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INTERIM FINAL FEASIBILITY STUDY APPENDICES A THROUGH D NAB LITTLE CREEK VA

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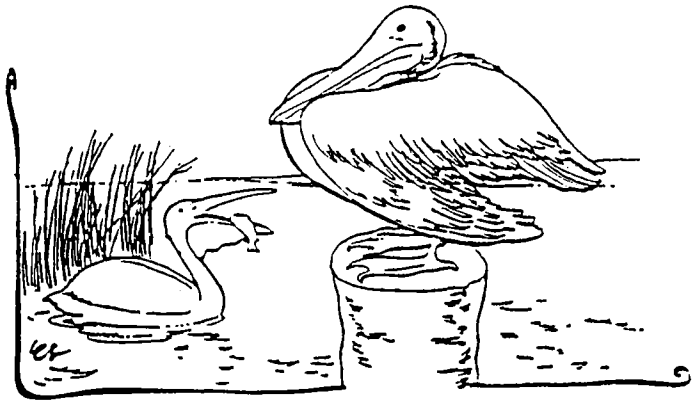
U S ARMY CORPS OF ENGINEERS

Interim Final Feasibility Study
Appendices A- D

ELIZABETH RIVER BASIN, VIRGINIA

ENVIRONMENTAL RESTORATION



U.S. Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, VA 23510

June 2001

INTERIM FINAL FEASIBILITY REPORT
APPENDICES A-D
ELIZABETH RIVER BASIN, VIRGINIA
ENVIRONMENTAL RESTORATION FEASIBILITY INVESTIGATION

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B	REAL ESTATE SUPPLEMENT
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Engineering and Cost Data

APPENDIX A
ENGINEERING AND COST DATA

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INTRODUCTION

PURPOSE AND SCOPE

The feasibility study evaluates the potential for Federal interest in existing watershed problems associated with ecosystem and environmental restoration in the Elizabeth River Watershed, Hampton Roads, Virginia. More specifically, these watershed problems fall into two major categories in the Elizabeth River: loss of wetlands and bottom sediment contamination.

This engineering appendix supports the feasibility study investigations and provides engineering evaluations of wetland restoration sites and sediment clean-up alternatives and their associated engineering requirements and construction cost estimates.

The initial screening process helped discern which restoration alternatives were cost effective and engineeringly feasible based upon the investigations documented in this Appendix and elsewhere in the feasibility study report.

HYDROLOGY AND HYDRAULICS

WATER QUALITY CONDITIONS

The surface waters the Elizabeth River typically are heavily influenced by urban development. The Commonwealth of Virginia has listed those water bodies that do not meet the numeric and narrative water quality standards that were adopted to protect water quality. The following monitored water bodies in the Hampton Roads area do not meet the water quality standards: Elizabeth River, Eastern Branch Elizabeth River, Southern Branch Elizabeth River, and the Lafayette River (DEQ, 1996).

The Elizabeth River is designated as Class II (a) waters. Compliance with these water quality criteria requires a minimum of 4.0 mg/l dissolved oxygen (DO), pH between 6.0 and 8.5, and temperature increase no greater than 4 degrees Fahrenheit (°F) in summer and 1.5 °F in winter. Special standard (a) is applicable to the waters of Hampton Roads as this standard applies to all waters capable of propagating shellfish, including those that are restricted or condemned by the State Department of Health. The shellfish beds of the Elizabeth River are condemned for harvest but shellfish may be transplanted to acceptable areas for later harvest. The Elizabeth River, including the Eastern and Southern Branches as well as the Lafayette River, do not meet the Class II (a) water quality standards (VDOT DEIS, 1999).

The Elizabeth River has very poor flushing characteristics resulting from little freshwater input and a slight topographical relief. Any freshwater entering the system is a result of stormwater runoff and Dismal Swamp drainage. This poor flushing tends to increase the amount of sediment and associated pollutants that are trapped within the river system (Neilson and Kuo, 1973-4).

Hydrodynamic changes have not been well studied in the past but are evident. Nichols and Howard-Strobel state that 24 percent of the tidal prism of the Elizabeth River has been lost as a result of filling and that tidal currents at the mouth of the river have been reduced by 17 percent. These changes have likely contributed to the low flushing rates in the Elizabeth River. While such changes have exacerbated the poor water quality of the Southern Branch, they have also acted to contain the high loading of contaminants within the Southern Branch (VDOT, 1999).

The state began testing water quality, sediment quality, and living resources at 12 to 175 stations throughout the Elizabeth River system in 1998-99. In September 1999, a panel of scientists analyzed initial findings. At the State of the (Elizabeth) River Conference 2000 the results were presented. The following information is taken from the conference proceedings.

Monitoring Results for Water Column Dissolved Metal

Dissolved metals in water are available to animals and have the potential to cause toxicity. This data is now being collected at fourteen (14) stations in the river. Testing did not target known problem areas, but was spaced throughout the river. Preliminary data indicates that the levels of most of these dissolved metals in the Elizabeth River are significantly lower than historical data suggested.

Key Points.

- With the exception of copper, all metals evaluated showed surprisingly low dissolved levels.
- Highest dissolved copper levels were observed in the Southern Branch where DEQ's chronic water quality criteria of 3.8 ug/L was exceeded at four stations.
- While the highest zinc concentrations were observed in the Western Branch, levels were not indicative of even a borderline problem.

Monitoring Results for Water Toxicity

Ambient water bioassays were used to test the overlying waters for their impacts on more mobile animals such as fish and invertebrates.

Key Points.

- No toxic effects from the water column have been determined to date at any of the 11 stations where data was collected by the state program.
- Monitoring Results for Conventional Water Quality – Dissolved oxygen and nutrients such as phosphorus are good indicators of the general health of an estuary. Ten-year trends from data collected by numerous agencies (Status and Trends in Water Quality and Living Resources in the Virginia Chesapeake Bay: 1985-1998).

Key Points.

- Dissolved oxygen shows an improving trend throughout the river with very few values below the standard since 1996.
- No recent problems indicated with low dissolved oxygen even in deep bottom waters where problems most often occur.
- Nutrient levels are generally decreasing, but even the decreased levels are of concern in many instances.

EROSION CONTROL REQUIREMENTS

Several wetland restoration sites have erosion control/protection features incorporated into their designs. These sites include the ODU drainage canal site; and the Jordan Bridge site. Requirements for erosion control were determined by examining geomorphology, fetch, orientation, boat wake, etc. These sites will require a low-crested rock sill on the riverside of the constructed wetland.

SURVEY, MAPPING, AND GEOSPATIAL REQUIREMENTS

WETLAND RESTORATION SITES

Topographic survey information was used to develop wetland restoration plans at each of the candidate sites, specifically for tidal saltmarsh communities. Topographic data also assisted in evaluating the feasibility of restoring wetlands at these sites, e.g., estimating volumes and costs to remove fill material. Survey and profile maps included the following information and data:

Vertical Control

Vertical control was referenced to the National Geodetic Vertical Datum of 1929 (NGVD – 1972 adjustment). Semi-permanent benchmarks were established and clearly identified on the survey for each site.

Horizontal Control

Horizontal control was referenced to the Virginia State Plane Coordinate System-South Zone North American Datum of 1983 (NAD 83) 1986 adjustment. Where applicable, survey baseline was established with monuments of a semi-permanent nature. Angle points and/or end points along the survey baseline were properly referenced for future recovery.

Profiles

Cross-section profiles were used to estimate excavation and fill quantities necessary for saltmarsh development. Surveying methods to accomplish this task such as baseline locations, transect locations, profile intervals, and/or other methods were developed in consultation with the USACE prior to conducting surveys.

Points of Interest

Points of interest were located and referenced to aid in the development of restoration plans. For example, significant resources were identified that required avoidance of disturbance or mitigation for proposed disturbance. Points of interest include:

- Vegetation zones (e.g., low marsh, high marsh, Common Reed);
- Jurisdictional wetlands delineation line;
- Tidal datums MLW and MHW;
- Existing structures (e.g., buildings, utilities, fences, etc.);
- Canopy (perimeter) of treed areas;
- Significant individual trees;
- Conspicuous debris piles (e.g., asphalt mounds, concrete piles, etc.); and
- Above ground utilities (e.g., light posts, telephone poles, manholes, electrical boxes, water valves, etc.).

The Corps of Engineers (USACE) delineated the jurisdictional wetlands, low marsh, high marsh, and Common Reed vegetative zones. Significant individual trees means those trees which are considered significant pursuant to established local municipal policies and regulations. In consultation with the local municipal government, the USACE shall identify which trees are significant and thus need be located.

Property Boundaries

Property boundaries were surveyed and depicted on survey maps.

Reference Wetland

Elevations and profiles from a 'reference' wetland, assisted in determining restoration elevations for the study area. These elevations commonly referred to as biologic benchmarks represent the elevations at which certain vegetation grows. The USACE identified the reference wetland, which is a wetland that possesses similar characteristics to that of the proposed restored wetland and is preferably in close proximity to the study area

Spot elevations and shoreline profiles at the reference wetland were obtained and developed. Spot elevations of the reference wetland included, where present: the channelward limit of saltmarsh, center of low marsh, boundary between low marsh and high marsh, center of high marsh, boundary between high marsh and upland (i.e., wetlands delineation line), 50' and 100' landward of boundary between high marsh and upland.

Products

Maps were developed at a scale of 1" = 30' with 1' contour intervals in both electronic and hardcopy bond maps. Maps utilized, to the maximum extent practicable, various colors or symbols to depict important features of the survey (e.g., different vegetation zones, tidal datums, points of interest, etc.).

SEDIMENT CLEAN-UP AT SCUFFLETOWN CREEK

Hydrographic surveys in Scuffletown Creek were completed during summer 2000. The hydrographic surveys were accomplished by the USACE, Norfolk District. The survey information was used to develop a feasible design for removal of contaminated bottom material within the creek, and to determine the equipment, including dredging equipment, which could operate within the depth limitations, and other site constraints of the creek.

The hydrographic survey of the Scuffletown Creek project area was performed utilizing a hydrographic survey vessel equipped with an Innerspace Technology Model 448 Thermal Depth Recorder operating at a frequency of 208 kilohertz to obtain soundings. Horizontal positioning was electronically recorded using an Ashtech Z-12 Global Positioning System (GPS) receiver, with corrections obtained from the U.S. Coast Guard beacon located at Cape Henry, Virginia. The horizontal plane of reference was the Virginia Grid (South Zone), based on the North American Datum of 1983 (NAD 83). The vertical plane of reference was National Ocean Service (NOS) Mean Lower Low Water (MLLW), 1960 to 1978 tidal epoch. Hydrographic mapping was performed using Accugraph MountainTop MTX950, Version 7.3 drafting software.

The hydrographic survey information was then incorporated into a Geospatial Information System (GIS) format and displayed on aerial photography of the site for further analysis of both creek and upland boundary site constraints.

GEOSPATIAL INFORMATION SYSTEM (GIS)

A Geospatial Information System (GIS) was utilized as an analytical and data management tool in the formulation of this study and its recommendations. Multiple data layers were collected, created, and imported into GIS where they were processed into one unique coordinate system. Survey data in Computer Aided Design (CAD) format and GIS layers were provided by the USACE and the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach and included buildings, utilities, parcels, roads, water bodies, contours, vegetation, and aerial photography. These layers, in combination with

the alternative wetland restoration designs, and the GMS contour depictions (for sediment clean-up), served as the basis for analysis and presentation of data.

Data is stored on the Norfolk District's GIS data server and in the future will be stored through the Norfolk District's Geospatial website at http://gisweb.nao.usace.army.mil/Geospatial/.

GEOTECHNICAL

REGIONAL AND SITE GEOLOGY

The Elizabeth River Basin area is extremely flat, low lying and featureless, with an average elevation of approximately 11 feet above mean sea level, except for isolated sand dunes along beach areas. The area is traversed by numerous bays and estuaries; streams are shallow and their channels wide and meandering. Except for dredged channels, water depths in the inland bays and connecting waterways are generally less than 10 feet. Because of the elevations, the area is quite often subject to tidal flooding caused by hurricanes and northeasters that frequent the area. Flooding of the low-lying land adjacent to the entrances has caused loss of life, damage to property, and blocking of land traffic arteries. Much of the land in downtown sections of the cities was formerly wetlands or completely under water and has been converted to upland by use of fill material.

The Elizabeth River lies in the Atlantic Coastal Plain. A wedge of unconsolidated and semi-consolidated sediment that dips and thickens to the east underlies the Coastal Plain. This sediment lies on a consolidated pre-Cambrian basement rock, which generally consists of deformed igneous and metamorphic rocks. The Coastal Plain sediments are composed of sand, gravel and clay, with some limestone, and range in age from Recent to Cretaceous or older. In the Elizabeth River area, these sediments are approximately 2,800 feet thick and range in age from late Mesozoic to Recent. Although the sediment has not been subjected to deformation, thickness and lithologic composition

can be highly variable. Mineral resources of sand, gravel, and peat are available in some of the surface formations in the Coastal Plain.

Soils in the Coastal Plain were developed from unconsolidated marine sediments. The texture of these soils is generally sandy silt from flood plain deposits, clayey silt on fluvial terraces, fine silty sand on higher marine terraces, and clayey silt from Coastal Plain peneplain. These soils are deep but their drainage characteristics range from well drained to poorly drained. Wetness and poor drainage are prevalent in a number of locations in the region. Low-lying and upland soils are tidal marsh and manmade land fill material.

GEOPHYSICAL AND CHEMICAL INVESTIGATIONS

Wetlands Restoration

The GeoEnvironmental Engineering Section of the Norfolk District U.S. Army Corps of Engineers (USACE) was tasked by the Environmental Analysis Branch of the Norfolk District USACE to assist in the Wetlands Restoration Evaluation of the Elizabeth River Environmental Restoration - Feasibility Study. The GeoEnvironmental Section was tasked to perform a Wetlands Subsurface Investigation to evaluate the Hazardous, Toxic, and Radioactive Waste (HTRW) potential of the following six (6) candidate sites on the Elizabeth River watershed in Virginia:

1. Grandy Village, Norfolk, Virginia.
2. Portsmouth City Park, Portsmouth, Virginia.
3. Carolanne Farms, Virginia Beach, Virginia.
4. Somme Avenue, Norfolk, Virginia.
5. Swimming Point (Crawford Bay), Portsmouth, Virginia.
6. Sugar Hill (Scotts Creek), Portsmouth, Virginia.

The primary objective of the Elizabeth River Wetlands subsurface investigation was to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Physical and chemical characterization was accomplished through the use of test pits, soil borings, and laboratory analyses of samples representative of distinct subsurface strata.

Field activities commenced on 9 November 1999 and extended through 18 November 1999. The complete set of analytical results was received on 31 January 2000. All analytical data were independently validated to ensure that data of sufficient quality were generated.

The GeoEnvironmental Section performed a thorough evaluation of the results of the Elizabeth River Wetlands Subsurface Investigation to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Physical characterization includes identification and classification of distinct subsurface strata and approximating the vertical extent of the strata based on soil boring and test pit logs. Chemical characterization includes identification of potential contaminants of concern (COCs) within the distinct subsurface strata, based on the chemical analyses of samples representative of the distinct subsurface strata.

The complete report appears as Attachment C to Appendix A.

River Bottom Sediments Investigations

A two-phase approach to evaluating the condition of bottom sediments within the Elizabeth River (selected sites) is depicted on Figure 16. Generally, the Phase I investigations looked at both chemical and biological indicators of sediment toxicity and degradation. The Phase 2 investigations then proceeded to further define the vertical extent of sediment contamination and evaluate potential remediation technologies.

EA Engineering, Science, and Technology, Inc. conducted the Phase I sediment investigation for the Norfolk District USACE during the period of February though June 1999. Four specific areas of the Elizabeth River were investigated during this phase: Scuffletown Creek (Southern Branch), Scotts Creek (tributary off mainstem), east of the Campostella Bridge (Eastern Branch), and adjacent to the prior Eppinger and Russell wood treatment facility (Southern Branch).

The sampling and analysis of the sediment was required to:

- Document existing physical and chemical characteristics of the sediment in each of the four sites;
- Identify potential chemicals of concern; and
- Identify areas that may require further investigation.

The Phase I Data Report presents a synopsis of the Phase I sampling program and the results of bulk chemistry testing for each of the four project areas in the Elizabeth River. The project schedule, list of key personnel, Field Sampling Plan (FSP), laboratory Quality Assurance Project Plan (QAPP), and Site Safety and Health Plan (SSHP) are documented in the Work Plan (EA 1999) that was submitted to and approved by the Norfolk District USACE and the members of the Elizabeth River Steering Committee in March 1999.

The short-term objectives of the Elizabeth River Phase I sediment investigation were to:

- Collect sediments representative of each the four proposed remediation areas of the Elizabeth River (Scuffletown Creek, Scotts Creek, East of Campostella Bridge, and prior Eppinger and Russell site).

- Test bulk sediments for semivolatile organic compounds, organochlorine pesticides, polychlorinated biphenyl (PCB) aroclors and congeners, polychlorinated terphenyl (PCT) aroclors, priority pollutant (PP) metals, total organic carbon (TOC), and physical characteristics (grain size).

- Provide validated, analytical data in a usable format.
- Compare validated analytical data to selected Data Quality Objectives (DQOs) (marine sediment quality guidelines).

Overview of Field Sampling Activities

Mobilization for the Elizabeth River Phase I Sediment Investigation commenced in February 1999. Sample collection was initiated on 03 March 1999 and continued through 27 April 1999. Sampling activities began at the previous Eppinger and Russell site, and proceeded to the Scuffletown Creek area, followed by East of Campostella Bridge and Scotts Creek. A total of 244 stations were successfully sampled out of 281 target locations. Sampling was attempted at every targeted location, with the exception of those stations that were located onshore. The majority of sediment cores were collected using gravity coring techniques; however, hand coring was required at 23 locations where access was difficult due to either low bridges or shallow water depth.

A total of 689 cores were collected and composited for chemical analysis. In addition, 29 cores were collected from the prior Eppinger and Russell site for photography and lithological description. The number of cores collected at each station was dependent upon the sediment recovery in each core. Stations in Scuffletown Creek and at the prior Eppinger and Russell site required the collection of at least two cores to obtain the sample volume required for analytical testing and QC analysis. Only a few stations in Scotts Creek and East of Campostella Bridge required collection of more than one core.

Overall, only 36 of the 281 targeted stations were not successfully sampled (13%). Insufficient sample recovery precluded successful sediment collection at seven (7) target locations (5 in Scuffletown Creek and 2 East of Campostella Bridge) (Table 2-1). In addition, 29 of the targeted stations were located onshore (28 at Scuffletown and one at Scotts Creek).

Scuffletown Creek. A total of 148 of 181 targeted locations were sampled in Scuffletown Creek. Sampling at 40 stations (22%) in Scuffletown Creek yielded insufficient sediment recovery from the 1-2 ft depth interval to conduct analytical testing. In addition, five stations located in Scuffletown Creek yielded either no sediment recovery or insufficient recovery to conduct analytical testing for both the 0-1 ft and 1-2 ft depth intervals. Twenty-eight (28) locations at Scuffletown Creek were not sampled because the stations were located onshore. Hand coring was employed to sample eleven (11) stations located east of and under the Interstate 464 bridge.

Scotts Creek. A total of 31 of 32 targeted locations were sampled in Scotts Creek. One target station for Scotts Creek was located onshore and was not sampled. In addition, hand coring was employed at twelve (12) shallow locations in the southernmost areas of Scotts Creek.

East of Campostella Bridge. A total of 32 of 34 targeted locations were sampled East of Campostella Bridge. Originally, target locations were located east of the Campostella Bridge. However, the fine grid was re-located by Norfolk District USACE to the west of the Campostella Bridge to sample an area of suspected contamination. After initial site reconnaissance and prior to sampling, stations located east of the Campostella Bridge were adjusted to avoid a barge mooring area located east of the bridge, a sunken barge, and an underground high voltage cable crossing the river parallel to the bridge. In the field, stations CBF004 and CBF008 were re-adjusted approximately 100 ft to the east due to a floating dry dock located over the target locations. Sampling at two stations located east of the bridge yielded either no sediment recovery or insufficient recovery to conduct analytical testing.

Eppinger and Russell. A total of 34 of 34 targeted locations were sampled near the prior Eppinger and Russell site. Samples collected from 5 locations were submitted for analytical testing and 29 cores were photographed and described for lithology.

Analytical Testing of Bulk Sediments. Analytical testing of the sediment was conducted by EA Laboratories in Sparks, Maryland. Bulk sediments were tested for the following compounds using the most current EPA SW-846 guidelines: semivolatile organic compounds, PCB aroclors and congeners, PCT aroclors (5432 and 5460), organochlorine pesticides, PP metals, and TOC. Grain size determination was conducted in EA's Ecotoxicology Laboratory.

In addition to sediment samples, quality control (QC) samples were submitted to the laboratory for analysis. Field duplicate (FD) samples, field blanks, equipment rinsate blanks, and processing blanks were analyzed for the project. Extra sample volume was submitted to the laboratory for matrix spike (MS) and matrix spike duplicate (MSD) analyses.

The complete Phase 1 sediment investigations report is presented in Appendix E (Environmental Technical Reports), Attachment C.

Phase 1 Biological Testing and Investigation

Toxicity Tests. Surficial sediment (0 to 2 cm) from three sites: Scuffletown Creek, Scott's Creek, and in the vicinity of Campostella Bridge were used in sediment bioassays with estuarine fish and amphipods to assess ambient toxicity. Bioassays performed on sediments collected from these sites in October 1999 with the amphipod *Leptocheirus plumulosus* showed very little toxicity at any site, but the results were suspect since reference toxicant tests were invalid. The fish (Sheepshead minnow – *Cyprinodon variagatus*) bioassays on the same sediments were flawed and failed to provide meaningful data. Sediment from these same sites and locations were collected again in April 2000 and the bioassays were run. In the second round of sediment bioassays, no strata were impaired based on amphipod survival, amphipod growth, fish larvae survival or fish larvae growth. No statistically different acute or growth effects with either test species were observed when the strata were compared to a reference site.

