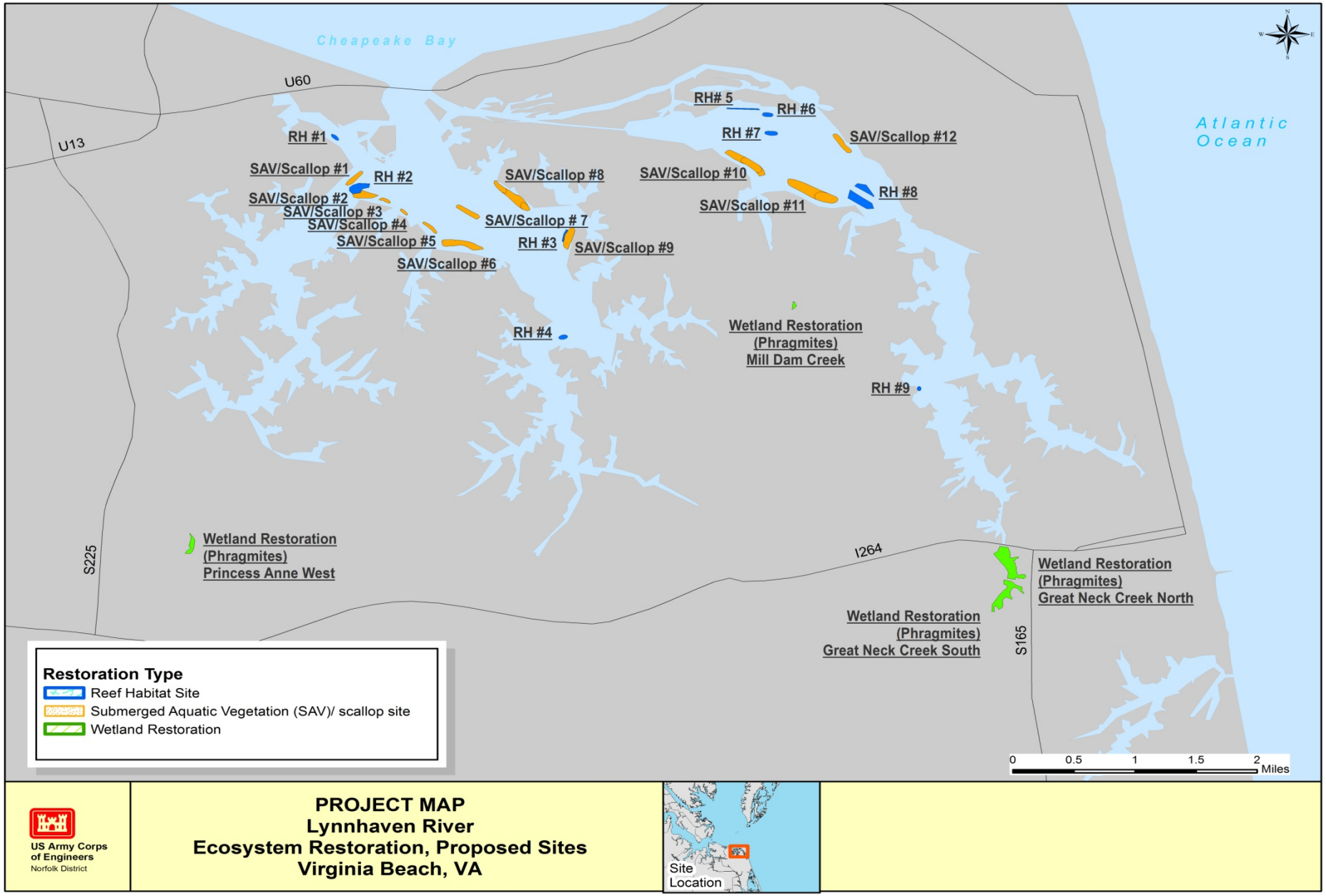
The recommended plan is worth the cost because it will restore significant ecological resources that are currently scarce in the Lynnhaven River Basin. The recommended plan is acceptable, efficient, effective, and complete. Because it is a highly developed basin, there are very limited opportunities to restore this river to a measure of its historical conditions. The enormous community and political support and the identification of a feasible restoration plan that will provide tangible ecosystem benefits all underscore the importance this project.

Systems / Watershed Context. The recommended plan includes restoration of various habitats throughout the Lynnhaven River Basin. The basin was studied in a holistic manner, and actions implemented throughout the watershed enhance the health of the overall basin. Success in providing suitable aquatic habitat conditions in the overall watershed would include increasing the amount of SAV and reef habitat. The project would also improve the structure and function of existing salt marsh. Once SAV has become established throughout the river basin, a population of bay scallops would be reintroduced into the Lynnhaven River. The sites proposed for restoration efforts are located throughout the entire system, allowing environmental improvements throughout the system.

Environmental Operating Principles. The *Lynnhaven River Basin Ecosystem Restoration Draft Integrated Feasibility Report and EA* was conducted in a manner consistent with the intent of the USACE's Environmental Operating Principles, that is, to ensure its commitment to the environmental quality of the Lynnhaven River Basin in balance with the economy of the region. This integrated feasibility study complies with the Environmental Operating Principles as follows:

1. *Foster sustainability as a way of life throughout the organization.* This integrated feasibility report/EA uses an approach that considers the sustainability of the project in order to maintain a healthy, diverse and sustainable condition needed to support life.

2. *Proactively consider environmental consequences of all Corps activities and act accordingly.* This integrated feasibility report/EA includes an analysis of the environmental consequences of the project on all resources within the Lynnhaven River Basin, including socioeconomic resources, interdependently with ecosystem restoration plan formulation and project recommendations.


Cheapeake Bay
Atlantic Ocean
U60
U13
S225
I264
S165
RH #1
SAV/Scallop #1
RH #2
SAV/Scallop #2
SAV/Scallop #3
SAV/Scallop #4
SAV/Scallop #5
SAV/Scallop #6
SAV/Scallop #8
SAV/Scallop # 7
RH #3
SAV/Scallop #9
RH #4
RH# 5
RH #6
RH #7
SAV/Scallop #12
SAV/Scallop #10
SAV/Scallop #11
RH #8
Wetland Restoration (Phragmites) Mill Dam Creek
RH #9
Wetland Restoration (Phragmites) Princess Anne West
Wetland Restoration (Phragmites) Great Neck Creek North
Wetland Restoration (Phragmites) Great Neck Creek South
Restoration Type
Reef Habitat Site
Submerged Aquatic Vegetation (SAV)/ scallop site
Wetland Restoration
0 0.5 1 1.5 2 Miles
US Army Corps of Engineers
Norfolk District
PROJECT MAP
Lynnhaven River
Ecosystem Restoration, Proposed Sites
Virginia Beach, VA
Site Location

3. *Create mutually supporting economic and environmentally sustainable solutions.* The *Lynnhaven River Basin Ecosystem Restoration Integrated Feasibility Report and EA* has been conducted in a multiagency, regional planning context to ensure that land use, residential, and commercial development patterns and economic considerations are incorporated into the development of sustainable and synergistic ecosystem restoration solutions. BMPs or restoration initiatives have been identified in a manner that achieves a balance between economic development and the environmental stewardship.

4. *Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments.* Effective coordination between the project delivery team and the resources agencies, through stakeholder meetings, public meetings and day-to–day correspondence, has ensured that the Corps has met all of its responsibilities under law. The components of the tentatively selected ecosystem restoration plan have been formulated to ensure that no significant adverse impacts to human health and welfare will result from project implementation.

5. *Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.* A detailed monitoring and adaptive management plan was developed for the Lynnhaven River Basin Ecosystem Restoration study as a strategy to manage the future risk of the project. A systems-based approach that considers all elements of the Basin environment was applied to confirm that effects from project implementation on the environment are beneficial, as the project purpose is ecosystem enhancement and restoration.