The U.S. Environmental Protection Agency (EPA) performed toxicity tests using Scuffletown Creek (and vicinity) sediments with the amphipod *Ampelisca abdita*. The sediments used for the bioassays were depth integrated from 0 to 1-foot depth samples collected at randomly selected stations. In contrast to the toxicity tests using the surficial sediments, eight (8) out of eleven (11) stations showed high toxicity (0-40 percent survival) and the remaining three stations showed moderate toxicity (40-80 percent survival).

This data may be suggesting that toxicity in the surficial layer is minimal, while at depth the contaminants are bioavailable or in sufficient concentrations to be toxic. This hypothesis, in fact, appears to be supported by the results of the assessment of benthic community health (B-IBI). The B-IBI for Scuffletown Creek and vicinity shows that deep dwelling organisms are absent, yet the shallow dwelling organism (primarily one pollution tolerant species) is present with abundance similar to reference conditions.

The complete toxicity test results are presented in Appendix E (Environmental Technical Reports), Attachment F.

Benthic Index of Biotic Integrity (B-IBI)

A study of the macrobenthic communities of the Elizabeth River watershed was conducted in summer 1999. The three objectives of the Benthic Biological Monitoring Program of the Elizabeth River watershed Chesapeake Bay are:

1. To characterize the health of regional areas of the tidal waters of the Elizabeth River watershed Chesapeake Bay as indicated by the structure of the benthic communities. These characterizations are based upon application of benthic restoration goals and the B-IBI developed for the Chesapeake Bay to five (5) primary strata; the Mainstem of the river, the Lafayette River, the Southern Branch, Western Branch, and Eastern Branch. Within each stratum samples were randomly allocated in a probability-based sampling design. A probability-based sampling design allows calculation of confidence intervals around estimates of condition of the benthic communities.

2. To conduct trend analyses on long-term data at fourteen (14) fixed-point stations to relate temporal trends in the benthic communities to changes in water and/or sediment quality. Trend analyses will be updated annually as new data are available.

3. To produce an historical data base that will allow annual evaluations of biotic impacts by comparing trends in status within probability-based strata and tends at fixed-point stations to changes in water and/or sediment quality. In addition, in the 1999 sampling event two additional strata were sampled for benthic community condition; (1) Scuffletown Creek, a proposed location for sediment contaminant remediation and (2) an additional nearby small creek system-the Jones and Gilligan Creek complex.

The condition of the seven (7) strata was compared to the results for all Virginia tidal waters for 1999 based upon the random sampling of 100 sites as part of the on-going Virginia Benthic Monitoring Program. In 1999 Virginia tidal waters averaged 30% degraded benthic bottom. All seven (7) strata for the Elizabeth River were higher than this value: 52% for the Mainstem of the River, 64% for the Lafayette River, 64% for the Eastern Branch, 72% for the Western Branch and 92% for the Southern Branch. Scuffletown Creek and Jones-Gilligan Creek both averaged 76% area failing the Benthic Restoration Goals. In general for all Elizabeth River strata species, diversity and biomass were below reference condition levels while abundance values were within reference condition levels. Community composition was unbalanced with levels of pollution indicative species above and levels of pollution sensitive species below reference conditions. The only exceptions to these patterns were the Mainstem of the river where biomass and levels of pollution sensitive species were within reference condition levels.

The complete B-IBI report is presented in Appendix E (Environmental Technical Reports), Attachment A.

Phase II Sediment Evaluation at Scuffletown Creek

In addition to the Phase I sediment sampling that was conducted on four sites in the Elizabeth River watershed, a Phase II investigation was conducted on sediments at

Scuffletown Creek. Foster Wheeler was contracted by the Norfolk District to execute the Phase II investigation in support of this study. The main work elements of the Phase II investigation were as follows:

- Acquire samples at twelve (12) station locations within previously identified "hotspots" to a depth of 6 feet, analyzing the sediment for contaminants in the 2-3 foot, 3-4 foot, 4-5 foot and 5-6 foot intervals.

- Apply remediation technologies on extracted sediments to identify options which are cost efficient and effective in reducing contaminant levels.

Phase II Site Analysis Methodology

In the Phase II investigation, the twelve (12) station locations were selected to reside within "hotspots" that were identified in the Phase I investigation in Scuffletown creek through the ERM SQV method. The twelve (12) samples were taken using vibracore equipment, and each one-foot increment was homogenized for analysis in the lab. The results of the bulk chemical analysis on the twelve (12) stations were then converted into ERM SQV's and the SQV breakpoints as previously used to contour "hotspots" in the phase I investigation. This information was then used to contour ERM SQV "hotspots" at one-foot increments between 2 and 6 feet. In addition to bulk chemical data analysis, the samples were also analyzed by means of the Toxicity Characteristic Leachate Procedure (TCLP) to determine suitability for direct disposal in a regulated landfill.

Figures 1 through 4 show the results of the GMS analysis for the Phase II investigation at Scuffletown Creek. It must be noted that the "hotspots" identified are not as refined as those from the Phase I sampling due to a limited number of stations over a broad area.

By looking at the figures it is clear that there are considerable levels of contamination at the first two depth intervals (2-3 feet and 3-4 feet). As was expected, the data does show that after a certain depth (4 feet), contamination drops off considerably until the material does not exceed the ERM SQV clean-up level of 0.6.

Results of Phase II Treatability Study

Treatability studies were conducted on two bulk sediment samples collected from Scuffletown Creek, selected to represent the most highly contaminated sediments ("high strength") and sediment containing more typical concentrations of contaminants ("average strength"). The treatability study included characterization of the two sediment samples, followed by bench-scale testing of solid phase composting, slurry phase biological treatment and soil washing technologies. The following paragraphs summarize the results of these studies.

The characterization of the sediment samples for the treatability investigations indicated that the only organic compounds present at detectable concentrations in both the high and average strength sediment samples were PAHs. The total PAH concentrations in the high and average strength sediments were 48,100 µg/kg and 28,600 µg/kg, respectively. Semi-volatile TCLP results on the high strength sediment were all below detection limit levels.

The metals concentrations in the two sediment samples were similar. With the exception of antimony, beryllium, cobalt, silver and thallium, all TAL metals were present at detectable concentrations. However, with the exception of lead in the average strength sediment, all TCLP metals were below detection limit levels. The lead TCLP level in the average strength sediment sample was 0.166 mg/L, which is below the regulatory TCLP limit for lead of 5 mg/L. Based on these analyses, a treatability study on stabilization was eliminated from the planned testing protocol, since treatment of metals to meet off-site disposal requirements would not be necessary.

Both sediment samples had similar levels of the conventional parameters. The COD concentration in both sediments was approximately 120,000 mg/L. Both sediments contained 52 percent solids and 14 mg/kg ammonia. The total plate counts in the high and average strength sediment were 150,000 and 130,000 cfu/mL, respectively. Particle size distribution analysis indicated that the high strength sediment contained a higher fraction of fine particles.

The complete Phase II sediment testing results are presented in Appendix E (Environmental Technical Reports), Attachment D.

Treatment Technology Evaluations

Solid Phase Composting. Treatment by solid phase composting was tested by mixing sediment with an inoculum (consisting of a 2:1 ratio of wood chips to municipal compost) at two ratios (i.e., 2:1 and 5:1). Solid phase composting was tested under both aerobic and anaerobic conditions on both the high and average strength sediment for a period of 21 days. PAH removal by solid phase composting ranged from 24.3% to 74.4% (one reactor showed an increase in PAH concentration after treatment and is not included in this range). The highest removal of PAHs (i.e., 74.4%) was observed in the aerobic reactor treating the high strength sediment with a sediment to inoculum ratio of 2:1.

Slurry Phase Biological Treatment. Slurry phase biological treatment was tested by creating a 10 to 15 percent slurry of sediment in an acclimated biological sludge from a refinery wastewater treatment plant. Slurry phase treatment was tested under aerobic conditions on both high and average strength sediment for a period of 4 weeks. Five (5) samples were collected over the operating period and showed varying levels of PAH removal. The final samples indicated 86% removal of PAHs from the high strength sediment and 99% removal of PAHs from the average strength sediment by slurry phase treatment. It should be noted that the slurry phase treatment operating and sampling procedure required the treated sediment to be separated from the slurry by a process similar to soil washing. As a result, some of the PAH removal may be attributed to the soil washing process; based on the soil washing results, it is possible that 20 to 80 percent of the removals could be attributed to soil washing.

Soil Washing. Treatment of sediment by soil washing was tested using a water wash, double volume water wash, high temperature water wash, acid wash, and surfactant (Igepal CA-270) wash at two doses (20 mg/g and 200 mg/g). Both the high and average strength sediment were subjected to each treatment. The highest removals of PAHs observed on the high strength sediment were achieved using a hot water wash (98% PAH removal) and surfactant wash at 20 mg/g (96% PAH removal). The highest removals of PAHs observed on the average strength sediment were achieved using a double volume water wash (85% PAH removal) and surfactant wash at 20 mg/g (83% PAH removal).

Summary of Treatability Study Results

Throughout the treatability studies, significant variations were observed in the removal of PAHs from the sediment. These variations were observed within each technology tested, between the technologies and between the average and high strength sediment samples. Of the three (3) technologies tested, the highest PAH removals were associated with slurry phase biological treatment on the average strength sediment (99% PAH removal) and soil washing on the high strength sediment (96-98% PAH removal). Solid phase composting did not achieve PAH removal percentages as high as the other two processes; however, 74% removal of PAHs from the high strength sediment was

achieved over a 21-day period through composting. Since composting is a slower process than either soil washing or slurry phase treatment, this removal percentage is significant. Despite the variations in PAH removal, a general conclusion that can be drawn from the treatability study is that all three (3) of the technologies are capable of achieving some significant level of removal of PAHs from the Scuffletown Creek sediment.

Preliminary Evaluation of Treatment Technologies

During performance of the Feasibility Study for Scuffletown Creek, evaluation of these three technologies (individually or in combination) for treatment of the sediment was performed based on their effectiveness, implementability and relative cost (representing 3 general evaluation criteria, which are further supplemented by 4 additional specific evaluation criteria for the Detailed Analysis of Alternatives – see Section 3.7 of the Project Work Plan). The following paragraphs provide a synopsis of the evaluation of these technologies.

Effectiveness. Based on the treatability study results, soil washing and slurry phase treatment would be considered the more effective treatments, depending on the contaminant levels in the dredged sediments. Solid phase composting would be considered less effective, since the highest PAH removals achieved were significantly lower than for the other two technologies. However, in completing the evaluation of effectiveness, critical items to identify are the contaminant levels in the dredged sediment (as there is natural variability in sediment composition) and the level of treatment required to meet the disposal requirements for the chosen final disposition of the treated sediments. If the PAH levels achievable by solid phase composting are acceptable for the final disposition (e.g., placement into a dredge material storage area), then solid phase composting can also be considered an effective treatment technology, particularly if longer treatment durations are allowed. In general, it appears as if the contaminants present in the stable, aged sediments in Scuffletown Creek are not as bioavailable (and thus amenable to biodegradation) as contaminants already present in the dissolved

phase (i.e., pore water). This observation lends itself to the general conclusion that slurry phase biological treatment has greater PAH reduction potential than solid phase composting. In the slurry phase treatment it should be noted that 20 to 80% of PAH removal is attributed to soil washing.

Implementability - All three (3) technologies tested have pros and cons in the implementability evaluation. Solid-phase composting is easy to implement from a technical standpoint. It requires minimal equipment and moderate (periodic) labor, however, it does require substantial land area dedicated for treatment for an extended period of time. Slurry phase treatment requires design and construction of a treatment system, substantial monitoring of the process and intensive labor. Additional equipment and/or land area may be required for separating treated sediment from the slurry and/or dewatering. However, slurry phase treatment would occur very quickly; the remediation of sediments could be accomplished in a substantially shorter time period than composting. Also, the complexities associated with slurry phase treatment could be greatly reduced by accomplishing treatment within a modified landfarm treatment cell. Soil washing, like slurry phase treatment, would require substantial equipment and labor, but could also be completed much more quickly than composting. Soil washing has the added disadvantage of not providing any biological degradation of contaminants, but merely transferring them from the sediment to the liquid phase, which would require separate treatment or disposal. The overall volume of sediments to be dredged and the feasibility of segregating sediments of varying contaminant concentrations are critical factors in evaluating and comparing the implementability of these technologies.

Cost - Generally, based on preliminary engineering estimates, composting would be the lowest cost treatment, soil washing would be the higher cost, and slurry phase biological treatment would be the highest cost. However, performance of slurry phase biotreatment in a landfarm cell could greatly reduce the cost, perhaps to a level comparable to solid phase composting. Several factors will affect the unit costs of the three treatment technologies. The total volume of sediment to be treated and the contaminant levels that must be achieved for final disposition of the treated sediment are

critical factors to be determined prior to performance of cost estimates for the three technologies. The anticipated contaminant levels in the dredged sediment are also critical, since additional costs to segregate sediments with differing contaminant levels may easily be offset by a smaller volume of sediment requiring treatment prior to disposal. In addition, consideration may be given to using a lower cost treatment for some portion of the removed sediment.

Conclusions of Treatability Studies

Overall, the treatability study has shown that any of the three (3) technologies tested could be used to effectively treat the dredged sediments from Scuffletown Creek. Identification of the optimum remedy requires an assessment of certain other factors, including total volume to be treated, expected contaminant levels, ability to segregate, final disposition and cleanup levels for disposition.

The complete Phase II treatability testing results are presented in Appendix E (Environmental Technical Reports), Attachment D.

POTENTIAL BORROW SITES AND DISPOSAL SITES

Wetland Restoration Borrow and Disposal Sites

For those wetland restoration sites requiring fill material, clean fill will be obtained from commercial sources or will be acquired from on-site. At the Woodstock neighborhood park site, fill material will be obtained by dredging shallow areas within the adjacent borrow pit.

Excavated material will be used on-site to the greatest extent practicable or will be trucked or barged to appropriate regulated landfills. Where fill material includes large pieces of concrete and other recyclable construction debris, efforts will be made to utilize commercial recycling facilities.

Sediment Clean-Up Disposal Sites

Alternatives that were assessed after the initial screening pertained to dredging technologies, dredging scenarios, transfer/dewatering options, treatment technologies, transportation to a disposal site and eventual disposal of dredged sediment at a dredged material placement site and/or a regulated solid waste landfill site. These alternative plan components were subsequently considered in various potential combinations, and progressively evaluated by USACE, Norfolk District's, "Scuffletown Dredging Team" and the Sediment Subcommittee. Alternatives were assessed for engineering and economic feasibility, and environmental and social acceptability.

The two (2) dredged material management sites under consideration are Craney Island Dredged Material Management Area (CIDMMA) and the Higgerson Buchanan Site, located on the Southern Branch and formerly used for dredged material placement in the early 1980's in connection with the Southern Branch deepening to 35 feet. By law, dredged material cannot be placed permanently into CIDMMA unless it is navigation related. The environmental dredging proposed at Scuffletown Creek would not qualify as "navigation related" dredging since it is strictly for environmental restoration, not navigation. CIDMMA could, however, be used as a temporary placement site or staging area prior to treatment or final deposition at another site. At this time it has not been finally identified which site, or sites, will finally be used to dispose the material removed from Scuffletown Creek; however, either is feasible.

CIVIL DESIGN

SITE SELECTION AND DEVELOPMENT

Wetland Restoration

Numerous candidate wetland restoration sites were evaluated during the course of this study and the reconnaissance investigations. The majority of the sites considered were wetlands at one time and were identified using historical maps. The site selection and screening process is discussed in detail in the feasibility report to which this is an

appendix. The wetland site alternatives which proceeded to the preliminary design level are described in the following paragraphs.

Virginia Geotechnical Services, P.C., was tasked to complete preliminary design for wetland restoration at eight (8) sites within the Elizabeth River Basin. These sites are:

- Carolanne Farms, Virginia Beach, Virginia
- Crawford Bay (Swimming Point), Portsmouth, Virginia
- Jordan Bridge, Chesapeake, Virginia
- Lancelot Drive, Virginia Beach, Virginia
- Scuffletown Creek, Virginia
- Somme Avenue, Norfolk, Virginia
- Sugar Hill (Scotts Creek), Portsmouth, Virginia
- Woodstock Neighborhood Park, Virginia Beach, Virginia

The USACE, Engineering Division, was tasked to complete preliminary design for wetland restoration at three sites within the Elizabeth River Basin. These sites are:

- Grandy Village
- Portsmouth City Park
- Old Dominion University (ODU) Drainage Canal

Wetland Restoration Site Descriptions and Restoration Design Concepts

Carolanne Farms, Virginia Beach, Virginia. A 1937 aerial photograph indicates that the site was upland and apparently used for agricultural purposes. Portions of the site were developed in the 1960s as a privately operated wastewater treatment facility for the adjoining subdivision. The city of Virginia Beach acquired the site in 1982 when the treatment plant was closed. The site was subsequently developed into a neighborhood park. Two mounds in the vicinity of the site contain structures associated with the former treatment plant. These structures can be seen in a 1985 aerial photograph, but

subsequently the city has covered the structures with earthen material. Adjacent to and west of the site, the city has constructed a canoe launch. A hiking trail connects the neighborhood to the canoe launch through the site. The trail is surfaced with hardwood mulch. The western margin of the site has been used by local school groups for decorative tree planting.

USACE personnel conducted a field investigation of the site in November 1999. They completed five (5) soil borings and collected two (2) soil samples for chemical analysis. The borings encountered apparently original wetland soils at depths ranging from two to four feet below ground surface. The stratigraphy appeared to be consistent between the five soil borings. Chemical analytical results for soil samples collected at the site suggest that arsenic and mercury compounds are contaminants of concern at the site.

Existing Topographic Data - Site topography was provided by the Corps. Surveying was performed June 7 and 8, 1999 by the Norfolk District, USACE. The assumed base low marsh elevation is approximately -0.5 feet (MSL). The top elevation of the low marsh is about elevation +2.0 feet. The assumed top elevation of the high marsh is about 4.0 feet.

Restoration Design Concept - Wetland restoration at the Carolanne Farms site will consist of excavation and regrading with suitable soils to design elevations shown on drawing. The excavation concept will create a bowl-shaped depression draining into a tidal estuary into the middle of the site. The estuary will provide some open-water habitat surrounded by high quality low-marsh. The regarding concept minimizes disturbance in and around the mounds covering the former sewage treatment structures. Excavated soils will be used onsite to create a pedestrian walkway connecting hiking trails and observation stations along the existing mounds.

It is anticipated that excavation will require utilization of temporary timber matting and placement of stone to provide a suitable bearing surface for excavation equipment. It is assumed that soils excavated will not require disposal as contaminated materials.

Crawford Bay, Portsmouth, Virginia. A 1913 map indicates that this site was a tidal creek with associated salt marshes. The historic creek has had several aliases: Church Creek, Tar Creek, and Buck Creek. A 1937 aerial photograph shows that this site had undergone partial filling, mainly at the headwaters of the historic tidal creek. A 1940s aerial photograph suggests the site had converted almost entirely to upland with scrub/shrub vegetation present. Existing and historic adjacent land use has been residential, commercial (Portsmouth Naval Hospital), and industrial (a manufactured gas plant). The former Portsmouth Gas Company was located to the southwest of Crawford Bay and operated from 1856 to 1956. In 1992, the Virginia Department of Environmental Quality (VDEQ) received Phase I and Phase II Environmental Assessments prepared in connection with the sale of the Patio Plaza Apartments, which occupies part of the original MGP site. Several incidents of a petroleum sheen on water discharging from a stormwater outfall pipe into the Elizabeth River at Crawford Bay near Swimming Point have been documented.

Existing Topographic Data - Glenn and Sadler, Inc., completed topographic and hydrographic survey of the site in January 2000. Survey data indicate that the site generally slopes from a high elevation of about +2 feet in the southwest corner to the northeast. The survey data indicates an enclosed depression with a bottom elevation of about -12 feet about 420 feet northeast of the southwest corner of the site area.

The site is bordered along the west and south by a concrete bulkhead. A city of Portsmouth storm sewer outfall discharges to the northeast in the southwest corner of the site. The outfall drains the adjacent residential area to the south of the site.

Mean low water elevation at the site is about -1.22 feet. Mean high water is about elevation +1.58 feet. We estimate that the base low marsh elevation is about -1.0 feet and the top of the low marsh is at about elevation +2.0 feet. There is no existing wetland vegetation at the site.

The southwest corner of the site is currently a collection area for windswept debris. A significant fetch across Crawford Bay creates a relatively high-energy environment in this area.

Restoration Design Concept - Restoration of this site would be primarily through filling to create a "wetland shelf" to the west and east of the discharge from the stormwater outfall. The outward (leading) edges of the shelf system will be protected from wave and wind erosion using a rip-rap breakwater. Additionally, the discharge system for the stormwater outfall will be improved by excavation of a northeastward oriented trough towards the topographic depression.

Northwest Jordan Bridge, Chesapeake, Virginia. This site is located on the north side of the northwest end of the Jordan Bridge. The site is proximal to both the former Wycoff Creosoting operation and Atlantic Wood Industries. Both of these facilities caused creosote-laden runoff that has contaminated sediments in the site area.

Existing Topographic Data - Glenn and Sadler, Inc., completed a topographic and hydrographic survey of the site in January 2000. The western portion of the site is elongate west-east and parallel to the Jordan Bridge. The site widens to the east as it merges into the Elizabeth River channel. Pilings from an old railroad pier are aligned generally west-east through the site. It is estimated that the elevation of the base of the low marsh at this site is about -0.5 feet. The elevation of the top of the low marsh is about +2.0 feet. The elevation of the top of the high marsh is about +3.0 feet.