6. *Leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.* Effective coordination between the project delivery team, the project's steering comprised of a variety of basin stakeholders, public meetings and communication with the appropriate partnering agencies ensured that the project benefited from a range of diverse perspectives and ideas. This integrated knowledge base enhances the performance and sustainability of project features, through incorporation of a greater understanding of the Lynnhaven River Basin.

7. *Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.* The *Lynnhaven River Basin Ecosystem Restoration Draft Integrated Feasibility Report and EA* has benefitted from incorporating a range of diverse perspectives and regional technical expertise. Interagency collaboration has been fostered through the efforts of a steering committee and project delivery team meetings held regularly. By implementing a multiagency collaboration and public involvement strategy, a range of technical input was incorporated into the study analyses from multiple disciplines. This approach built trust and positive relationships, supporting innovative "win-win" solutions to identified ecosystem restoration issues.

Peer Review. A Review Plan was updated in June 2013 for the PED and Construction Phase. Reviews include District Quality Control reviews and Agency Technical Reviews of the Feasibility Scoping and Final Reports. Additional reviews include cost engineering review and certification, legal review and certification, and model review and approval.

On the basis of the USACE peer-review guidance (EC 1165-2-209), this study does not meet the triggers for an independent external peer review (IEPR) because (1) an EIS is not included, (2) the TSP is not likely to have significant economic, environmental, or social affects to the nation, (3) the study is not likely to have significant interagency interest, (4) the study does not involve significant threat to human life, (5) the study is less than $45 million in total, (6) the study is not highly controversial, and (7) the study is not based on novel methods, does not present complex challenges for interpretation, does not contain precedent-setting methods or models, or present conclusions that are likely to change prevailing practices. The Norfolk District has received an IEPR exclusion July 31, 2013.

EXPECTED PROJECT PERFORMANCE
First Project Costs (Oct 2012).

	($1,000's)		
Description	**Cost**	**Contingency**	**Total**
Lands & Damages	699	26	725
Construction	24,238	4,660	28,898
Preconstruction Engineering and Design	2,536	127	2,663
Construction Management	1,937	190	2,127
TOTAL IMPLEMENTATION COST	**29,410**	**5,003**	**34,413**

Equivalent Annual Costs and Benefits. All costs for this project have been allocated to the purpose of NER.

Lynnhaven River Basin Ecosystem Restoration Project **Annual Benefits and Costs (Oct 2012):**	
Investment Costs	
Total First Project Construction Costs	$34,413,000
Interest during Construction	$588,000
Total Investment Costs	$35,001,000
Average Annual Costs	
Interest and Amortization of Initial Investment	$1,497,000
Average Annual Monitoring*	$30,000
Average Annual OMRR&R	$2,000
Total Average Annual Costs	$1,529,000

1. Annual costs are amortized over a 50-year period of analysis using the current discount rate of 3.75 percent.
2. Average annual monitoring costs include various amounts for each year of the 50-year period of analysis and for each project measure. It is expected that the initial 10 years of monitoring will be the most intense. All monitoring costs after the initial 10 years (including the fish reefs, wetlands, SAV, and scallops) will be the responsibility of the local sponsor, the City of Virginia Beach.

The ecological benefits estimated for the recommended plan include an average annual increase in secondary production (aquatic biomass) of 285,000 kg and an average annual increase in the BIBI per acre of approximately two index points (on a scale of 1-5). The wetland restoration component of the recommended plan is expected to increase the USEPA Marsh Assessment Score by an average of approximately 70 for each site restored.

Cost Sharing. Cost-sharing for construction of this environmental ecosystem restoration project will be 65 percent Federal and 35 percent non-Federal. The Sponsor (City of Virginia Beach) will provide all lands, easements, relocations, rights-of-way, and disposal or borrow areas (LERRD) required for construction and subsequent maintenance. At October 2012 price levels the Federal cost-share will be $22,368,000; while the non-Federal sponsor's cost-share will be $12,045,000.

Lynnhaven River Basin Ecosystem Restoration Project Cost Sharing (October 2012 Price Level)			
Item	Federal Cost	Non-Federal Cost	Total Cost
Ecosystem Restoration (ER)			
PED[1]	$ 1,731,000 (65)	$ 932,000 (35)	$ 2,663,000
LERR&D	$ 0	$ 725,000	$ 725,000
Ecosystem Restoration	20,638,000	10,387,000	31,025,000
Subtotal	$ 20,638,000 (65)	$ 11,112,000 (35)	$ 31,750,000
Total Project Costs	$ 22,368,000 (65)	$ 12,045,000 (35)	$ 34,413,000

[1]Sponsor contributes 25% during the design phase and the remaining 10% the construction phase

Project Implementation. The Non-Federal sponsor for project implementation is the City of Virginia Beach. The Corps will be the lead agency for PED and Construction. Annual monitoring will be conducted for each of the measures to ensure that project objectives are being fulfilled, for up to 10 years post construction. Total cost for 10 years of monitoring and adaptive management is estimated to be $561,000 and $1,750,000, respectively.

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R). The non-Federal sponsor shall be responsible for performing all required project operation, maintenance, repair, rehabilitation, and replacement (OMRR&R). It is estimated that OMRR&R will cost approximately $2,000 annually.

Key Social and Environmental Factors. Estuarine ecosystems are important whereby their component wetland and aquatic habitats provide a wealth of human services. Commercial and recreational fisheries that are supported by these habitats drive the local economies of coastal towns via the seafood industry and tourism. Hard reef structure provide habitat for oysters, a keystone estuarine species that provide food, habitat and water filtration, and the associated reef community. This habitat attracts fish and provides a fishery for recreation and commercial use. The PDT worked with the local land owners to ensure project could be completed without negative impact to the property owners in the area.

Stakeholder Perspectives and Differences. Throughout this study, stakeholders, including resource agencies were actively involved in the planning process; many served as members of a steering committee for the project. The USACE and stakeholders worked together to identify restoration measures that would add value to ongoing projects by other Federal, state, and local agencies and to recommend projects as the tentatively selected plan. Concerns expressed by stakeholders, the general public and the resource agencies during the plan formulation or review

processes were addressed and used to guide the PDT in the development of the project. The PDT will continue to involve the steering committee and other centers of expertise, included the Virginia Institute of Marine Science, Old Dominion University and Lynnhaven River NOW, during the PED phase of the project.

Environmental Compliance. As an integrated report, this document meets the technical requirements for USACE feasibility reports and NEPA compliance. This EA is written pursuant to and complies with ER 200-2-2 (33CFR Part 230): Environmental Quality - Procedures for Implementing the National Environmental Policy Act (NEPA) and 40 CFR Parts 1500 to 1508 the Council on Environmental Quality (CEQ) Regulations for Implementing the National Environmental Policy Act (NEPA).

State and Agency Review. The Draft Integrated Feasibility Report and EA were made available to a list of local, State and Federal regulatory agencies and the public on April 26, 2013 for a 30-day review and comment period. The Feasibility Report and EA were also placed in three public libraries and on the Norfolk District Website.

State and Agency review for the draft Chief's Report, as required by the Flood Control Act of 1944, will occur on approval by the Civil Works Review Board.

State and agency comments received during review of the final report/environmental impact statement included comments from state and federal agencies… (To be inserted by HQUSACE after S&A Review ends.)

Certification of Peer and Legal Review. Agency Technical Review (ATR) of the Pre-Alternatives Formulation Briefing Report and Appendices was certified April 7, 2011, and a second one on June 25, 2013. An ATR of the final report was completed on August 20, 2013. Legal Certification of the Final Report is dated April 22, 2013.

Policy Compliance Review.
To be completed by HQUSACE after Documentation of Review Findings are complete.