Restoration Design Concept - Restoration of this site will consist of creation of a saltmarsh "shelf." The eastern margin of the shelf will be armored with a low profile rip-rap breakwater to protect the wetland from wind, wave, and boat wake erosion. The shelf will be graded to permit surface water drainage from the peripheral western shoreline.

Lancelot Drive, Virginia Beach, Virginia. The Lancelot Drive site contains about 15 acres of upland and moderate quality low marsh. Invasive species such as *Phragmites* have invaded the system and degraded the quality of this former low marsh. The USACE has not successfully negotiated access agreements with the current owner; consequently, field-work for this site has not been completed.

Existing Topographic Data - Detailed site survey information is not available. The USACE was not granted a release to access the property by the private landowner, but they provided a copy of a portion of a topographic map constructed by the city of Virginia Beach showing spot elevations across the site. Virginia Geotechnical Services (VGS) digitized the site features and spot elevations shown on the map and approximated the property boundary through discussions with the USACE. VGS used the commercially available mapping program, Surfer, to construct a topographic map of the site. VGS then used aerial photography dated August 1985 to estimate the portions of the site with deposited dredged materials and the heaviest infestations of *Phragmites*.

Restoration Design Concept - Restoration generally involves regrading of the site to eliminate those portions of the site filled by previous dredging activities and currently infested with *Phragmites*, with minimal disturbance of remaining portions of the site.

Scuffletown Creek, Chesapeake, Virginia. The site is along the north shore of Scuffletown Creek near its confluence with the Elizabeth River. The prior wetland has received random deposits of construction debris and rubble.

Existing Topographic Data - Glenn and Sadler, Inc., completed site topographic mapping in January 2000. The site generally slopes southward to the creek. The western margin of the site is bordered by a Colonial Pipeline easement. The western creek bank is

armored with rip-rap. Reference marsh elevations are difficult to discern at this site. The northern extent of the site is bounded by a relatively steep slope to upland vegetation, trees, and grasses. The site itself contains "soils" generally unsuitable for the propagation of wetland vegetation. Marsh bounding elevations were based on low and high tidal elevations.

The estimated basal low marsh elevation is about -0.25 feet. It is estimated that the elevation of the top of the low marsh is about +1.75 feet. The elevation of the top of the high marsh is about +3.0. There are stands of *Phragmites* to about elevation +5.0 north of the site boundary.

Restoration Design Concept - Restoration of the Scuffletown Creek site will consist of excavation of rubble and debris deposited along the creek bank and replacement with soils suitable for supporting wetland vegetation. A limited area in the eastern portion of the site will be excavated for open-water habitat development. It is estimated that excavation will average about two (2) feet across the site, however, the rubble and debris fill materials may extend to greater depths necessitating additional excavation and replacement.

Somme Avenue, Norfolk, Virginia. Historical aerial photographs indicate that this site was a tidal saltmarsh as late as 1956. Ms. Margaret Arnold of 2607 Somme Avenue, whose property is on and adjacent to the site, stated that the site was filled around 1960 with debris from road construction on 26th and 27th Streets in Norfolk. The 1974 aerial photographs show the site continually being filled, but the photographs are inconclusive for determining the type of fill material. Field observations suggest that the majority of the fill material is debris from road reconstruction specifically, concrete, granite, and asphalt slabs. A few gravel piles are present. Post fill vegetative growth does not appear to be stressed and no soil staining has been detected. Adjacent land use is mostly residential with the exception of a gas station to the northwest of the site, across a small tidal creek. Potential contaminant source are asphalt, and concrete.

Field activities at this candidate site were conducted on 16 November 1999. Sampling was conducted by the GeoEnvironmental Section of the Norfolk District and test pit excavation services were provided by Allard Environmental.

A total of four (4) test pits were excavated at the site. Sampling personnel collected two (2) soil samples for chemical analysis. Chemical analytical test results indicate the presence of PAH compounds, metals, and diesel-range petroleum compounds. Following qualitative risk analysis completed by GeoEnvironmental, benzo(a)pyrene, benzo(g,h,I) perylene, dinenz(a,h)anthracene, phenanthrene, arsenic, mercury, and TPH-DRO are considered contaminants of concern at this site. Additional testing for Resource Conservation and Recovery Act (RCRA) waste characteristics indicates that the soils are not likely to classify as a RCRA hazardous waste. The maximum detected concentration of TPH-DRO in soils exceeded the VDEQ release-reporting requirement of 100,000 ug/kg. The GeoEnvironmental Section has recommended the owner/operator report a release to the VDEQ. Potential risks to human health associated with mercury may warrant a site-specific study of risks.

The stratigraphy appeared to be fairly consistent between the three test pits. Suspected fill material primarily consisted of silty sand intermixed with debris consisting of bricks, cobblestones, concrete, curbing, gravel, and terra cotta piping. Suspected fill material was encountered at the surface and extended down to an average depth of about 7.2 feet below ground surface (range from 5 to 10 feet). Suspected in-situ material primarily consisted of gray clay with vegetation and roots.

Existing Topographic Data - Site topography was provided by the Corps. Surveying was performed by the city of Norfolk Department of Public Works, September 1999. Based on apparent in-situ conditions peripheral to the site, the assumed reference high marsh elevation is approximately 2.0 feet (MSL). The seaward edge of the low marsh is about elevation -1.1 feet. The average low marsh midpoint is at elevation +0.3±. A reference low marsh elevation is at about -0.5 ft (MSL), about midway between these elevations.

Restoration Design Concept - Wetland restoration at the Somme Avenue site would consist of excavation of unsuitable debris fill material and regrading with suitable soils to design elevations. It is anticipated that excavation will require utilization of temporary timber matting and placement of stone to provide a suitable bearing surface for excavation equipment.

Sugar Hill (Scotts Creek), Portsmouth, Virginia. The 1940 aerial photographs show that this area was a tidal creek with associated saltmarshes. Filling activities bifurcated the original marsh/creek and subsequently created the present day peninsula. Sometime between the 1940s and 1985 the site was filled. Known previous land use activities include storage/staging area for box containers from the nearby Portsmouth Marine Terminal, as can be seen in 1985 aerial photographs. The Portsmouth Port and Industrial Commission (property owners) stated that unauthorized dumping activities became problematic in the late 1980s, and they then fenced and gated the property. Currently the site is not in use. Field observations indicate a broad range of fill material. Filled material includes, but may not be limited to, tires, shingles, smelting byproduct debris, and household trash. Adjacent land use is residential and commercial port facilities.

The western margin of the site is bordered by Quebec Street. The Quebec Street corridor has been proposed for reconstruction during development of the Pinner's Point Bridge and will be the location of a ramp serving the bridge.

Existing Topographic Data - Topographic mapping of this site was completed for the USACE by MAPP Engineering. The site slopes from west to east. The western portion of the site is generally open and unvegetated. The eastern portion of the site is covered by a vigorous stand of saltbush. The northern and southern margins of the site are bordered by existing marsh habitat. Scott's Creek borders the site to the north.

The basal low marsh elevation at this site is about -1.5 feet. The top of the low marsh is about +2.0 feet and the top of the high marsh is about +3.5 feet. An infestation of *Phragmites* in the southwestern corner of the site extends to about elevation +4.5 feet.

Wetland Design Concept - The eastern portion of the site contains a healthy stand of saltbush and will not be disturbed. The western margin of the site will be impacted by construction of ramps for the Pinner's Point Bridge. The planned construction scheme for the bridge system was superimposed on the site and shows this as a uniform slope oriented generally north-south across the western third of the site. The Pinner's Point Bridge plans provided are still preliminary and subject to change. Also, the plans made available were not surveyed drawings; some nominal error in compilation is assumed.

Restoration of this site will consist of creation of a channel bisecting the site north-south. This will separate runoff and slopewash from the Pinner's Point Bridge system from the marsh habitat, allow cyclic flushing of the system through tidal action, and create the moderately drained habitat favored by *Spartina alterniflora*.

Woodstock Neighborhood Park, Virginia Beach, Virginia. The Woodstock Neighborhood Park site is a sand and gravel pit that was used during construction of the Interstate 64 system. The pit was allowed to flood and is connected to the Elizabeth River through a narrow cut along the western margin. The Woodstock neighborhood, including a small recreational park, borders the flooded pit. Homes along the pit include docks with boats and have access to a borrow pit lake and to the river system through the cut.

Existing Topographic Data - Topographic data for this site was completed in May and June 1999 by the USACE. The park area is generally flat at about elevation +10. The park area has a steep slope down to the pond elevation (about +0.0 feet) and the bottom elevations of the pond slope southward at about 1:6 to about -5.0 feet. The basal elevation of the low marsh is about +0.0 feet. The top of the low marsh is about +3.0 feet and the top of the high marsh is about +5.0 feet. The southwestern corner of the park area extends westward as a narrow peninsula separating an existing marsh habitat to

the north from the current open-water environment to the south. Along the southern margin of the park area, at the top of the slope above the open-water, we identified an abandoned 4-inch pipe.

Wetland Design Concept - Restoration at this site will consist of creation of a wetland shelf along the eroding steep bank and in the current open water environment. The slope from the park area will be reduced and the southwestern peninsula removed. Regrading of the slope will provide suitable material for a wetland bench which will be augmented by borrow material (soils) excavated from within the shallow areas of the borrow pit lake. The bench will extend from the current park area into the open water of the borrow pit and is designed to stabilize and prevent further erosion of the embankment.

Old Dominion University (ODU) Drainage Canal, Norfolk, Virginia. The site is located on the west side of the ODU adjacent to the sailing center and student housing complex on the main stem of the Elizabeth River. The canal is approximately 1,000 feet long and is a part of a stormwater drainage system that drains a large portion of the campus. The entire canal is tidally influenced and has some flow at low tide.

Existing Topographic Data - Glenn & Sadler Associates completed a topographic and hydrographic survey of the site in January 2000. The project site is adjacent to a former landfill on city of Norfolk property, destined to become a city golf course, and ODU property. The existing shoreline is covered with rubble concrete to the top of the bank at elevation 10+ feet. The invert elevation of the 78-inch diameter pipe discharging into the canal is –2.49 feet.

Wetland Design Concept - The concept design for this site consists of a vegetated wetland fringe in the intertidal zone where the canal discharges into the Elizabeth River. Components of the project include a rock weir for low-water flow dissipation (discharge

from the canal); sand fill for proper elevation of wetland plants; and a low-crested rock sill on the river side of the constructed wetland for wave dissipation. The proposed area of vegetated wetland is approximately 0.6 acres.

Portsmouth City Park, Portsmouth, Virginia. The Portsmouth City Park site is located on Bailey's Creek on the Western Branch of the Elizabeth River. A swale marks the location of the proposed wetland restoration at City Park. Aerial photography from the late 1930's indicates that the swale was formerly a tidal creek, and that a fringe marsh once existed where there is now filled upland and erosion is now attacking the bank. The wetlands were reportedly filled with debris resulting from roadwork, which is confirmed by the existence of asphalt debris, concrete, brick, and granite pieces and slabs. The eroded shoreline has outcroppings of the various fill materials and the shoreline is littered with the aforementioned debris. The adjacent land use is primarily recreational.

A site investigation was accomplished on 11 and 12 November 1999 by members of the USACE GeoEnvironmental Section, Allard Environmental, and Fishburne Drilling. A total of four (4) test pits and four (4) borings were conducted during the sub-surface investigation of this site. No RCRA hazardous waste or petroleum contaminated waste are anticipated at this site based on the investigation results. Potential risks to human health associated with mercury may warrant a site-specific study.

Existing Topographic Data - Site topography was provided by the USACE, *Survey of June 1999, Portsmouth City Park.* Mean Low Water corresponds to Elevation –1.2 and Mean High Water is determined at Elevation +1.6, for a tide range of 2.8'. The existing *Spartina alterniflora* range is from approximate elevation +0.4 to +2.2, but the range does vary along the stretch of shoreline.

Restoration Design Concept - The proposed wetland restoration design for City Park will consist of an excavated inlet that results in a shallow wetland pocket or small embayment and an expanded wetland planting area. The wetland will include a sediment trap for capturing sediment-laden runoff from nearby parking areas. A stone check dam

will filter runoff into the wetland, while the new wetland plant regime will further enhance water quality. Existing, mature trees will be protected, and augmented with additional tree varieties along the upland buffer.

A large *Spartina alterniflora* wetland fringe will be created by expanding the area set at between elevation +0.5 to 2.4 within the wetland pocket. Areas of *Spartina patens* will be planted at slightly higher elevations, and an upland bench will surround the wetland. The upland bench will provide a protective buffer of saltbush and other shrubs that will prevent erosion and provide a more diversified habitat. The dominant tree species that exist on site include Pines, Hackberry, and Cypress. Low maintenance flowering trees consisting of crepe myrtle and eastern redbud will be added for interest and to provide seasonal color to the park setting.

Public access and appreciation of the wetland will be gained through use of the proposed trail and footbridge that will traverse the wetland. The trail will incorporate benches for relaxation, and will link the existing gazebos and other public use areas.

Grandy Village, Norfolk, Virginia. Grandy Village is named for the nearby Public Housing Complex, and is situated on the north shore of the Eastern Branch of the Elizabeth River. Historic photographs indicate that this site was a series of small tidal creeks and associated saltmarshes as late as 1949. A 1909 city base map indicates that this site was actually open surface water with a more undulating shoreline, contrary to the current linear condition.

The Grandy Village housing complex was constructed in the early 1950's on presumably high grounds and fill material within the saltmarsh. Aerial photographs from 1974 show extensive marsh filling activities on the site, with dump trucks and bulldozers spreading the material. Recent field observations suggest that the fill material consists of asphalt, concrete, sand, and miscellaneous debris. The site is dominated by post-fill

vegetation; however, two areas have sparse to no vegetation with sandy and silty soils. The adjacent land uses are residential, multifamily and single family homes with some open park area.

USACE personnel, assisted by technical service contractors, conducted a field investigation of this site on 9 and 10 November 1999. A total of seven (7) test pits and four (4) soil borings were excavated and advanced during the subsurface investigation of this candidate site. Summary findings of the investigation indicate the presence of Total Petroleum Hydrocarbons-Diesel Range Organics (TPH-DRO) in the drainage area behind the Grandy Village housing complex. The report also indicated that potential risks to human health associated with the detected compounds and analytes are not anticipated at this site.

Existing Topographic Data - Site topography was provided by the city of Norfolk, and was titled *Topographic Survey of Property South of Grandy Village, Div. of Surveying, Dept of Public Works,* dated 8/25-99. Horizontal datum is the Virginia State Plane, South Zone, NAD83 (1993). Vertical datum is NAVD 88 (NGS Monument C 307). Average mean low water is at elevation –1.4, with the fringe of the *Spartina alterniflora* low marsh ranging from –0.7 to +1.1. The high marsh boundary at elevation +1.1 extends to elevation 2.71.

Restoration Design Concept - The wetland restoration concept for this site will consist of returning the shoreline to a more irregular and undulating configuration which existed prior to the deposition of massive fill material. This concept will require excavation and removal of deposited fill material to create several low marsh areas while increasing the available shoreline for new plantings. Ideally, these areas will be constructed at desired points that will allow for tidal inflow cuts to be made without impacting significant areas of existing *Spartina* marsh. An effort has been made in the preliminary plans to design around existing stands of vegetation and tree growth on the

site. A conceptual rendering of the site shows how the created marsh areas will be linked with elevated, pedestrian walkways and bridges to allow the public limited access to the site.

The total site-planting plan will provide a variety of planting areas, with low-marsh sprigs in the range from –0.7 to +1.1 and high marsh varieties from 1.1 to 2.7 ft. Marsh areas will be screened with upland benches planted with saltbush and other varieties. Larger trees suitable for bayscaping will be added to complement the existing pines, cedars, and willow on the site.

The city of Norfolk is working with a consultant, Siska Aurand, to develop an integrated use plan for the area that compliments the housing community nearby. Those conceptual plans will be coordinated in the future to insure a project that is acceptable to all interests.

SITE SELECTION AND PROJECT DEVELOPMENT

Sediment Clean-Up

The site selection process and development of the sediment clean up project at Scuffletown Creek is described in detail in the Plan Formulation Section (VII), of the main feasibility report. This discussion includes the initial screening of alternatives, possible solutions, environmental dredging plan component assessments and evaluations, extent and volume of contamination, sediment evaluations at other sites, and evaluation of capping as an alternative to environmental dredging.

REAL ESTATE

The lands, easements, rights-of-way, and borrow and disposal sites needed for construction, operation, and maintenance of the project are described in Appendix B, the Real Estate Supplement.

STRUCTURAL REQUIREMENTS

FUNCTIONAL DESIGN REQUIREMENTS

Wetlands Restoration

Priest (1999) suggested that "...studies of historical (wetland) losses provide a framework for a comprehensive management program within the Elizabeth River system by:

1. Providing the basis necessary to direct focus of restoration efforts to those areas that have experienced the greatest losses and would stand to benefit most from restoration.

2. Providing locations of former wetlands having the greatest potential to be successfully reestablished through restoration efforts. These areas, which once supported various wetland communities, have the potential advantage of continuing a hydrological link with the watershed that could make restoration efforts more effective and efficient at restoring lost wetland functions and values.

3. Focusing restoration efforts in former wetland areas, restoration programs avoid the public perception of converting established habitats, such as riparian forest buffers into wetlands. Because many converted wetlands never fully recover ecologically and remain disturbed habitats of relatively low ecological value, the loss of existing natural function can be minimized.

4. Providing opportunity, to select former sites of appropriate landscape position, significant size, and level of disturbance, the (information) supports economy of scale and reestablishment of natural functions that make wetlands restoration a very effective tool for habitat and water quality improvement within the Elizabeth River watershed."

Most of the wetland sites selected for restoration in this investigation were wetlands at some time in the historical past. During the period from 1944 to 1977 approximately 50 percent of tidal wetlands were lost in the Elizabeth River Basin (Priest,

1999). Many of these wetland areas were filled to create uplands and provide dry land for industrial, military, and residential development. Some of the historical maps obtained for sites under investigation in this study show wetland filling in progress. Three of the proposed wetland restoration sites (Crawford Bay, ODU Drainage Canal, and NW Jordan Bridge) are currently shallow water or intertidal open water areas adjacent to stormwater canals, drainage features, or stormwater outfall structures.

Two basic solutions are proposed for wetland restoration/creation: excavation and filling. Excavation and regrading is required at those sites where (historical) wetlands have been filled. Once the fill material is removed, the site is regraded and the proper elevations required to sustain tidal emergent wetlands are established. Filling to build a "bench" or substrate elevation for wetland plants is required for creation of emergent wetlands in those areas which are now tidal or subtidal. Table A-1 depicts the proposed solution at each of the candidate sites.

Sediment Clean-Up Functional Design Requirements

The Scuffletown Creek dredging site is located in the City of Chesapeake, and is partially located in the Southern Branch. To the north, the dredging site is located adjacent to an active public park, boat ramp and boat landing dock (west of the Beltline Railroad bridge) and an active vegetative waste staging area (east of the Beltline Railroad bridge). The park and boat ramp are used primarily during the weekend. If dredging is performed mechanically with barge transportation to either Higgerson-Buchanan or Craney Island, interruption to the public use of the site will be minimal. If dredging is performed mechanically with truck haul to SPSA, Higgerson-Buchanan or Craney Island, temporarily closing off the park and boat ramp from public use may be necessary. Vessel and barge passage under the Beltline Railroad bridge is very limited, and will likely require dredging an access channel between the bridge piers.

Table A-1. WETLAND SITES AND PROPOSED RESTORATION SOLUTIONS

Location	Current Condition	Proposed Solution
Scuffletown Creek, Chesapeake	Filled (former) Wetland	Excavate, grade, plant
Somme Avenue, Norfolk	Filled (former) Wetland	Excavate, grade, plant
Grandy Village, Norfolk	Filled (former) Wetland	Excavate, grade, plant
ODU Drainage Canal, Norfolk	Intertidal Shallow Water Stormwater	Fill, grade, plant
Sugar Hill, Portsmouth	Filled (former) Wetland	Excavate, grade, plant
NW Jordan Bridge, Portsmouth	Intertidal Shallow Water Stormwater	Fill, grade, plant
Crawford Bay, Portsmouth	Intertidal Shallow Water Stormwater	Fill, grade, plant
Portsmouth City Park, Portsmouth	Filled (former) Wetland	Excavate, grade, plant
Lancelot Drive, Virginia Beach	Filled (former) Wetland	Excavate, grade, plant
Carolanne Farms, Virginia Beach	Upland	Excavate, grade, plant
Woodstock Park, Virginia Beach	Borrow Pit Eroding bank Shallow water	Dredge, fill, grade, plant

The Higgerson–Buchanan placement site is located adjacent to Bainbridge Boulevard in the City of Chesapeake and adjacent to Mains Creek, a tributary of the Southern Branch. The Higgerson–Buchanan site actually consists of two distinctly separate areas:

- The northern portion with an area of 50 +/- acres has a perpetual easement deeded to the City and the U.S. for the purpose of dredged material placement in connection with the Southern Branch 35-Ft. Extension Channel Project. The 35-Ft. Extension was constructed during 1979-1980. The northern portion presently consists of large inactive borrow pits with a surrounding perimeter road. The intent of the perpetual easement was to reserve this area for the future maintenance dredging of the 35-Ft. Extension project.

- The southern portion with an area of 100 acres +/- was also used for dredged material placement in connection with the 1979-1980 construction of the 35-Ft. Extension channel project. Its use was under a temporary easement that expired at the end of the channel construction. The owner is using this parcel for a combination of open storage of equipment, vehicles and materials, and a landfill with weigh station that accepts construction debris and soil material (not refuse, sanitary waste nor hazardous waste).

Higgerson–Buchanan, Inc. has advised that both or either of their two parcels could be available for acceptance of the dredged material from Scuffletown Creek. For placement of material within the landfill, the material would need to meet the applicable standards for the landfill as contained in their Virginia Department of Environmental Quality (DEQ) operating permit. In addition, a tipping fee per ton would need to be paid to Higgerson-Buchanan, Inc. Placement of material within the northern portion, which has the perpetual easement, would need to be agreeable to all parties involved (U.S.

Army Corps of Engineers, City of Chesapeake, and Higgerson-Buchanan, Inc.). The placement of material from Scuffletown Creek would also need to be in compliance with applicable criteria for placement of dredged material at this site.

Structural Requirements. The dredging areas are adjacent to a concrete boat ramp, mooring dock, rip rap and rubble revetments, wooden pile bulkheads, concrete pier highway bridge (Interstate 464), concrete pier draw bridge (Jordon Brige) and wooden pier railroad trestle (Beltline Railroad). The bulkhead and revetment are in poor condition; all other structures appear to be in good repair. To minimize potential impacts to the structures, the bottom toe of the area to be dredged was set back 15 feet from the bulkhead, revetment and mooring dock; the bottom toe of the area to be dredged was set back 20 feet from the railroad trestle and highway bridges.

A petroleum pipeline crosses beneath the sediment surface in the area to be dredged. The pipeline is operated by Colonial Pipeline Company of Atlanta, Georgia (800 926-2728). Additionally, there is a radio transmission tower located on the upland, adjacent to the area to be dredged. The tower has a guy wire anchor located on the shoreline immediately adjacent to the area to be dredged.

Dredging six feet of sediment from the creek bottom has the potential to impact the stability and integrity of some of the structures mentioned above, and should be further investigated and evaluated prior to any construction activities.

SITE RESTRICTIONS

Wetland Restoration

Potential site restrictions at each of the eight proposed wetland restoration sites are described in the following narrative.

Carolanne Farms. This site is an upland parcel located on the Eastern Branch of the Elizabeth River and is owned by the city of Virginia Beach. It was formerly the site of a small sewage treatment plant and was prior to that, probably farmland. Excavation,

grading and planting wetland grasses will be required to restore the site. It is currently a city park, and lies adjacent to a residential neighborhood (Carolanne Farms). The site is accessible by a city street (Gainsborough Road). No utility relocations would be required to restore the site.

Lancelot Drive. This site is located in the city of Virginia Beach on the Eastern Branch of the Elizabeth River and is privately owned. It was formerly a wetland site that was filled. Excavation, grading and planting wetland grasses will be required to restore it to the condition that once existed. A portion of the site is encumbered with a Hampton Roads Sanitation District sewage force main that is above grade and should not be affected by this project. The site is adjacent to a residential neighborhood and is accessible by a city street (Lancelot Drive) or by water.

Woodstock Neighborhood Park. This site is located in the city of Virginia Beach and it is presently a borrow pit adjacent to a city park. Some privately owned parcels may be involved and the city will be required to obtain easement and then assign them to the Government. To recreate the wetlands that previously existed, fill, grading and planting of wetland grasses will be required. No known utilities are present that will require relocation. The site is located on the Eastern Branch of the Elizabeth River. Land ingress/egress is limited to a narrow city right-of-way off of a city street (Woodstock Road).

Scuffletown Creek. The wetland restoration project is located along the shoreline of Scuffletown Creek, a tributary of the Southern Branch of the Elizabeth River in Chesapeake, Virginia. The former wetland has been filled with broken concrete and other construction debris. This site is owned by the city and is adjacent to a city owned park, the Elizabeth River Park. The site is accessible from Poindexter Street near the Jordan Bridge. Much of the work will be done from the water, but there is adequate land ingress/egress through city owned property, if needed.

Grandy Village. This site is located behind the Grandy Village Public Housing complex in Norfolk on the Eastern Branch of the Elizabeth River. The site is owned by the Norfolk Redevelopment and Housing Authority (NRHA) and the city of Norfolk and consists of a former wetland area (now filled). The proposed restoration solution would be to excavate, grade and plant. The site is undeveloped vacant land with the only structure on the site being a Federal Aviation Administration (FAA) directional beacon. There are no known utilities effecting the project. There is electric power that is fed from an upland location, going to the directional beacon. There are no utilities or structures in close proximity to the proposed restoration site that may have an effect on this project. There is adequate ingress/ egress to the site by way of city housing authority property and adjoining the city street (Kimball Terrace) and/or water.

ODU Drainage Canal. This site is presently a shallow water inter-tidal area also used for stormwater drainage and is owned by the city of Norfolk. The site is located at the west edge of the ODU campus, adjacent to the student housing complex and ODU sailing center. It is located in the city of Norfolk on the Elizabeth River main stem. Most of this site is subaqueous. The actions required will be filling, grading and planting of wetland grasses. The restoration site is undeveloped. The possible relocation of an existing storm-drain easement will have to be addressed as construction plans are developed, and no other relocations are anticipated. Most of the work will be done from the water. Although the terrain is steep, the site may be accessed through the university campus and/or West 48th Street.

Northwest Side of Jordan Bridge. This site is located on the Southern Branch of the Elizabeth River just northwest of the Jordan Bridge in the city of Portsmouth. It is known as the old Wycoff Pipe site, which was a creosote facility. The subject site currently receives significant stormwater drainage from adjacent upland parcels and would require fill, grading and planting of wetland grasses to re-establish it. No utilities are known to exist, and the plans are to have the work performed from the waterside of the property.

Portsmouth City Park. This site is on the Western Branch of the Elizabeth River in the city of Portsmouth and is a part of a public park facility owned by the city of Portsmouth. It is a former wetland site that was filled to create upland for the park facility and will require excavation, grading and planting of wetland grasses. The site is remote from the actively used portions of the park and does not have any known utilities that would require relocation. There is adequate ingress/egress via a city street (City Park Avenue) and through the park to the site.

Sediment Clean-Up at Scuffletown Creek

The sediment cleanup project will be performed at Scuffletown Creek, a tributary of the Elizabeth River. It is located in the South Norfolk section of the city of Chesapeake, Virginia. On the north it is bounded by the city owned Elizabeth River Park, a city-owned mulch/debris site, the Jordan Bridge's toll/maintenance facilities and two properties owned by Chesapeake Tower, Inc. The portion of Scuffletown to be dredged is bounded by Interstate 464 to the east, private property and an American Oil Company fuel storage tank farm to the south, and the Southern Branch of the Elizabeth River to the west. Also located within the project area is a 20-foot Colonial Pipeline Easement which crosses Scuffletown Creek, and a wooden Beltline Railroad bridge which crosses the creek. Several parcels of land will be involved with this project. The parcels are identified as follows:

1. Scuffletown Creek Staging and Rehandling Site. The city of Chesapeake, one of the local sponsors, owns two sites that are located adjacent to the area to be dredged. One parcel is currently being used as a bulk storage yard and has stockpiles of materials such as mulch, sand, etc. This site will be used for staging and re-handling of any material that must be decontaminated before being transferred to the dredged material disposal site. No utility relocation is foreseen at this location.

2. Higgerson Buchanan Dredged Material Placement Site. The proposed, privately owned, primary Dredge Material Placement Site is encumbered by an easement, which the city of Chesapeake acquired for the placement of material from the dredging of

the Southern Branch of the Elizabeth River. The site has approximately 54.0 acres and is adjacent to a 79.0 acre former dredge material management site that is currently being used as a construction debris landfill. The easements were transferred, by deed dated March 21, 1979, from the city of Chesapeake to the United States of America. The easement rights on the 79-acre tract were released back to the underlying fee owner. These sites are owned by Higgerson and Buchanan and have been used in the past for deposit of dredged material from the Southern Branch of the Elizabeth River. Since the easements acquired from the city of Chesapeake specified that they are to be used for deposit of material from the construction and maintenance of the Southern Branch channel and the subject material will be coming from a sediment mediation site, additional real estate interest will be needed. The parcels are bound by Dominion Boulevard to the southeast, and Bainbridge Boulevard on the Northwest. This site, shown in Exhibit 9, would be used for the permanent placement of the material.

3. Higgerson and Buchanan Barge Landing and Easements to the Disposal Site – It has been determined that the movement of the material from the barge to the disposal site will be made requirements in the proposals for bids. The successful contractor will be responsible for acquiring easements for pumping, staging and any other real estate required to move the material from the barges to the disposal site.

4. Craney Island Dredged Material Management Area. Craney Island Dredged Material Management Area is a 2500 acre dredged material placement area owned and operated by the Corps of Engineers. Material can be placed in this facility if it is derived from navigation related dredging projects and the dredging takes place within the geographic boundary specified in the law (generally Hampton Roads harbor and vicinity).

HAZARDOUS AND TOXIC MATERIALS

Hazardous, Toxic and Radiological Waste (HTRW) investigations were conducted in accordance with ER 1165-2-132 "Water Resources Policies and Authorities, HTRW Guidance for Civil Works Projects" and NAD DR 1165-2-1, "Procedures for

Conducting and Coordinating HTRW Investigations for Civil Works Projects." Specifically, the evaluations conducted during this feasibility phase of study in the Elizabeth River included the following activities:

1. Define the project boundaries where construction and/or excavation would take place for proposed wetland restoration and sediment clean-up projects.

2. Research historical maps, photos, documents, and conduct interviews to discover where and what type industries had been located in the project areas in the past. Review existing and past property uses according to the likelihood of discovering HTRW.

3. Look at current aerial photos, location maps, and conduct visual site surveys to dentify industries, landfills, storage tanks, and other potential HTRW sites.

4. Consult with state regulatory agencies for license/permit actions, for any violation, enforcement, and/or litigation against property owners, and for general information about local HTRW problems such as illegal dumping, leaking underground storage tanks, soil or groundwater contamination, etc.

5. Conduct field investigations for HTRW as warranted by background investigations described previously.

WETLANDS RESTORATION

The Norfolk District, GeoEnvironmental Engineering Section, performed wetlands subsurface investigations to evaluate HTRW potential of six (6) of fourteen (14) candidate wetland restoration sites. These six sites were selected because they are sites where excavation of fill materials will be required for restoration of the site. Six sites were not evaluated for subsurface HTRW potential because they will require no excavation (planting and/or filling only). One site (Lancelot Drive) was not performed

because of low HTRW potential based on historical use of site, and HTRW field investigations were not performed at the final site (Scuffletown Creek) because this site was not identified until after the subsurface investigations were completed.

The results of these investigations are included in the CIVIL DESIGN, Site Description and Restoration Design Concepts portion of this appendix and a summary of results is descibed in the following narrative.

The GeoEnvironmental Engineering Section of the Norfolk District U.S. Army Corps of Engineers (USACE) was tasked to perform a Wetlands Subsurface Investigation to evaluate the HTRW potential of the following six (6) candidate sites on the Elizabeth River watershed in Virginia:

- Grandy Village, Norfolk, Virginia.
- Portsmouth City Park, Portsmouth, Virginia.
- Carolanne Farms, Virginia Beach, Virginia.
- Somme Avenue, Norfolk, Virginia.
- Swimming Point (adjacent to Crawford Bay), Portsmouth, Virginia.
- Sugar Hill (Scotts Creek), Portsmouth, Virginia.

The primary objective of the Elizabeth River Wetlands Subsurface Investigation was to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Physical and chemical characterization was accomplished through the use of test pits, soil borings, and laboratory analyses of samples representative of distinct subsurface strata.

Field activities commenced on 9 November 1999 and extended through 18 November 1999. The complete set of analytical results was received on 31 January 2000. All analytical data were independently validated to ensure that data of sufficient quality were generated.

The GeoEnvironmental Section performed a thorough evaluation of the results of the Elizabeth River Wetlands Subsurface Investigation to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Physical characterization includes identification and classification of distinct subsurface strata and approximating the vertical extent of the strata based on soil boring and test pit logs. Chemical characterization includes identification of potential contaminants of concern (COCs) within the distinct subsurface strata, based on the chemical analyses of samples representative of the distinct subsurface strata.

A brief summary of the GeoEnvironmental Section's Conclusions and Recommendations for each of the six (6) candidate sites is presented below:

1. Grandy Village, Norfolk, Virginia.

- Potential risks to human health associated with the detected compounds and analytes are not anticipated at this site.
- Resource Conservation and Recovery Act (RCRA) hazardous wastes are not anticipated at this site.
- The GeoEnvironmental Section recommends the owner/operator report to the Tidewater Regional Office of the Virginia Department of Environmental Quality (VDEQ) the presence of Total Petroleum Hydrocarbons-Diesel Range Organics (TPH-DRO) in excess of 100,000 micrograms per kilogram (ug/kg) in the drainage area behind the Grandy Village housing complex. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VDEQ *Storage Tank Program Technical Manual.*

2. Portsmouth City Park, Portsmouth, Virginia.

- Potential risks to human health associated with mercury may warrant a site-specific study of risks.
- RCRA hazardous wastes are not anticipated at this site.

- Petroleum contaminated wastes are not anticipated at this site.

3. Carolanne Farms, Virginia Beach, Virginia.

- Potential risks to human health associated with mercury may warrant a site-specific study of risks.
- RCRA hazardous wastes are not anticipated at this site.
- Petroleum contaminated wastes are not anticipated at this site.

4. Somme Avenue, Norfolk, Virginia.

- Potential risks to human health associated with mercury may warrant a site-specific study of risks.
- RCRA hazardous wastes are not anticipated at this site.
- The GeoEnvironmental Section recommends the owner/operator report to the Tidewater Regional Office of the VDEQ the presence of TPH-DRO in excess of 100,000 ug/kg. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VDEQ *Storage Tank Program Technical Manual.*

5. Swimming Point (Crawford Bay), Portsmouth, Virginia.

- Potential risks to human health associated with mercury may warrant a site-specific study of risks.
- RCRA hazardous wastes are not anticipated at this site.
- The GeoEnvironmental Section recommends the owner/operator report to the Tidewater Regional Office of the VDEQ the presence of TPH-DRO in excess of 100,000 ug/kg. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VDEQ *Storage Tank Program Technical Manual.*

6. Sugar Hill (Scotts Creek), Portsmouth, Virginia.
    - Potential risks to human health associated with mercury may warrant a site-specific study of risks.
    - RCRA hazardous wastes are not anticipated at this site.
    - Petroleum contaminated wastes are not anticipated at this site.

SEDIMENT CLEAN-UP

For sediment restoration, CECW Implementation Guidance dated 25 April, 2001, Environmental Dredging (Section 312 of WRDA 1990, as amended by Section 205 WRDA 1996 and Section 224 of WRDA 1999), provides for removal of contaminated sediments outside the boundaries of, and adjacent to, a Federal navigation project as part of the operation and maintenance of the project (part a); or for the removal of contaminated sediments for the purpose of environmental enhancement and water quality improvement if such removal was requested by a non-Federal sponsor and the sponsor agreed to pay 35 percent of the cost of removal and 35 percent of the cost of disposal (part b). Disposal costs are considered those not directly related to removal (dredging), remediation (treatment), and transport of the material to reasonably proximate disposal sites; and includes those costs associated with lands, easements, rights-of-way, retaining dikes, bulkheads, embankments, excavation of subaqueous pits, capping/liner requirements, fish and wildlife mitigation associated with the disposal area, and maintenance and management of the disposal area.

For sediment restoration, USACE Implementation Guidance dated 25 April 2001, Environmental Dredging (Section 312 of WRDA 1990, as amended by Section 205 WRDA 1996 and Section 224 of WRDA 1999), provides for removal of contaminated sediments outside the boundaries of and adjacent to a Federal navigation project as part of the operation and maintenance of the project (part a); or for the removal of contaminated sediments for the purpose of environmental enhancement and water quality improvement if such removal was requested by a non-Federal sponsor and the sponsor

agreed to pay 35 percent of the cost of removal and 35 percent of the cost of disposal (part b).

Paragraph 3 of the Implementation Guidance states that "...As a matter of policy, where Section 312 authority is used to remove or remediate contaminated sediments complying with the definition of hazardous substance in the Comprehensive Environmental Response, Compensation, and Liability Act 42 U.S.C 9601 et seq (CERCLA), such removal or remedial action shall not be undertaken unless the Corps obtains reasonable protection from liabilities which may arise as the result of the removal or remediation. Such actions will be performed in a manner that (1) identifies all poetentail responsible parties which contributed to the contaminated sediments being removed or remediated, (2) documents all CERCLA hazardous substances, as defined in 42 U.S.C 9601 (14) that are contained in the contaminated sediments, and (3) pursues cost recovery or other appropriate actions in conjunction with involved federal and state regulatory agencies..." The site of sediment remediation investigation during this feasibility study, Scuffletown Creek, is not within the boundaries of a site designated by EPA or a state for a response action under CERCLA, and it is not part of NPL site under CERCLA. The appropriate "reasonable protection from liabilites" would be secured prior to construction.

While Corps policy is that dredged material is not a solid waste and not subject to RCRA regulations, sediment remedial activities that might require a RCRA permit include the storage, treatment, and disposal of contaminated sediments (or the residue from a pretreatment or treatment process) that are defined or characterized as hazardous under RCRA. The owner/operator of the facility that generates RCRA-hazardous materials must obtain a permit. If treated soils are ultimately placed in a solid waste disposal facility, then it would have to be demonstrated that the material meets the specific standards required by that disposal facility.

The findings from the VDEQ Underground Storage Tank (UST) Program (investigations on location and condition of underground storage tanks) in the proposed

project areas show that there are no active registered UST's in the proposed wetland sites or sediment restoration site.

CONSTRUCTION PROCEDURES

WETLANDS RESTORATION

Construction

Two basic construction procedures are proposed for wetland restoration/creation: excavation and filling. Excavation and regrading is required at those sites where (historical) wetlands have been filled. Once the fill material is removed and, where required, clean backfill is added, the site is regraded to the proper elevations required to sustain tidal emergent wetlands. Through topographic survey, these "proper elevations" have been derived from adjacent wetlands so as to closely duplicate on-site marsh elevations. Filling to build a "bench" or substrate elevation for wetland plants is required for creation of emergent wetlands in those areas which are now tidal or subtidal.

Construction of wetlands requires greater attention to detail than do most other earth moving projects. Contracts need to specify exact elevations, grades, construction tolerances, materials, and techniques. Some flexibility must be written into the contract to allow modifications as the project develops.

Soil Handling Processes and Equipment

Soil handling for a wetlands restoration project is generally accomplished in three phases:

1. Excavation or cut (loosening or dislodging the soil or fill material from its in-situ location)
2. Removal and transport (movement of the soil from its in-situ location to the deposition area)
3. Deposition or fill (placement and manipulation of the soil in a land fill or a land or water disposal area)

Excavation

The equipment for mechanical excavation includes cutting devices (dozers, loader-scrapers) and scooping systems (backhoes, shovels, bucket ladder, draglines, and

clamshells). Hydraulic excavation equipment includes various types of equipment for dislodging the soil for inclusion in a slurry to be removed by suction (direct suction, cutter suction, bucketwheel suction).

The suitability of an excavation device depends on the trafficability of the surface and the characteristics of the soil to be excavated. Mechanical cutting devices depend on traction from wheels or tracks for reaction to cutting forces; therefore are generally limited to firm surfaces. Hydraulic slurry systems require large quantities of water and are generally mounted on floating platforms, such as barges or self-propelled vessels.

Transportation Processes and Equipment

Once the soil has been excavated, its in-situ mass and dynamic properties are destroyed. However, the soil material properties remain unchanged and are still relevant. Mechanical equipment for transporting soils generally consists of containers such as loader-scrapers, wheeled trucks, conveyor belts, or barges. Trafficability of the excavation site and of haul roads will determine the necessary type and contact pressure of the hauling equipment. Hydraulic equipment consists of a slurry pipeline.

Soil properties affecting the transportation equipment are: bulking, pumpability, and abrasiveness. Bulking is the general increase in volume of a soil compared to its in-situ volume; this affects planning for required container volumes and measurement of production based on volume.

Deposition Site Processes and Equipment

Deposition at a fill site may be mechanical or hydraulic, depending on the transport method. If the excavated and transported soil is to be simply discarded, then mechanical dumping or hydraulic slurry placement on a land or water disposal site without manipulation is suitable. If, however, the soil is to be graded, used for a structure, or a fill is to be made, then the amount and type of compaction to be used will determine the type of processing methods and equipment.

Planting - General Vegetation Planting Scheme

Natural revegetation does not work well for *Spartina alterniflora* areas. Planting is important. For erosion prevention, 12"-18" centers are best; for general revegetation, 2 foot centers are acceptable. *Spartina alterniflora* seeds are not highly viable and do not revegetate well, taking much longer than the 2-foot center planting method. Most reproduction is vegetative so again the planting is important. Most recommend the use of slow release fertilizer placed in the hole with the plants. 1/2 ounce for sprigs and 1/2 to 1 ounce for baseball sized clumps. Good coverage should be reached in 2-3 growing seasons.

Sediment Clean-Up Functional Design Requirements

The Scuffletown Creek dredging site is located in the City of Chesapeake, and is partially located in the Southern Branch. To the north, the dredging site is located adjacent to an active public park, boat ramp and boat landing dock (west of the Beltline Railroad bridge) and an active vegetative waste staging area (east of the Beltline Railroad bridge). The park and boat ramp are used primarily during the weekend. If dredging is performed mechanically with barge transportation to either Higgerson-Buchanan or Craney Island, interruption to the public use of the site will be minimal. If dredging is performed mechanically with truck haul to SPSA, Higgerson-Buchanan or Craney Island, temporarily closing off the park and boat ramp from public use may be necessary. Vessel and barge passage under the Beltline Railroad bridge is very limited, and will likely require dredging an access channel between the bridge piers.

Table A-2. PLANTINGS FOR SALTMARSH RESTORATION

Common Name	Scientific Name	Elevation	Sprig or Container Stock	Spacing
Saltmarsh Cordgrass	*Spartina alterniflora*	Low Marsh	Sprig	18" centers, offset
Saltmeadow Hay	*Spartina patens*	Intermediate Marsh	Sprig	18" centers, offset
Saltbush (Wax Myrtle)	*Myrica cerifera*	Upper High Marsh	Container	6 ft. centers, offset
Saltbush (Groundsel Tree)	*Baccharis halimifolia*	Middle High Marsh	Container	6 ft. centers, offset
Saltbush (Marsh Elder)	*Iva frutescens*	Lower High Marsh	Container	6 ft. centers, offset

Saltmarsh Design/Construction.

Grade - Anything from MHW to Mean water level (1/2 tide) should support *Spartina alterniflora*. It will grow from just above MHW to below mid-tide. It does best in a range below MHW and above mid tide. Use a biological benchmark, if available.

- To preclude *Phragmites* (common reed grass invasion), it is best not to set the grade close to MHW, but stay within the above range. Studies have shown that salinity is more critical than inundation at precluding *Phragmites*. Salinity stresses the *Phragmites*.
- The grade should be slightly sloped so the water completely drains on low tides.
- *Spartina alterniflora* in pockets of standing water and above the MHW mark tend not to do well. Small drainage ditches (~a shovel width or more) that dewater ponded areas would be effective. Small drainages are natural features in tidal marshes.

SEDIMENT CLEAN-UP CONSTRUCTION PROCEDURES

Construction consists of dredging the contaminated and non-contaminated areas defined by the ERM level of 0.6 (dredging to 6' below bottom elevation): 60,270 cubic yards (35,820 cubic yards located downstream of the railroad bridge and 24,450 cubic yards located upstream of the railroad bridge). The stated yardage includes one foot of allowable over-dredging and 3:1 sideslopes. The different construction scenarios evaluated are described as follows:

a) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)
- Placing the dredged material into barges
- Transporting the material by barge to Craney Island (approximately 8 river miles each way)
- Offloading the material at Craney Island by small land or barge-based bucket crane or excavator
- Truck hauling the material into the Navy's bio-cell on Craney Island (approximately 2 miles each way)
- Running the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material)
- Truck hauling and final disposal of the material at the Southeastern Public Service Authority (SPSA) landfill in Suffolk (a truck haul distance of approximately 16 miles each way).

b) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement

mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)

- Placing the dredged material into barges
- Transporting the material by barge to Craney Island (approximately 8 river miles each way)
- Offloading the material at Craney Island by small land or barge-based bucket crane or excavator
- Truck hauling with final disposal of the dredged material at the SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles each way)

c) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)
- Placing the dredged material into barges
- Transporting the material by barge to the Higgerson-Buchanan site in Chesapeake (approximately 6 river miles each way)
- Offloading the material at Higgerson-Buchanan by small land or barge-based bucket crane or excavator
- Running the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material)
- Truck hauling with final disposal of the dredged material at the SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles each way)

d) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement

mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)

- Placing the dredged material into barges
- Transporting the material by barge to the Higgerson-Buchanan site in Chesapeake (approximately 6 river miles each way)
- Offloading the material at Higgerson-Buchanan by small land or barge-based bucket crane or excavator
- Truck hauling with final disposal of the dredged material at the previously-used confined upland dredged material placement site at Higgerson-Buchanan (a truck haul distance of approximately ½ mile each way)

e) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)
- Placing the dredged material into barges
- Offloading the material at the Elizabeth River Park boat ramp located at Scuffletown Creek by small land-based bucket crane or excavator
- Truck hauling the dredged material to the ABEX site in Portsmouth, Virginia (a truck haul distance of approximately 5 miles each way)
- Running the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material)
- Truck hauling with final disposal of the dredged material at the SPSA landfill in Suffolk (a truck haul distance of approximately 13 miles each way)

f) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement

mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)

- Placing the dredged material into barges
- Offloading the material at the Elizabeth River Park boat ramp located at Scuffletown Creek by small land-based bucket crane or excavator
- Truck hauling with final disposal of the dredged material at the SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles each way)

g) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)
- Placing the dredged material into barges
- Offloading the material at the Elizabeth River Park boat ramp located at Scuffletown Creek by small land-based bucket crane or excavator
- Truck hauling the dredged material to the Higgerson-Buchanan site (a truck haul distance of approximately 5 miles each way)
- Running the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material)
- Truck hauling with final disposal of the dredged material at the SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles each way)

h) Construction will consist of:

- Mechanically dredging the contaminated and non-contaminated material (utilizing a five to ten cubic yard bucket dredge for the areas west of the railroad trestle, and a two to five cubic yard barge-mounted excavator or a shallow displacement mechanical dredge of similar bucket capacity for the areas east of the railroad trestle)
- Placing the dredged material into barges

- Offloading the material at the Elizabeth River Park boat ramp located at Scuffletown Creek by small land-based bucket crane or excavator
- Truck hauling with final disposal of the dredged material at the previously-used confined upland dredged material placement site at Higgerson-Buchanan (a truck haul distance of approximately 5 miles each way)

Access Roads: The dredging site is located adjacent to a park, boat ramp and mooring piers owned by the City of Chesapeake, and is readily accessible from Poindexter Street, which joins Interstate 464. The Higgerson-Buchanan site is located on Bainbridge Boulevard (State Route 166) in the city of Chesapeake, Virginia. The Southeastern Public Service Authority (SPSA) landfill is located on Bob Foeller Drive in Suffolk, Virginia, which connects to U.S. Route 13.

Environmental dredging pertains primarily to removal of contaminated sediments by dredging with equipment that will minimize turbidity and the re-suspension of contaminated sediments. Criteria for selecting the dredging equipment to accomplish this removal action were identified. Numerous dredge types, including mechanical, hydraulic, and special purpose dredges were listed, characterized, and evaluated using the selection criteria. Several options appear acceptable, including mechanical dredges, the closed bucket clamshell, cutterhead, and horizontal auger dredge. Other operational controls may be considered, as appropriate.

The first identified environmental dredging alternative involves the use of a closed bucket clamshell (Figure 13), a mechanical dredge, to remove some contaminated sediments. This dredge is capable of high production rates, is able to remove both sediments and debris, and can navigate some portions of Scuffletown Creek. The use of a closed bucket clamshell, readily available within the Hampton Roads area, as well as consideration of operational controls, could help to minimize adverse environmental effects related to this dredging.

The second identified dredging alternative involves use of a cutterhead dredge (Figure 13), a hydraulic dredge, to excavate Scuffletown Creek sediments. This dredge is

the most commonly used dredging plant and is versatile, capable of dredging clays, silts, sands, gravels, etc. The cutterhead dredge is also able to dredge while generating reduced amounts of turbidity. As with the closed bucket, other operational controls may be considered to reduce environmental effects.

The third identified dredging alternative involves the use of both mechanical and special purpose hydraulic dredging equipment. A closed bucket clamshell dredge could be used first to remove the majority of the contaminated sediments. In order to excavate the last of the sediment intended for removal, without performing significant over-dredging, a special purpose dredge with greater vertical control than the closed bucket could complete the dredging operation. Two special purpose dredges that have greater vertical control and generate relatively low amounts of turbidity include the horizontal auger dredge and the matchbox suction head dredge. Additionally, the cable arm bucket provide greater vertical control.

Additionally, primary mechanisms of contaminant loss associated with remedial action activities were identified. Subsequently, an array of potential environmental protection measures were identified and evaluated for applicability to the project conditions and applicability to minimize primary mechanisms of contaminant losses. Applicable water quality controls, dredging operation controls, and/or environmental controls could be placed on the dredging operation to limit adverse impacts of this sediment removal action. Water quality controls may include placing limits on the amount of turbidity or concentrations of contaminants allowed in the water column outside the immediate dredging area. Dredge operation controls might include limiting the bucket cycle time, prohibiting nighttime dredging operations, and not allowing buckets and scows to be overfilled. In addition, watertight scows and/or trucks should be required for transporting contaminated sediments. While it is virtually impossible to completely eliminate all environmental impacts of this dredging action, controls such as these can greatly reduce impacts.

For purposes of this report, various types of mechanical dredges were considered feasible given the logistical constraints of Scuffletown Creek. Various types of bucket dredges, including a closed clamshell bucket, are being considered as the most appropriate equipment for dredging in the creek.

In addition to environmental dredging, remediating the contaminated sediments in Scuffletown Creek will also involve transport, possible treatment, and final disposal. These have all been evaluated as part of the clean-up "train" or process. The different trains are displayed in Figure 19. Candidate placement sites are displayed in Figure 20. The trains are grouped in sets of two, because not all of the material will need remediation. Trains one, three, six, and seven represent a system of removing, treating, and disposing contaminated material. These trains contain an additional step, which represents the treatment process (stabilization or bioremediation). The remaining trains (two, four, five, and eight) lack the remediation element because they describe a system of removing and disposal of material that does not need treatment. These trains outline a method of removing the material and transporting it for direct placement in the final placement location.

The two dredged material management sites under consideration are Craney Island Dredged Material Management Area (CIDMMA) and the Higgerson Buchanan Site, located on the Southern Branch and formerly used for dredged material placement in the early 1980's in connection with the Southern Branch deepening to 35 feet. By law, dredged material cannot be placed permanently into CIDMMA unless it is navigation related. The environmental dredging proposed at Scuffletown Creek would not qualify as "navigation related" dredging since it is strictly for environmental restoration, not navigation. CIDMMA could, however, be used as a temporary placement site or staging area prior to treatment or final deposition at another site. At this time it has not been identified which pair of trains will be used to transport, treat and dispose the material dredged from Scuffletown Creek, however all are feasible.

OPERATION, MAINTENANCE, AND SITE MONITORING

INTRODUCTION

ER 1105-2-100, Section V (Ecosystem Restoration), Subsection E-30, paragraph (i), Monitoring and Adaptive Management, states that "...Monitoring may be necessary to determine if the predicted outputs are being achieved and to provide feed back for future projects; and ... if cost shared post-implementation monitoring is being considered, it must be clearly defined, justified, and shall be limited to no more than five years following completion of construction. ...The cost of monitoring included in the total project cost and cost shared with the non-Federal sponsor should not normally exceed one percent of the first cost of the ecosystem restoration feature." Project monitoring after five years is a 100 percent non-Federal responsibility.

WETLAND RESTORATION SITES

Restored wetlands are designed to be completely self-sustaining and, once established, should require very little maintenance. Plant survival during the first 2-3 growing seasons would be required as part of the contract stipulations. Limited maintenance will consist of periodic debris removal and spot control of invasive plant species, such as common reed (*Phragmites* sp.), where applicable, which may be required only on a case-by-case basis.

Post construction monitoring at the wetland restoration sites would be performed by the contractor under the guidance of the Norfolk District, USACE. The plan is intended to measure and ensure achievement of the contract specifications. Specific requirements of the plan may include the following:

1. Final elevations shall be at the specified elevations required to sustain tidal salt marsh. Elevations shall be provided on 5-foot centers to check for these specifications.

2. In the first year, *Spartina alterniflora* and other wetland plantings shall achieve 70% coverage of the site. The site shall be replanted if this goal is not met.

SEDIMENT CLEAN-UP

Sediment clean-up in Scuffletown Creek would be designed to reduce levels of contamination which, in turn, would restore benthic community health, finfish and other aquatic life in the river. Once remediated, no maintenance is anticipated. As discussed in the feasibility report, risk of recontamination is expected to be minimal.

Follow-up monitoring may be conducted annually for up to five (5) years. The monitoring plan would be performed by or under the guidance of the Norfolk District, USACE in cooperation with the Virginia DEQ. The plan is intended to measure achievement of the goals and objectives established during planning. Monitoring would include limited evaluation of bulk chemicals in the sediments, but would primarily focus on benthic community health using a field survey analysis called a Benthic Index of Biotic Integrity (B-IBI). The B-IBI was used to evaluate Scuffletown Creek during the feasibility study. After sediment clean-up, the B-IBI would be used in both Scuffletown Creek and an unremediated reference area, Jones Creek, that was also evaluated during the feasibility study.

COST ESTIMATES

COST EVALUATION

Sediment Clean-Up Cost Estimates

Cost estimates were prepared by Norfolk District's Engineering Support Section utilizing the Tri-Service Automated Cost Engineering System (TRACES) module of Building Systems Design, Inc.'s MCACES for Windows, Release 1.2c. Estimates were prepared for the ERM level of 0.6 (dredging to 6' below bottom elevation): 60,270 cubic yards (35,820 cubic yards located downstream of the railroad bridge and 24,450 cubic yards located upstream of the railroad bridge). The stated yardage includes one foot of allowable over-dredging and 3:1 sideslopes.

a) Mechanically dredge contaminated material, place into barge, transport by barge to Craney Island (approximately 8 river miles), offload at Craney Island, truck haul to the Navy's bio-cell on Craney Island (approximately 2 miles), run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at the Southeastern Public Service Authority (SPSA) landfill in Suffolk (a truck haul distance of approximately 16 miles). Estimate shall include the cost of mobilizing and operating a portable pug mill at the bio-cell.

b) Mechanically dredge contaminated material, place into barge, transport by barge to Craney Island (approximately 8 river miles), offload at Craney Island, and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles).

c) Mechanically dredge contaminated material, place into barge, transport by barge to Higgerson-Buchanan site in Chesapeake (approximately 6 river miles), offload material, run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles). Estimate includes the cost of mobilizing and operating a portable pug mill at the Higgerson-Buchanan site.

d) Mechanically dredge contaminated material, place into barge, transport by barge to Higgerson-Buchanan site in Chesapeake (approximately 6 river miles), offload material, and truck haul material for permanent disposal at the Higgerson-Buchanan dredged material placement site (a truck haul distance of approximately ½ mile).

e) Mechanically dredge contaminated material, place onto trucks, transport to ABEX site in Portsmouth (a truck haul distance of approximately 5 miles), run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in

Suffolk (a truck haul distance of approximately 13 miles). Estimate includes the cost of mobilizing and operating a portable pug mill at the ABEX site.

f) Mechanically dredge contaminated material, place onto trucks, and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles).

g) Mechanically dredge contaminated material, place onto trucks, transport by truck to Higgerson-Buchanan site in Chesapeake (approximately 5 miles), offload material, run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in Suffolk. Estimate includes the cost of mobilizing and operating a portable pug mill at the Higgerson-Buchanan site.

h) Mechanically dredge contaminated material, place onto trucks, transport by truck to Higgerson-Buchanan site in Chesapeake for permanent disposal at the Higgerson-Buchanan dredged material placement site (a truck haul distance of approximately 5 miles).

(Note: All distances stated above are one-way distances. The material to be dredged is anticipated to be fine-grained clays and silts, with moderate amounts of sand.)

Additionally, an estimate was prepared for the cost of installing a two-foot clean sand cap over the contaminated areas dredged for the ERM level of 0.6. Estimate includes the cost of the sand, transporting it to the site, and hydraulically placing the sand over all of the dredged contaminated areas.

All estimates were performed under the assumptions that: areas west of the railroad trestle would be dredged by a five to ten cubic yard bucket dredge; areas east of the railroad trestle would be dredged by a two to five cubic yard barge-mounted excavator or a shallow displacement mechanical dredge of similar bucket capacity; all

dredged material shall be placed on a barge and offloaded at its transfer site (Elizabeth River Park, Craney Island or Higgerson-Buchanan) by a land-based bucket crane or excavator; all dredged material to be truck hauled will be placed into ten cubic yard sealed dump trucks; and all dredged material to be pugged will be placed in the back of the dump truck directly from the pug mill.

A summary of cost estimates (including contingencies) associated with sediment clean-up alternatives at Scuffletown Creek is shown in Tables A-1 and A-2. Construction costs were based on similar dredging, transport, and sediment treatment projects.

Table A-3. SCUFFLETOWN CREEK SEDIMENT REMEDIATION COSTS

0.6 ERM SQV, 6-FOOT DEPTH

Treatment Train (%)	Total Quantity (cy)	Estimated Cost	15% Contin-gency	Total Cost	Additional 25% Contingency	Final Cost	Unit Cost
1 (50%)	30,135	3,117,219	467,583	3,584,802	896,200	4,481,002	149
2 (50%)	30,135	1,871,224	280,684	2,151,908	537,977	2,689,885	89
System Total =	60,270	4,988,443	748,266	5,736,709	1,434,177	7,170,887	119
3 (50%)	30,135	3,049,838	457,476	3,507,314	876,828	4,384,142	145
4 (50%)	30,135	625,581	93,837	719,418	179,854	899,272	30
System Total =	60,270	3,675,419	551,313	4,226,731	1,056,683	5,283,414	88
5 (50%)	30,135	710,666	106,600	817,265	204,316	1,021,582	34
6 (50%)	30,135	3,165,974	474,896	3,640,870	910,217	4,551,087	151
System Total =	60,270	3,876,639	581,496	4,458,135	1,114,534	5,572,669	92
7 (50%)	30,135	3,115,090	467,264	3,582,354	895,588	4,477,942	149
8 (50%)	30,135	1,796,924	269,539	2,066,462	516,616	2,583,078	86
System Total =	60,270	4,912,014	736,802	5,648,816	1,412,204	7,061,019	117

Table A-4. SCUFFLETOWN CREEK –
TOTAL SYSTEMATIC REMEDIATION COSTS

ERM SQV, 0-6 foot depth			
Train (% material)	0.8	0.6	0.4
1 (50%)	2,950,412	4,481,002	9,463,512
2 (50%)	1,778,014	2,689,885	5,672,146
System Total[1] =	$4,728,426	$7,170,887	$15,135,657
3 (50%)	2,888,487	4,384,142	9,259,123
4 (50%)	625,831	899,272	1,822,980
System Total =	$3,514,318	$5,283,414	$11,082,103
5 (50%)	699,771	1,021,582	2,043,007
6 (50%)	2,991,290	4,551,087	9,574,779
System Total =	$3,691,061	$5,572,669	$11,617,786
7 (50%)	2,944,330	4,477,942	9,416,982
8 (50%)	1,705,014	2,583,078	5,402,802
System Total =	$4,649,344	$7,061,019	$14,819,784

[1] Assumes dredging above and below the RR bridge. Includes contingency.

Preconstruction, Engineering and Design (PED) costs for the sediment clean-up component of the NER plan is estimated at $777,000 and Construction Management is estimated at $572,000. These costs are added to the system total final costs in Tables A-3 and A-4 to give total project first costs. Total project first costs are presented in the Main Report, Table 34.

Wetland Sites – Cost Estimates

In July 2000, Virginia Geotechnical Services (VGS) provided construction costs for all wetland sites. The construction costs provided by VGS were revised and adjusted

by the Norfolk District Cost Engineering Section to reflect costs of similar USACE projects. The construction costs for all sites consist of three categories- site preparation, earthwork, and landscaping. Site preparation costs include mobilization, brush clearing, timber matting, stone, erosion control, and demobilization. The earthwork category includes all costs for either excavation or filling, as applicable for each site. As examples, costs for an excavation site would include the actual excavation, hauling and disposing of the material, while costs for a filled site the costs include acquiring the material, transporting it to the wetland site, and depositing it. The final category of costs, landscaping, includes all costs associated with constructing the wetland, such as topsoil, plants, and planting. Construction costs included in this analysis have been developed using TRACES estimates; they represent total or fixed fee cost estimates. They are a conceptual representation of the approximate order-of-magnitude costs associated with the design concepts described. These estimates are not based upon solicitations from qualified contractors, but rather are based upon representative unit costs for similar construction projects in the Tidewater Virginia area. A 25 percent contingency was added to all construction estimates in order to capture any unforeseen complications.

In addition to the construction costs, costs associated with real estate acquisition have also been considered and included in the analysis. The local sponsors own most of the identified wetland sites, so the costs consist primarily of the assessed values. The estimates are based upon the following assumptions:

1. The property rights would be used for wetlands creation or enhancement;
2. Estimated values apply only to land above the mean high water line;
3. Navigational Servitude will be sufficient for any work below m.h.w.;
4. No improvements would be acquired for the project;
5. Local sponsors will be entitled to credit for the real estate acquired.

Real Estate assumptions and estimates are defined in more detail in the Real Estate Supplement, Appendix B.

Table A-5. WETLAND RESTORATION COSTS

Location	Initial Construction Estimates [1]	Total Construction Estimates [2]	Land Costs [3]	Total Site Cost	AAEC [4]
Sugar Hill, Portsmouth	$85,501	$106,876	$2,500	$109,376	$7,400
Carolanne Farms, Virginia Beach	$198,905	$248,631	$14,000	$262,631	$17,700
Somme Avenue, Norfolk	$223,688	$279,610	$2,500	$282,110	$19,000
Scuffletown, Chesapeake	$54,905	$68,631	$2,500	$71,131	$4,900
NW Jordan Bridge, Portsmouth	$185,251	$231,564	$2,500	$234,064	$15,800
Crawford Bay, Portsmouth	$279,130	$348,913	$2,500	$351,413	$23,600
Woodstock Park, Virginia Beach	$377,390	$471,738	$2,500	$474,238	$31,800
Lancelot Drive, Virginia Beach	$1,242,463	$1,553,079	$6,000	$1,559,079	$104,300
Grandy Village, Norfolk	$791,528	$989,410	$5,000	$994,410	$66,600
ODU Drainage Canal, Norfolk	$138,236	$172,795	$2,500	$175,295	$11,900
Portsmouth City Park, Portsmouth	$263,295	$329,119	$11,000	$340,119	$22,900

[1] Construction estimates represent estimated projected costs. These values do not contain contingency or inflation factors. All figures are represented in FY 2001 dollars.

[2] Total construction estimates include an additional 25% contingency. This amount was added to the initial construction costs to cover any cost items not anticipated in the feasibility study.

[3] Land costs provided by Real Estate. See Real Estate Appendix B for description of costs.

[4] Average annual equivalent costs derived using an interest rate of 6-3/8%, assuming maintenance costs of $1,000 every five years over 50 year project life.

BOLD = Eight sites representing wetland component of NER Plan

Preconstruction, Engineering and Design (PED) costs for the eight wetland restoration sites recommended in the NER plan is estimated at $223,000 and Construction Management is estimated at $327,000. These costs are added to the total site costs in Table A-5 to give total project first costs. Total project first costs are presented in the Main Report, Table 34.

CONTINGENCY COSTS

All construction estimates include a 10 to 15 percent contingency to cover the possibility of minor variations in estimated quantities, minor variations in fuel costs, variations in equipment availability, variations in dredge efficiency, weather delays, marine traffic delays, variability of sediment properties (dredgability), limited site accessibility, variability of required equipment, and minor variations in other risk factors.

An additional contingency of 25 percent was applied to the estimated contract costs to cover implementation of various treatment methodologies and variances in volumes of material that would have to be treated. Application of contingencies is in accordance with the guidance in ER 1110-2-1302, dated 31 March 1994, Cost Estimates – Planning and Design Stages, U.S. Army Corps of Engineers.

SCHEDULE FOR DESIGN AND CONSTRUCTION

The time to construction depends largely on the submittal requirements for both the wetlands restoration component and the sediment clean-up component of the project. Preconstruction, Engineering, and Design (PED) can run concurrently for both (wetlands and sediment clean-up), and should take 12-18 months from receipt of funds to produce the design documents. A draft of the Project Cooperation Agreement (PCA) should be developed to support the submission of the final feasibility report. The final PCA should be produced and negotiated concurrently with the PED phase, and the PCA should be executed and included in support of the PED package. Review times and time awaiting approval and funding should be added to this package. The final plans and specifications will take approximately one year to produce after receipt of funds. Real estate could be acquired once the PCA is executed.

The duration of the construction activities is listed below. The scenario for each of the activities below are listed in the Cost Estimate summary above. An additional mobilization / demobilization time of up to one month (contractor dependant) should be added to the durations listed below.

Table A-6. CONSTRUCTION DURATION – SEDIMENT CLEAN-UP

Scenario[1]	Duration (months)
A	6.25
B	6.0
C	5.75
D	5.25
E	8.5
F	8.75
G	9.0
H	7.5

[1]See Attachment A (Detailed Cost Estimates), A-1, for scenario descriptions.

It should be noted that durations could be reduced if additional equipment and manpower (over and above the equipment and manpower projected to be used in the preparation of the cost estimates) is used to perform the work.

It will take approximately one year for construction of the wetland restoration sites.

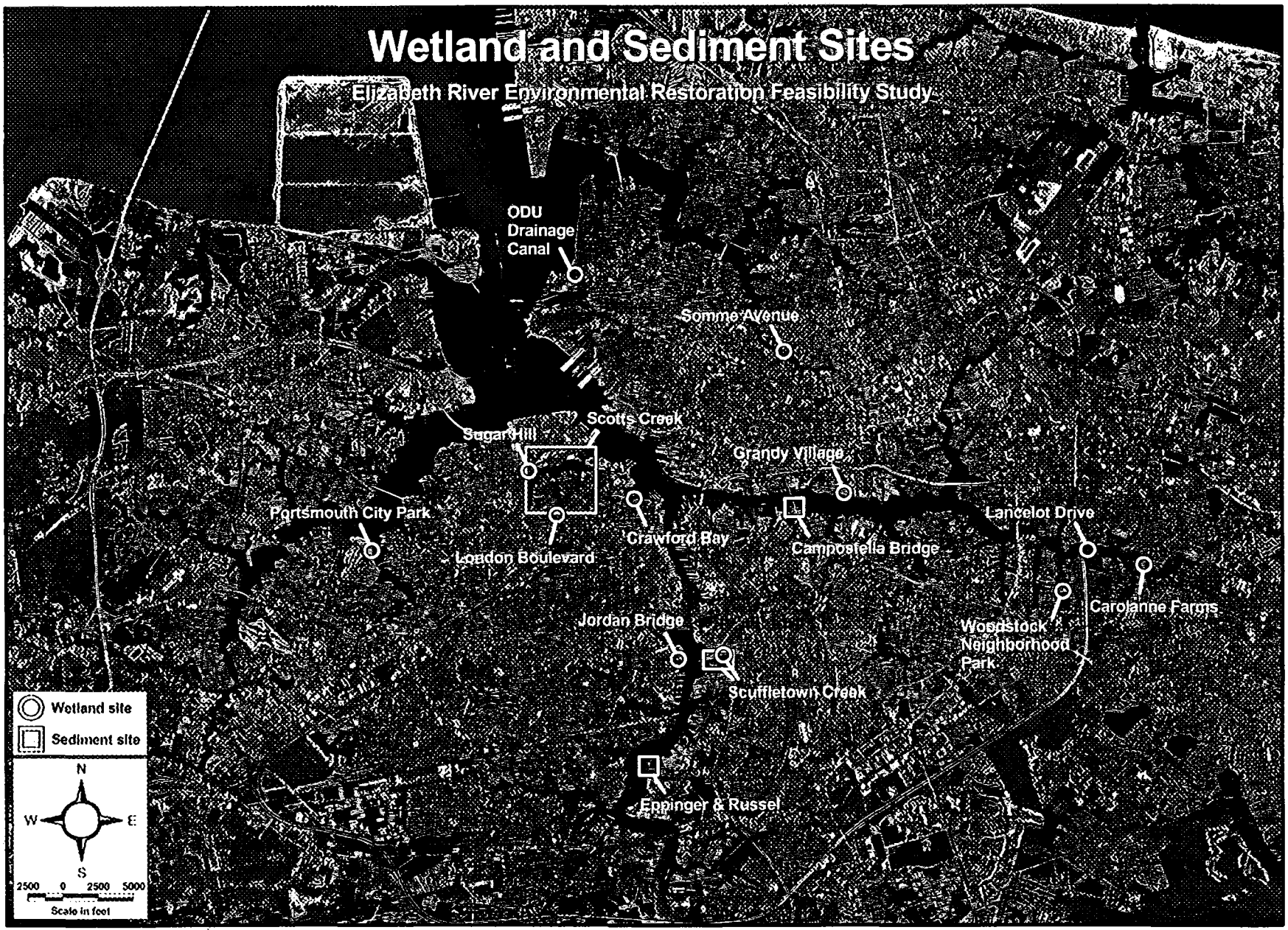
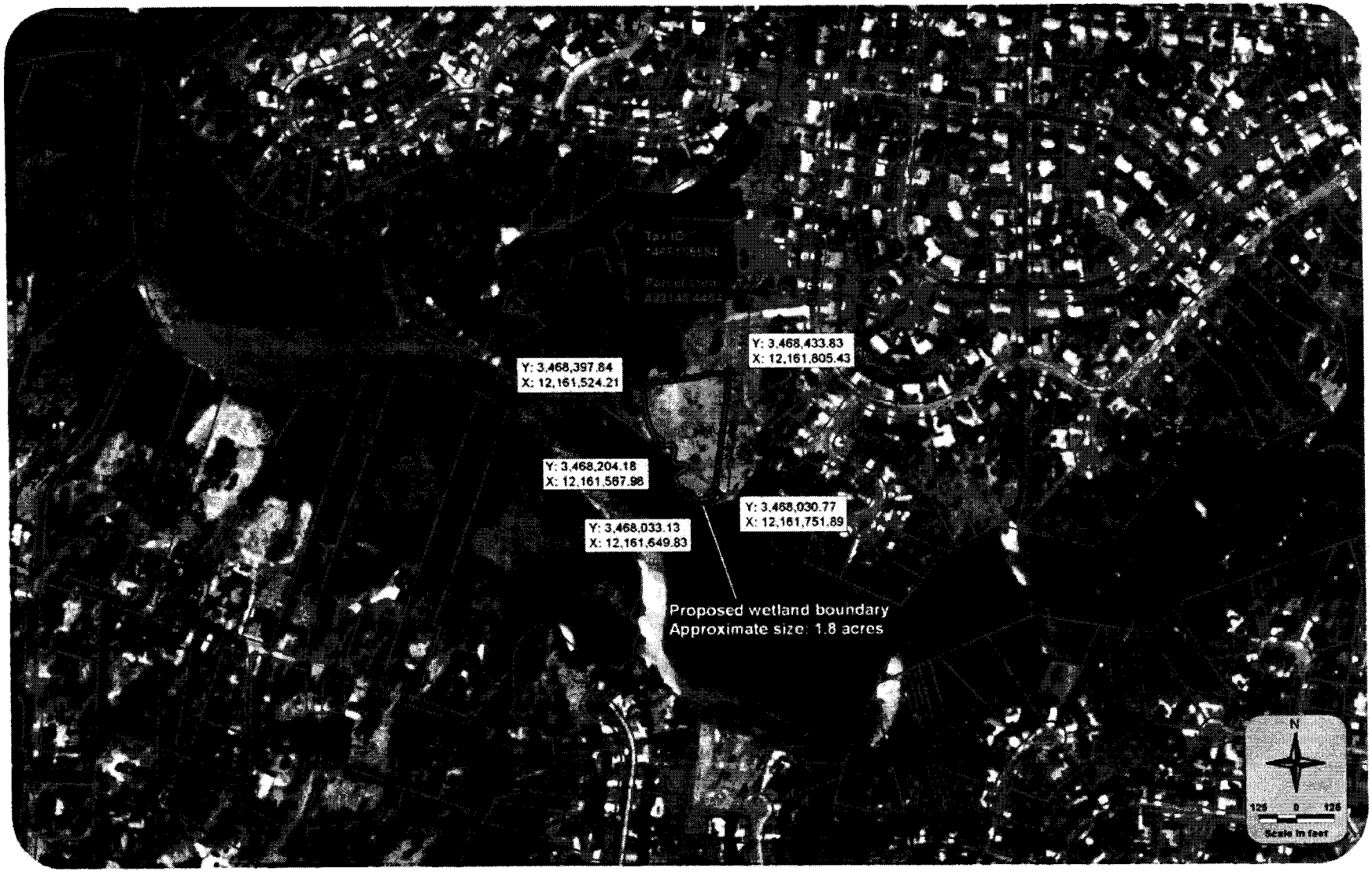

Wetland and Sediment Sites
Elizabeth River Environmental Restoration Feasibility Study
ODU Drainage Canal
Somme Avenue
Scotts Creek
Sugar Hill
Grandy Village
Portsmouth City Park
London Boulevard
Crawford Bay
Campostella Bridge
Lancelot Drive
Carolanne Farms
Woodstock Neighborhood Park
Jordan Bridge
Scuffletown Creek
Eppinger & Russel
Wetland site
Sediment site
N
W
E
S
2500 0 2500 5000
Scale in feet

PLATE A-1

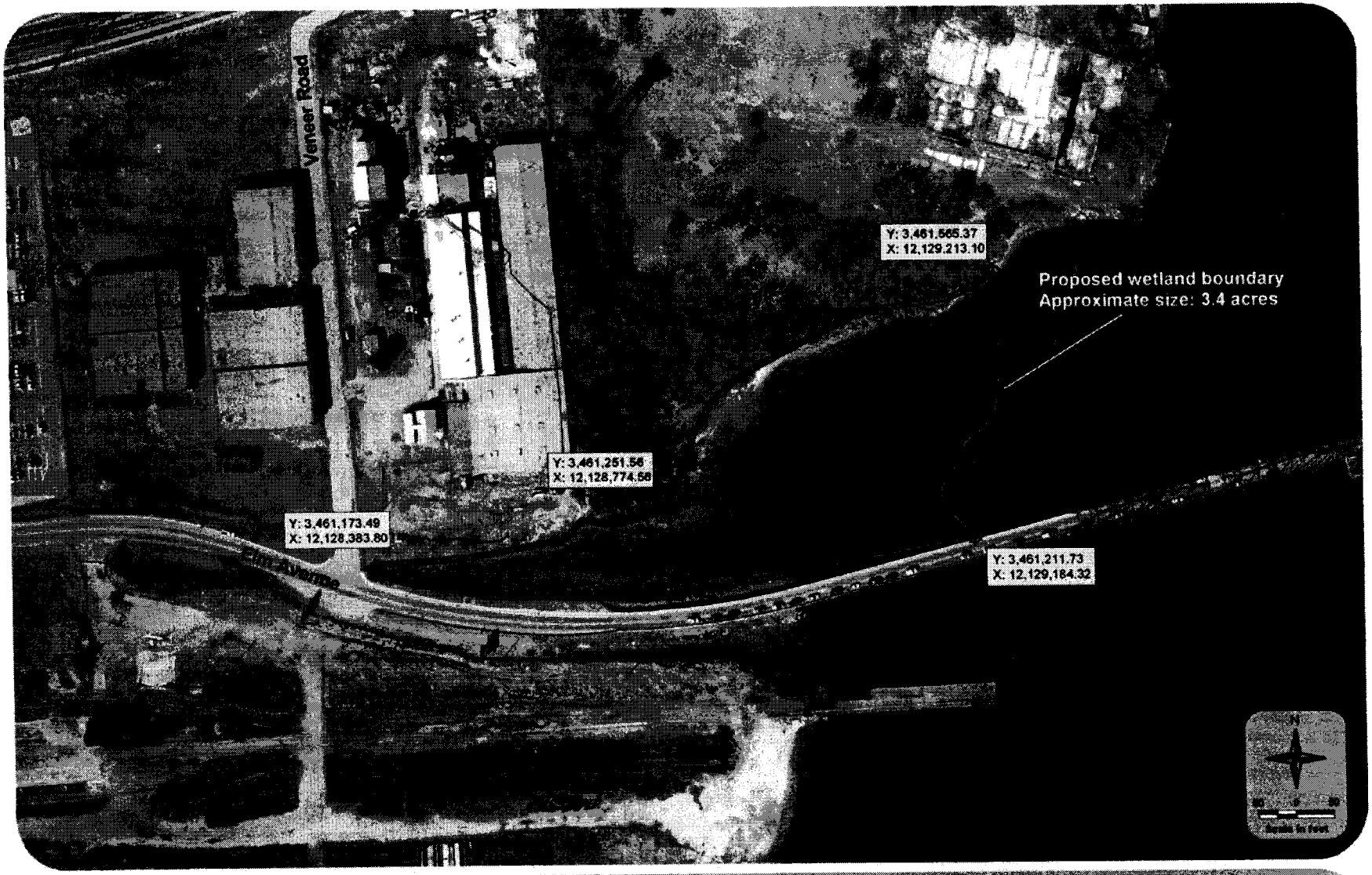


Carolanne Farms

Candidate Wetland Site, City of Virginia Beach

Elizabeth River Environmental Restoration Feasibility Study

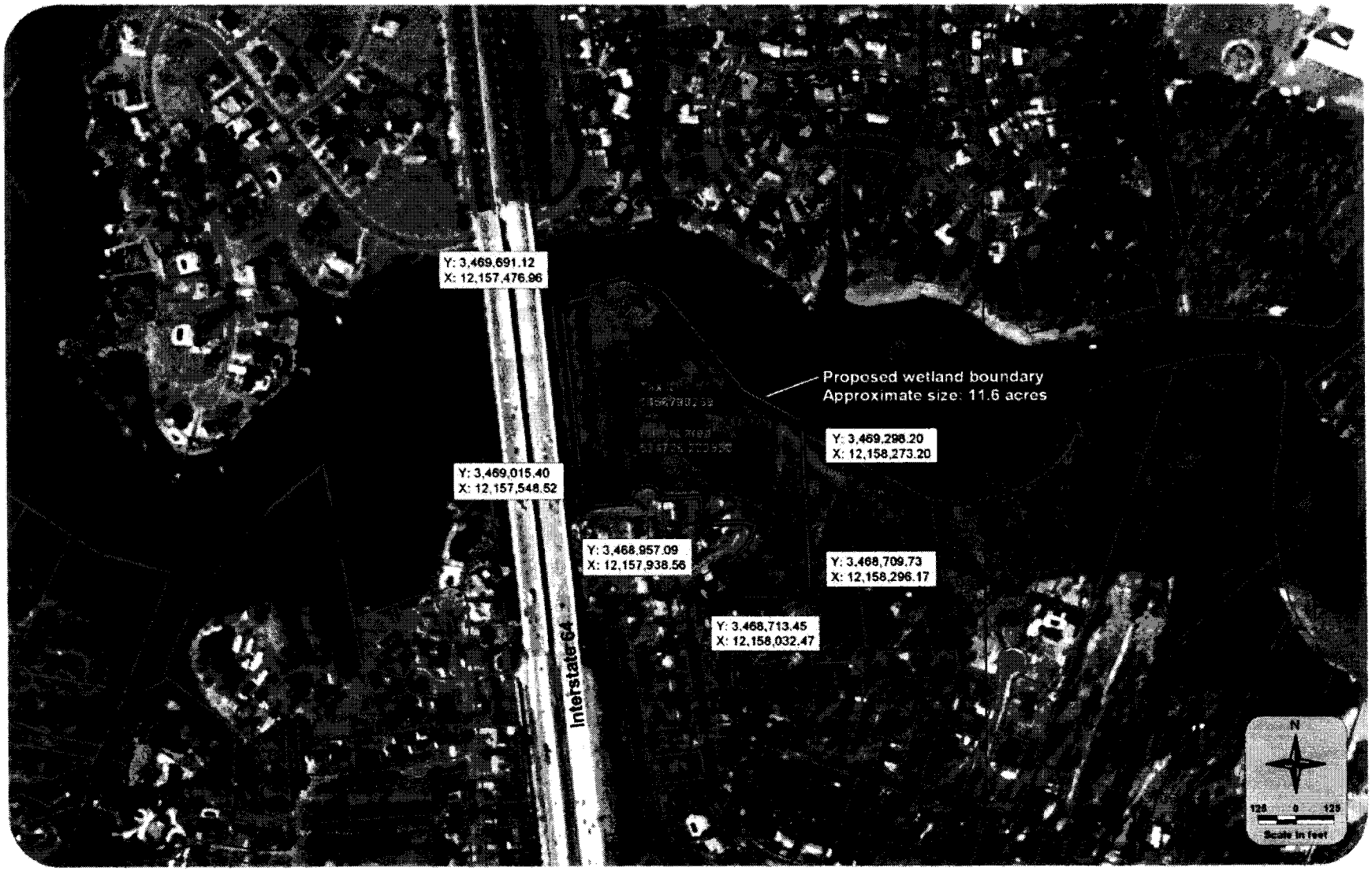
PLATE A-2



Jordan Bridge

Candidate Wetland Site, City of Portsmouth
Elizabeth River Environmental Restoration Feasibility Study

PLATE A-3



Lancelot Drive

Candidate Wetland Site, City of Virginia Beach
Elizabeth River Environmental Restoration Feasibility Study

PLATE A-4

Scuffletown Creek

Candidate Wetland and Sediment Site, City of Chesapeake

Elizabeth River Environmental Restoration Feasibility Study

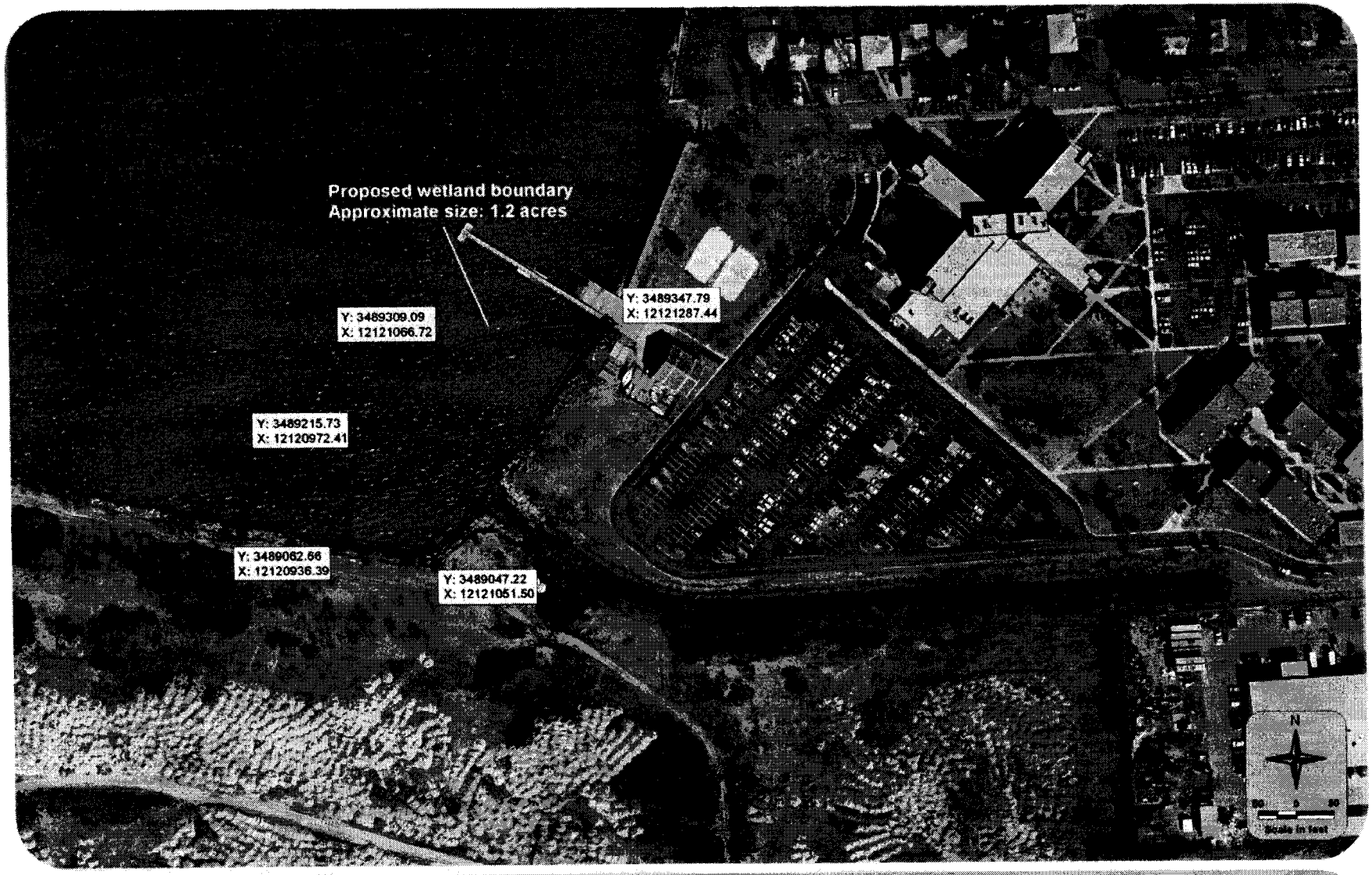
PLATE A-5

Woodstock Neighborhood Park

Candidate Wetland Site, City of Virginia Beach

Elizabeth River Environmental Restoration Feasibility Study

PLATE A-6

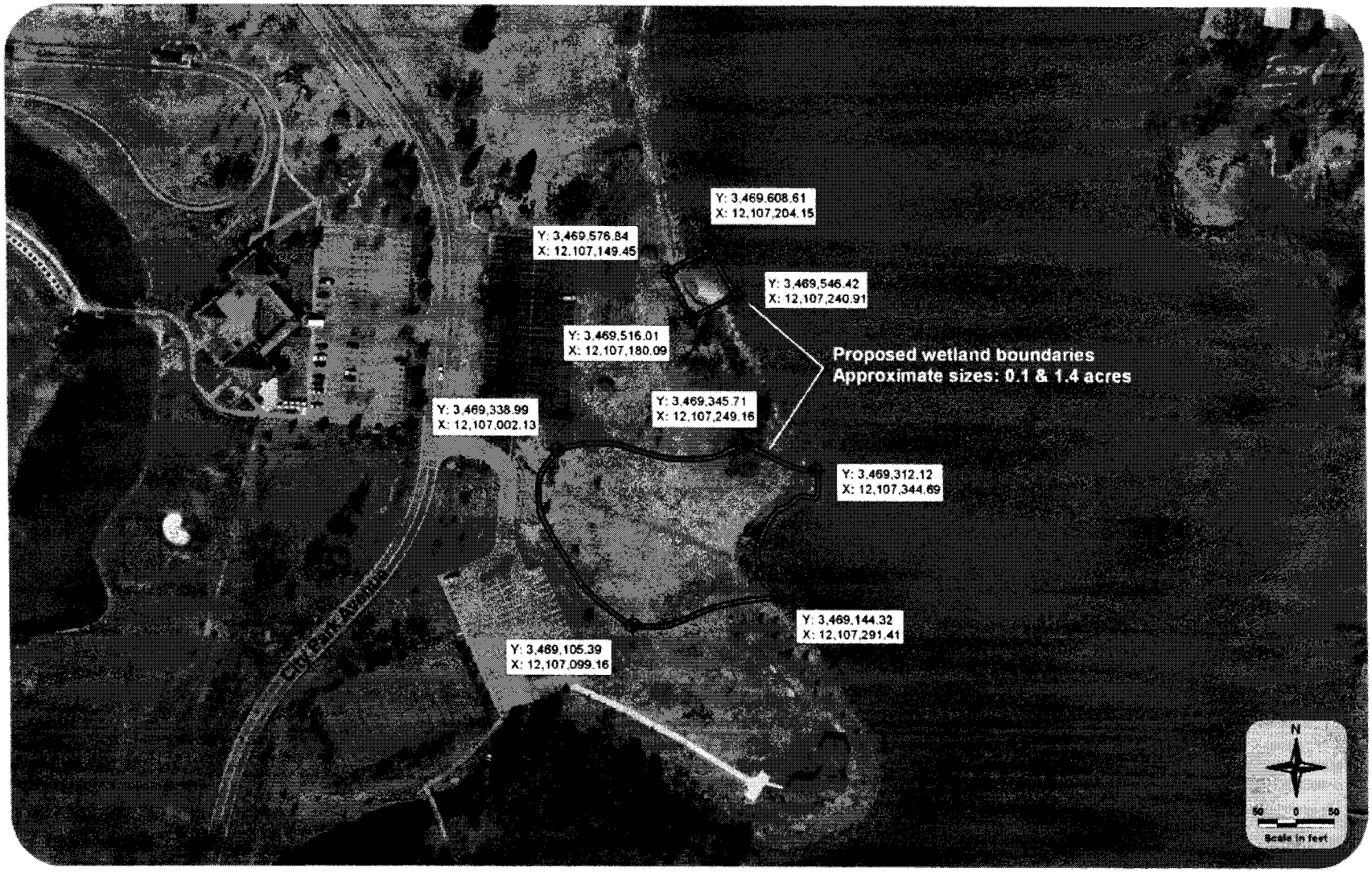


ODU Drainage Canal

Candidate Wetland Site, City of Norfolk

Elizabeth River Environmental Restoration Feasibility Study

PLATE A-7



Portsmouth City Park

Candidate Wetland Site, City of Portsmouth

Elizabeth River Environmental Restoration Feasibility Study

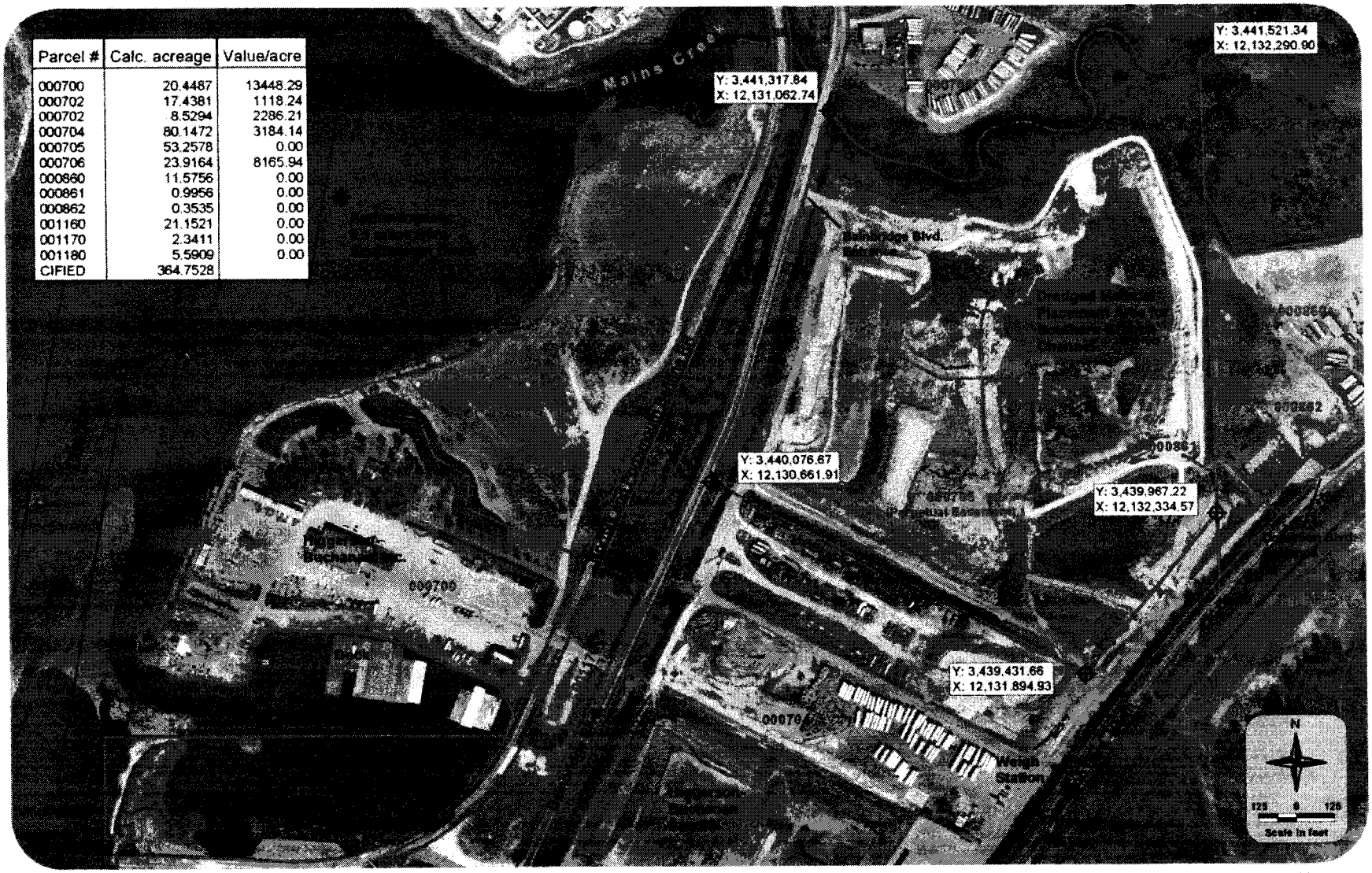
PLATE A-8

Grandy Village

Candidate Wetland Site, City of Norfolk

Elizabeth River Environmental Restoration Feasibility Study

PLATE A-9



Higgerson-Buchanan

Dredged Material Placement Site, City of Chesapeake

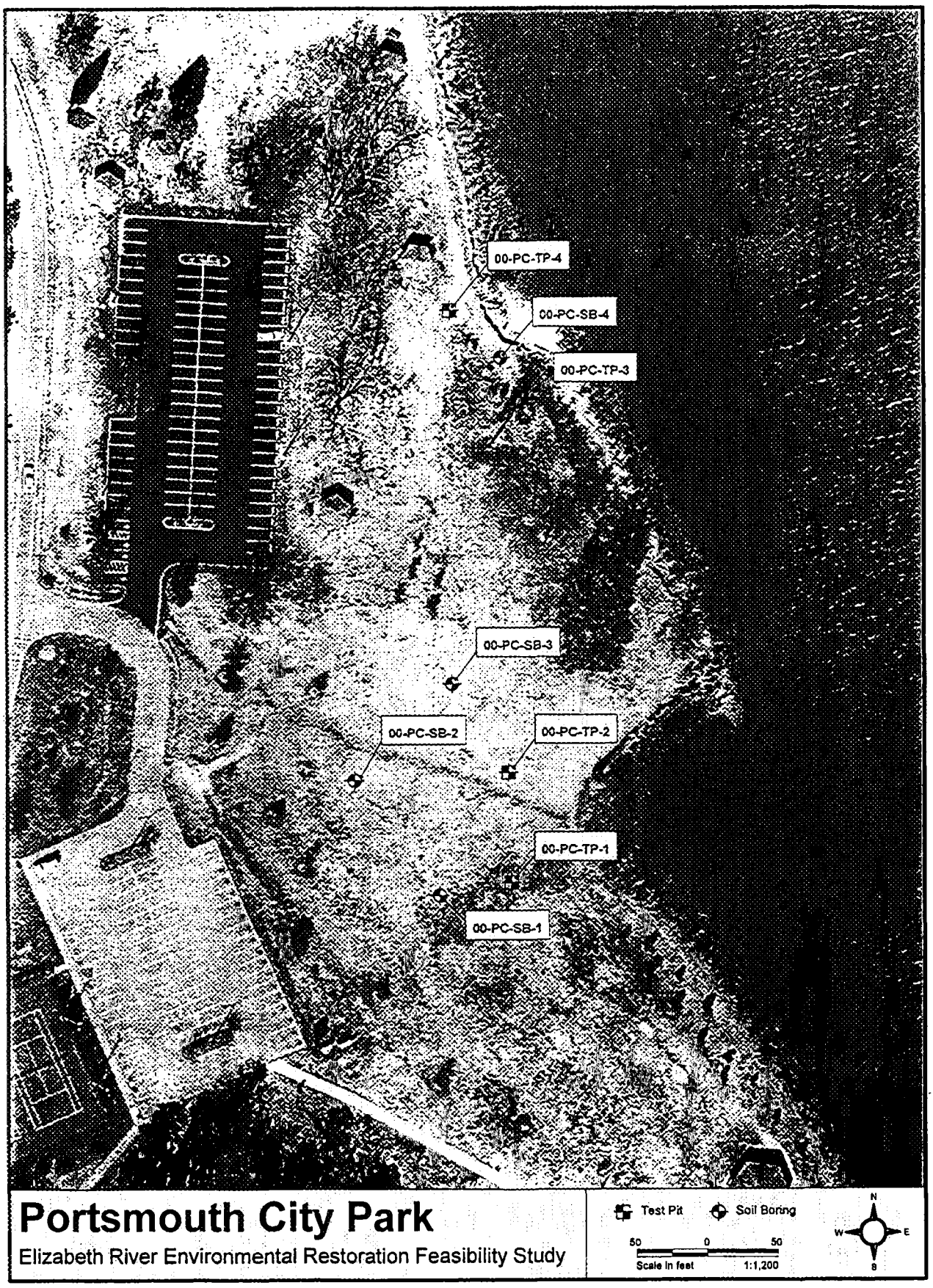
Elizabeth River Environmental Restoration Feasibility Study

00-CF-SB-5
00-CF-SB-4
00-CF-SB-3
00-CF-SB-1
00-CF-SB-2
Carolanne Farms
Elizabeth River Environmental Restoration Feasibility Study
Soil Boring
75 0 75 150
Scale in feet 1:3,000
N
W
E
S

PLATE A-11

00-GV-SB-4
00-GV-SB-3
00-GV-TP-1
00-GV-SB-2
00-GV-SB-1
00-GV-TP-2
00-GV-TP-7
00-GV-TP-3
00-GV-TP-4
00-GV-TP-5
00-GV-TP-6
Grandy Village
Elizabeth River Environmental Restoration Feasibility Study
Test Pit
Soil Boring
75 0 75 150
Scale in feet
1:3,000
N
W
E
S

PLATE A-12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00-PC-SB-4
00-PC-TP-3
00-PC-SB-3
00-PC-SB-2
00-PC-TP-2
00-PC-TP-1
00-PC-SB-1
Portsmouth City Park
Elizabeth River Environmental Restoration Feasibility Study
Test Pit
Soil Boring
50 0 50
Scale in feet
1:1,200
N
W
E
S

PLATE A-13

APPENDIX A
ENGINEERING AND COST DATA

ATTACHMENTS

Attachment A - DETAILED COST ESTIMATES

Attachment B - WETLAND SITES DESIGNS AND DRAWINGS

Attachment C - SUBSURFACE SOIL INVESTIGATIONS – WETLANDS

Attachment D - SCUFFLETOWN CREEK HYDROGRAPHIC SURVEY

ATTACHMENT A

DETAILED COST ESTIMATES

FEASIBILITY STUDY COST ESTIMATE

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

THIS ESTIMATE IS BASED ON THE DRAFT FEASIBILITY STUDY, DATED MARCH 2001

PROJECT ELIZABETH R. BASIN ENVIRON RESTORATION
LOCATION: ELIZABETH RIVER BASIN, VIRGINIA

DISTRICT NORFOLK, VIRGINIA
P.O.C.. ALAN ELLINWOOD, CHIEF, COST ENGINEERING

		MCACES EST PREPARED: MAR FY 01 EFFECTIVE PRICING LEVEL: OCT FY 02				AUTH/BUDGET YR: FY 03 EFFECT PRICING LEVEL. OCT FY 03				FULLY FUNDED ESTIMATE				
ACCT NUM	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MD PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
06	FISH & WILDFIRE FACILITIES (Wetlands)	2,928	732	25.0%	3,660	6.6%	3,121	780	3,902	Aug-03	3.2%	3,221	805	4,026
12	NAVIGATION, PORTS, & HARBORS (Sediments)	5,737	1,434	25.0%	7,171	6.6%	6,116	1,529	7,645	Aug-03	3.2%	6,311	1,578	7,889
14	RECREATION FACILITIES	323	81	25.0%	404	6.6%	344	86	430	Aug-03	3.2%	355	89	444
	TOTAL CONSTRUCTION COSTS	8,988	2,247	25.0%	11,235		9,581	2,395	11,977			9,888	2,472	12,360
01	LANDS AND DAMAGES (Wetlands)	46	-	0.0%	46	6.6%	49	-	49	Feb-03	0.0%	49	-	49
01	LANDS AND DAMAGES (Sediments)	10	-	0.0%	10	6.6%	11	-	11	Feb-03	0.0%	11	-	11
30	PRECONSTR., ENGINEERING AND DESIGN	909	91	10.0%	1,000	6.6%	969	97	1,066	Feb-03	0.0%	969	97	1,066
31	CONSTRUCTION MGT (8%)	817	82	10.0%	899	6.6%	871	87	958	Aug-03	3.2%	899	90	989
	TOTAL PROJECT COST	10,770	2,420	22.5%	$13,190		11,481	2,579	$14,060			11,815	2,659	$14,474

TOTAL PROJECT COSTS: $13,190

DISTRICT APPROVED:

Michael K. Hall — CHIEF, COST ENGINEERING

Gillard H. Horton — CHIEF, REAL ESTATE

Mark T. Mansfield — CHIEF, PLANNING

Lorrentino — CHIEF, TSD

M Thomasson — CHIEF, PPMD

Robert N. Pretlow, Jr. — PROJECT MANAGER

ATTACHMENT A-1

DETAILED COST ESTIMATES – SEDIMENT CLEANUP

CENAO-EN-CP 12 September 2000

MEMORANDUM THRU Chief, Design Section

FOR Cost Engineer

SUBJECT: Skuffletown Creek Environmental Dredging, Chesapeake, Virginia

1. Currently, alternatives are being evaluated for the dredging, transportation, disposal and possibly capping of the contaminated material in Skuffletown Creek. I have spoken with Mike Hall concerning the subject work, and he is familiar with the project.

2. Please perform reconnaissance-level estimates for each of the following scenarios, utilizing each of the volumes listed in paragraph 3 below:

a) Mechanically dredge contaminated material, place into barge, transport by barge to Craney Island (approximately 8 river miles), offload at Craney Island, truck haul to the Navy's bio-cell on Craney Island (approximately 2 miles), run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles). Estimate shall include the cost of mobilizing and operating a portable pug mill at the bio-cell.

A

b) Mechanically dredge contaminated material, place into barge, transport by barge to Craney Island (approximately 8 river miles), offload at Craney Island, and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles).

B

c) Mechanically dredge contaminated material, place into barge, transport by barge to Higgerson-Buchanan site in Chesapeake (approximately 6 river miles), offload material, run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles). Estimate shall include the cost of mobilizing and operating a portable pug mill at the Higgerson-Buchanan site.

C

d) Mechanically dredge contaminated material, place into barge, transport by barge to Higgerson-Buchanan site in Chesapeake (approximately 6 river miles), offload material, and truck haul material for permanent disposal at the Higgerson-Buchanan dredged material placement site (a truck haul distance of approximately ½ mile).

D

e) Mechanically dredge contaminated material, place onto trucks, transport to ABEX site in Portsmouth (a truck haul distance of approximately 5 miles), run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 13 miles). Estimate shall include the cost of mobilizing and operating a portable pug mill at the ABEX site.

E

f) Mechanically dredge contaminated material, place onto trucks, and truck haul and final disposal of material at SPSA landfill in Suffolk (a truck haul distance of approximately 16 miles).

F

g) Mechanically dredge contaminated material, place onto trucks, transport by truck to Higgerson-Buchanan site in Chesapeake (approximately 5 miles), offload material, run the dredged material through a pug mill (estimate 200 lbs. lime per cubic yard of dredged material), and truck haul and final disposal of material at SPSA landfill in Suffolk. Estimate shall include the cost of mobilizing and operating a portable pug mill at the Higgerson-Buchanan site.

G

h) Mechanically dredge contaminated material, place onto trucks, transport by truck to Higgerson-Buchanan site in Chesapeake for permanent disposal at the Higgerson-Buchanan dredged material placement site (a truck haul distance of approximately 5 miles).

H

Note: all distances stated above are one-way distances.

3. The material to be dredged is anticipated to be fine-grained clays and silts, with moderate amounts of sand. Please run each of the above-listed scenarios using the volumes stated below. Drawings depicting the locations of the areas to be dredged are attached.

a) ERM 0.4 (dredging to 3' below bottom elevation): 67,770 cubic yards (35,390 cubic yards located downstream of the railroad bridge and 32,380 cubic yards located upstream of the railroad bridge).

b) ERM 0.4 (dredging to 6' below bottom elevation): 129,680 cubic yards (67,750 cubic yards located downstream of the railroad bridge and 61,930 cubic yards located upstream of the railroad bridge).

c) ERM 0.6(dredging to 3' below bottom elevation): 30,950 cubic yards (18,390 cubic yards located downstream of the railroad bridge and 12,560 cubic yards located upstream of the railroad bridge).

d) ERM 0.6 (dredging to 6' below bottom elevation): 60,270 cubic yards (35,820 cubic yards located downstream of the railroad bridge and 24,450 cubic yards located upstream of the railroad bridge).

e) ERM 0.8 (dredging to 3' below bottom elevation): 19,850 cubic yards (11,170 cubic yards located downstream of the railroad bridge and 8,680 cubic yards located upstream of the railroad bridge).

f) ERM 0.8 (dredging to 6' below bottom elevation): 38,800 cubic yards (22,060 cubic yards located downstream of the railroad bridge and 16,740 cubic yards located upstream of the railroad bridge).

All yardages stated above include one foot of allowable overdredging and 3:1 sideslpoes. Spreadsheets containing the above information are attached.

4. Additionally, please estimate the cost of installing a 2' clean sand cap over the contaminated areas dredged for the ERM 0.4, ERM 0.6 and ERM 0.8 scenarios (three separate estimates). Estimate shall include the cost of the sand, transporting it to the site, and hydraulically placing the sand over all of the dredged contaminated areas.

5. Craig Seltzer has informed me that funds have already been set up for your earlier involvement with the Elizabeth River Environmental Restoration work. Please use the same charge number for this work. If you need additional information concerning the funds, please contact Craig directly.

6. If there are further questions concerning this work, please contact me at EXT. 7788.

Stephen Powell
Design Section

Enclosures

	Environmental Dredging Remediation											
Shallow	CY	32,380		61,930		12,560		24,450		8,680		16,740	
Deep	CY	35,390		67,750		18,390		35,820		11,170		22,060	
TOTAL	CY	67,770		129,680		30,950		60,270		19,850		38,800	
	ERM →	0.4		0.4		0.6		0.6		0.8		0.8	
DEPTH	→	3 '		6 '		3 '		6 '		3 '		6 '	
Scenario	A	$8,047,970	$118.75	15,141,620	116.76	3,819,320	123.40	7,169,610	118.96	2,553,670	128.65	4,720,660	121.67
	B	4,836,370	$71.36	9,075,440	69.98	2,305,430	74.49	4,303,816	71.41	1,551,591	78.17	2,844,822	73.32
	C	7,877,080	$116.23	14,814,600	114.24	3,739,740	120.83	7,014,630	116.39	2,503,070	126.10	4,621,580	119.11
	D	1,618,170	$23.88	2,916,770	22.49	834,480	26.96	1,438,840	23.87	608,830	30.67	1,001,330	25.81
	E	8,009,230	$118.18	15,067,180	116.19	3,817,050	123.33	7,164,710	118.88	2,548,190	128.37	4,710,930	121.42
	F	4,611,050	$68.04	8,644,490	66.66	2,217,650	71.65	4,132,930	68.57	1,491,060	75.12	2,728,030	70.31
	G	8,140,894	$120.13	15,319,650	118.13	3,876,870	125.26	7,281,740	120.82	2,586,350	130.29	4,786,070	123.35
	H	1,801,750	$26.59	3,268,820	25.21	934,660	30.20	1,634,530	27.12	668,210	33.66	$1,119,640	28.86

	SAND CAPS				
			Low Cost	$15,319,650	
0.4	ERM	$1,261,030	High Cost	$608,830	
0.6	ERM	$567,820			
0.8	ERM	$363,520			

Revised ERM 0.8 - 3' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
A	A: Barge-Craney Is,PugM,SPSA							
A _ 1	Shallow Dredge-to Craney Island	8680.00	CY	151,564	22,735	0	174,299	20.08
A _ 2	Deep end Dredging-to Craney Isla	11170	CY	278,061	41,709	0	319,770	28.63
A _ 3	Craney Offload, Haul to Pugmill	19850	CY	59,590	8,939	0	68,529	3.45
A _ 4	Pugmill treatment	19850	CY	811,782	121,767	0	933,550	47.03
A _ 5	Haul & Dispose-16 miles	19850	CY	919,585	137,938	0	1,057,522	53.28
TOTAL	A: Barge-Craney Is,PugM,SPSA	19850	CY	2,220,583	333,087	0	2,553,670	128.65
B	B: Barge-Craney Is,SPSA							
B _ 1	Shallow Dredge-to Craney Island	8680.00	CY	151,564	22,735	0	174,299	20.08
B _ 2	Deep end Dredging-to Craney Isla	11170	CY	278,061	41,709	0	319,770	28.63
B _ 5	Haul & Dispose-16 miles	19850	CY	919,585	137,938	0	1,057,522	53.28
TOTAL	B: Barge-Craney Is,SPSA	19850	CY	1,349,210	202,381	0	1,551,591	78.17
C	C: Barge-Higg-Buch,PugM,SPSA							
C _ 1	Shallow Dredge-to Higg-Buch	8680.00	CY	142,016	21,302	0	163,319	18.82
C _ 2	Deep end Dredging-to Higg-Buch	11170	CY	259,072	38,861	0	297,933	26.67
C _ 3	Hg-Buch Offload, Haul to Pugmill	19850	CY	44,120	6,618	0	50,738	2.56
C _ 4	Pugmill treatment	19850	CY	811,782	121,767	0	933,550	47.03
C _ 5	Haul & Dispose-16 miles	19850	CY	919,585	137,938	0	1,057,522	53.28
TOTAL	C: Barge-Higg-Buch,PugM,SPSA	19850	CY	2,176,575	326,486	0	2,503,062	126.10
D	D: Barge-Higg-Buch							
D _ 1	Shallow Dredge-to Higg-Buch	8680.00	CY	142,016	21,302	0	163,319	18.82
D _ 2	Deep end Dredging-to Higg-Buch	11170	CY	259,072	38,861	0	297,933	26.67
D _ 3	Hg-Buch Offload, Haul to Disposa	19850	CY	44,120	6,618	0	50,738	2.56
D _ 5	Disposal-Higg-Buch	19850	CY	84,204	12,631	0	96,834	4.88
TOTAL	D: Barge-Higg-Buch	19850	CY	529,412	79,412	0	608,824	30.67
E	E: Truck-ABEX,PugM,SPSA							
E _ 1	Shallow Dredge-Truck to ABEX	8680.00	CY	152,139	22,821	0	174,960	20.16
E _ 2	Deep End Dredge-Truck to ABEX	11170	CY	344,703	51,705	0	396,409	35.49
E _ 3	ABEX Offload, Load Pugmill	19850	CY	21,286	3,193	0	24,479	1.23
E _ 4	Pugmill treatment	19850	CY	811,782	121,767	0	933,550	47.03
E _ 5	Haul & Dispose-13 miles	19850	CY	885,903	132,885	0	1,018,789	51.32
TOTAL	E: Truck-ABEX,PugM,SPSA	19850	CY	2,215,813	332,372	0	2,548,185	128.37

Rev ERM 0.6 - 3' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
F	F: Truck-SPSA							
F _ 1	Shallow Dredge- to Truck	12560	CY	148,368	22,255	0	170,624	13.58
F _ 2	Deep end Dredging-to Truck	18390	CY	377,840	56,676	0	434,515	23.63
F _ 5	Haul & Dispose to SPSA-16 miles	30950	CY	1,402,176	210,326	0	1,612,503	52.10
TOTAL F: Truck-SPSA		30950	CY	1,928,384	289,258	0	2,217,642	71.65
G	G: Truck-Hg-Buch, PugM,SPSA							
G _ 1	Shallow Dredge-Truck to Hg-Buch	12560	CY	211,371	31,706	0	243,077	19.35
G _ 2	Deep End Dredge-Truck to Hg-Buch	18390	CY	470,087	70,513	0	540,600	29.40
G _ 3	Hg-Buch Offload, Load Pugmill	30950	CY	32,133	4,820	0	36,953	1.19
G _ 4	Pugmill treatment	30950	CY	1,223,787	183,568	0	1,407,355	45.47
G _ 5	Haul & Dispose-16 miles	30950	CY	1,433,811	215,072	0	1,648,882	53.28
TOTAL G: Truck-Hg-Buch, PugM,SPSA		30950	CY	3,371,189	505,678	0	3,876,867	125.26
H	H: Truck-Hg-Buch							
H _ 1	Shallow Dredge-to Truck	12560	CY	148,368	22,255	0	170,624	13.58
H _ 2	Deep End Dredge-to Truck	18390	CY	377,840	56,676	0	434,515	23.63
H _ 5	Haul & Dispose-@ Site	30950	CY	286,540	42,981	0	329,521	10.65
TOTAL H: Truck-Hg-Buch		30950	CY	812,748	121,912	0	934,660	30.20
TOTAL Eliz R, Skfletown Cr Envir Dredg		1.00	EA	18,734,927	2,810,239	0	21,545,166	21545166

Rev ERM 0.4 - 3' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
A	A: Barge-Craney Is,PugM,SPSA							
A _ 1	Shallow Dredge-to Craney Island	32380	CY	511,804	76,771	0	588,575	18.18
A _ 2	Deep end Dredging-to Craney Isla	35390	CY	554,169	83,125	0	637,294	18.01
A _ 3	Craney Offload, Haul to Pugmill	67770	CY	202,245	30,337	0	232,581	3.43
A _ 4	Pugmill treatment	67770	CY	2,590,453	388,568	0	2,979,021	43.96
A _ 5	Haul & Dispose-16 miles	67770	CY	3,139,559	470,934	0	3,610,493	53.28
TOTAL	A: Barge-Craney Is,PugM,SPSA	67770	CY	6,998,230	1,049,735	0	8,047,965	118.75
B	B: Barge-Craney Is,SPSA							
B _ 1	Shallow Dredge-to Craney Island	32380	CY	511,804	76,771	0	588,575	18.18
B _ 2	Deep end Dredging-to Craney Isla	35390	CY	554,169	83,125	0	637,294	18.01
B _ 5	Haul & Dispose-16 miles	67770	CY	3,139,559	470,934	0	3,610,493	53.28
TOTAL	B: Barge-Craney Is,SPSA	67770	CY	4,205,533	630,830	0	4,836,362	71.36
C	C: Barge-Higg-Buch,PugM,SPSA							
C _ 1	Shallow Dredge-to Higg-Buch	32380	CY	476,186	71,428	0	547,614	16.91
C _ 2	Deep end Dredging-to Higg-Buch	35390	CY	494,006	74,101	0	568,107	16.05
C _ 3	Hg-Buch Offload, Haul to Pugmill	67770	CY	149,427	22,414	0	171,841	2.54
C _ 4	Pugmill treatment	67770	CY	2,590,453	388,568	0	2,979,021	43.96
C _ 5	Haul & Dispose-16 miles	67770	CY	3,139,559	470,934	0	3,610,493	53.28
TOTAL	C: Barge-Higg-Buch,PugM,SPSA	67770	CY	6,849,631	1,027,445	0	7,877,076	116.23
D	D: Barge-Higg-Buch							
D _ 1	Shallow Dredge-to Higg-Buch	32380	CY	476,186	71,428	0	547,614	16.91
D _ 2	Deep end Dredging-to Higg-Buch	35390	CY	494,006	74,101	0	568,107	16.05
D _ 3	Hg-Buch Offload, Haul to Disposa	67770	CY	149,427	22,414	0	171,841	2.54
D _ 5	Disposal-Higg-Buch	67770	CY	287,480	43,122	0	330,602	4.88
TOTAL	D: Barge-Higg-Buch	67770	CY	1,407,100	211,065	0	1,618,165	23.88
E	E: Truck-ABEX,PugM,SPSA							
E _ 1	Shallow Dredge-Truck to ABEX	32380	CY	513,947	77,092	0	591,039	18.25
E _ 2	Deep End Dredge-Truck to ABEX	35390	CY	765,312	114,797	0	880,108	24.87
E _ 3	ABEX Offload, Load Pugmill	67770	CY	70,266	10,540	0	80,806	1.19
E _ 4	Pugmill treatment	67770	CY	2,590,453	388,568	0	2,979,021	43.96
E _ 5	Haul & Dispose-13 miles	67770	CY	3,024,567	453,685	0	3,478,252	51.32
TOTAL	E: Truck-ABEX,PugM,SPSA	67770	CY	6,964,544	1,044,682	0	8,009,226	118.18

Rev ERM 04 - 3' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
F	F: Truck-SPSA							
F _ 1	Shallow Dredge- to Truck	32380	CY	351,523	52,729	0	404,252	12.48
F _ 2	Deep end Dredging-to Truck	35390	CY	587,790	88,168	0	675,958	19.10
F _ 5	Haul & Dispose to SPSA-16 miles	67770	CY	3,070,290	460,544	0	3,530,834	52.10
TOTAL F: Truck-SPSA		67770	CY	4,009,603	601,440	0	4,611,043	68.04
G	G: Truck-Hg-Buch, PugM,SPSA							
G _ 1	Shallow Dredge-Truck to Hg-Buch	32380	CY	513,947	77,092	0	591,039	18.25
G _ 2	Deep End Dredge-Truck to Hg-Buch	35390	CY	765,312	114,797	0	880,108	24.87
G _ 3	Hg-Buch Offload, Load Pugmill	67770	CY	69,767	10,465	0	80,233	1.18
G _ 4	Pugmill treatment	67770	CY	2,590,453	388,568	0	2,979,021	43.96
G _ 5	Haul & Dispose-16 miles	67770	CY	3,139,559	470,934	0	3,610,493	53.28
TOTAL G: Truck-Hg-Buch, PugM,SPSA		67770	CY	7,079,038	1,061,856	0	8,140,894	120.13
H	H: Truck-Hg-Buch							
H _ 1	Shallow Dredge-to Truck	32380	CY	351,523	52,729	0	404,252	12.48
H _ 2	Deep End Dredge-to Truck	35390	CY	587,790	88,168	0	675,958	19.10
H _ 5	Haul & Dispose-@ Site	67770	CY	627,426	94,114	0	721,540	10.65
TOTAL H: Truck-Hg-Buch		67770	CY	1,566,739	235,011	0	1,801,750	26.59
TOTAL Eliz R, Skfletown Cr Envir Dredg		1.00	EA	39,080,417	5,862,063	0	44,942,480	44942480

Revised ERM 0.8 6' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
A	A: Barge-Craney Is,PugM,SPSA							
A _ 1	Shallow Dredge-to Craney Island	16740	CY	274,076	41,111	0	315,188	18.83
A _ 2	Deep end Dredging-to Craney Isla	22060	CY	402,207	60,331	0	462,538	20.97
A _ 3	Craney Offload, Haul to Pugmill	38800	CY	116,003	17,400	0	133,404	3.44
A _ 4	Pugmill treatment	38800	CY	1,515,159	227,274	0	1,742,433	44.91
A _ 5	Haul & Dispose-16 miles	38800	CY	1,797,475	269,621	0	2,067,096	53.28
TOTAL	A: Barge-Craney Is,PugM,SPSA	38800	CY	4,104,921	615,738	0	4,720,659	121.67
B	B: Barge-Craney Is,SPSA							
B _ 1	Shallow Dredge-to Craney Island	16740	CY	274,076	41,111	0	315,188	18.83
B _ 2	Deep end Dredging-to Craney Isla	22060	CY	402,207	60,331	0	462,538	20.97
B _ 5	Haul & Dispose-16 miles	38800	CY	1,797,475	269,621	0	2,067,096	53.28
TOTAL	B: Barge-Craney Is,SPSA	38800	CY	2,473,759	371,064	0	2,844,822	73.32
C	C: Barge-Higg-Buch,PugM,SPSA							
C _ 1	Shallow Dredge-to Higg-Buch	16740	CY	255,662	38,349	0	294,012	17.56
C _ 2	Deep end Dredging-to Higg-Buch	22060	CY	364,705	54,706	0	419,411	19.01
C _ 3	Hg-Buch Offload, Haul to Pugmill	38800	CY	85,764	12,865	0	98,628	2.54
C _ 4	Pugmill treatment	38800	CY	1,515,159	227,274	0	1,742,433	44.91
C _ 5	Haul & Dispose-16 miles	38800	CY	1,797,475	269,621	0	2,067,096	53.28
TOTAL	C: Barge-Higg-Buch,PugM,SPSA	38800	CY	4,018,765	602,815	0	4,621,580	119.11
D	D: Barge-Higg-Buch							
D _ 1	Shallow Dredge-to Higg-Buch	16740	CY	255,662	38,349	0	294,012	17.56
D _ 2	Deep end Dredging-to Higg-Buch	22060	CY	364,705	54,706	0	419,411	19.01
D _ 3	Hg-Buch Offload, Haul to Disposa	38800	CY	85,764	12,865	0	98,628	2.54
D _ 5	Disposal-Higg-Buch	38800	CY	164,590	24,688	0	189,278	4.88
TOTAL	D: Barge-Higg-Buch	38800	CY	870,721	130,608	0	1,001,329	25.81
E	E: Truck-ABEX,PugM,SPSA							
E _ 1	Shallow Dredge-Truck to ABEX	16740	CY	275,184	41,278	0	316,462	18.90
E _ 2	Deep End Dredge-Truck to ABEX	22060	CY	533,821	80,073	0	613,894	27.83
E _ 3	ABEX Offload, Load Pugmill	38800	CY	40,655	6,098	0	46,753	1.20
E _ 4	Pugmill treatment	38800	CY	1,515,159	227,274	0	1,742,433	44.91
E _ 5	Haul & Dispose-13 miles	38800	CY	1,731,639	259,746	0	1,991,385	51.32
TOTAL	E: Truck-ABEX,PugM,SPSA	38800	CY	4,096,458	614,469	0	4,710,927	121.42

Revised GKM 0.8 - 6' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
F	F: Truck-SPSA							
F _ 1	Shallow Dredge- to Truck	16740	CY	191,213	28,682	0	219,895	13.14
F _ 2	Deep end Dredging-to Truck	22060	CY	423,164	63,475	0	486,639	22.06
F _ 5	Haul & Dispose to SPSA-16 miles	38800	CY	1,757,817	263,673	0	2,021,489	52.10
TOTAL F: Truck-SPSA		38800	CY	2,372,194	355,829	0	2,728,023	70.31
G	G: Truck-Hg-Buch, PugM,SPSA							
G _ 1	Shallow Dredge-Truck to Hg-Buch	16740	CY	275,184	41,278	0	316,462	18.90
G _ 2	Deep End Dredge-Truck to Hg-Buch	22060	CY	533,821	80,073	0	613,894	27.83
G _ 3	Hg-Buch Offload, Load Pugmill	38800	CY	40,157	6,023	0	46,180	1.19
G _ 4	Pugmill treatment	38800	CY	1,515,159	227,274	0	1,742,433	44.91
G _ 5	Haul & Dispose-16 miles	38800	CY	1,797,475	269,621	0	2,067,096	53.28
TOTAL G: Truck-Hg-Buch, PugM,SPSA		38800	CY	4,161,795	624,269	0	4,786,065	123.35
H	H: Truck-Hg-Buch							
H _ 1	Shallow Dredge-to Truck	16740	CY	191,213	28,682	0	219,895	13.14
H _ 2	Deep End Dredge-to Truck	22060	CY	423,164	63,475	0	486,639	22.06
H _ 5	Haul & Dispose-@ Site	38800	CY	359,217	53,883	0	413,099	10.65
TOTAL H: Truck-Hg-Buch		38800	CY	973,594	146,039	0	1,119,633	28.86
TOTAL Eliz R, Skfletown Cr Envir Dredg		1.00	EA	23,072,207	3,460,831	0	26,533,03826533038	

Revised ERM 0.6 - 6' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
A	A: Barge-Craney Is,PugM,SPSA							
A _ 1	Shallow Dredge-to Craney Island	24450	CY	391,268	58,690	0	449,959	18.40
A _ 2	Deep end Dredging-to Craney Isla	35820	CY	559,071	83,861	0	642,932	17.95
A _ 3	Craney Offload, Haul to Pugmill	60270	CY	179,918	26,988	0	206,905	3.43
A _ 4	Pugmill treatment	60270	CY	2,312,072	346,811	0	2,658,882	44.12
A _ 5	Haul & Dispose-16 miles	60270	CY	2,792,109	418,816	0	3,210,925	53.28
TOTAL	A: Barge-Craney Is,PugM,SPSA	60270	CY	6,234,438	935,166	0	7,169,603	118.96
B	B: Barge-Craney Is,SPSA							
B _ 1	Shallow Dredge-to Craney Island	24450	CY	391,268	58,690	0	449,959	18.40
B _ 2	Deep end Dredging-to Craney Isla	35820	CY	559,071	83,861	0	642,932	17.95
B _ 5	Haul & Dispose-16 miles	60270	CY	2,792,109	418,816	0	3,210,925	53.28
TOTAL	B: Barge-Craney Is,SPSA	60270	CY	3,742,448	561,367	0	4,303,816	71.41
C	C: Barge-Higg-Buch,PugM,SPSA							
C _ 1	Shallow Dredge-to Higg-Buch	24450	CY	364,373	54,656	0	419,029	17.14
C _ 2	Deep end Dredging-to Higg-Buch	35820	CY	498,177	74,727	0	572,904	15.99
C _ 3	Hg-Buch Offload, Haul to Pugmill	60270	CY	132,945	19,942	0	152,887	2.54
C _ 4	Pugmill treatment	60270	CY	2,312,072	346,811	0	2,658,882	44.12
C _ 5	Haul & Dispose-16 miles	60270	CY	2,792,109	418,816	0	3,210,925	53.28
TOTAL	C: Barge-Higg-Buch,PugM,SPSA	60270	CY	6,099,676	914,951	0	7,014,628	116.39
D	D: Barge-Higg-Buch							
D _ 1	Shallow Dredge-to Higg-Buch	24450	CY	364,373	54,656	0	419,029	17.14
D _ 2	Deep end Dredging-to Higg-Buch	35820	CY	498,177	74,727	0	572,904	15.99
D _ 3	Hg-Buch Offload, Haul to Disposa	60270	CY	132,945	19,942	0	152,887	2.54
D _ 5	Disposal-Higg-Buch	60270	CY	255,665	38,350	0	294,015	4.88
TOTAL	D: Barge-Higg-Buch	60270	CY	1,251,161	187,674	0	1,438,835	23.87
E	E: Truck-ABEX,PugM,SPSA							
E _ 1	Shallow Dredge-Truck to ABEX	24450	CY	392,886	58,933	0	451,819	18.48
E _ 2	Deep End Dredge-Truck to ABEX	35820	CY	772,779	115,917	0	888,696	24.81
E _ 3	ABEX Offload, Load Pugmill	60270	CY	62,600	9,390	0	71,990	1.19
E _ 4	Pugmill treatment	60270	CY	2,312,072	346,811	0	2,658,882	44.12
E _ 5	Haul & Dispose-13 miles	60270	CY	2,689,843	403,476	0	3,093,319	51.32
TOTAL	E: Truck-ABEX,PugM,SPSA	60270	CY	6,230,180	934,527	0	7,164,707	118.88

Revised ERM 0.6 - 6' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
F	F: Truck-SPSA							
F _ 1	Shallow Dredge- to Truck	24450	CY	270,241	40,536	0	310,777	12.71
F _ 2	Deep end Dredging-to Truck	35820	CY	593,100	88,965	0	682,065	19.04
F _ 5	Haul & Dispose to SPSA-16 miles	60270	CY	2,730,506	409,576	0	3,140,082	52.10
TOTAL F: Truck-SPSA		60270	CY	3,593,847	539,077	0	4,132,924	68.57
G	G: Truck-Hg-Buch, PugM,SPSA							
G _ 1	Shallow Dredge-Truck to Hg-Buch	24450	CY	392,886	58,933	0	451,819	18.48
G _ 2	Deep End Dredge-Truck to Hg-Buch	35820	CY	772,779	115,917	0	888,696	24.81
G _ 3	Hg-Buch Offload, Load Pugmill	60270	CY	62,102	9,315	0	71,417	1.18
G _ 4	Pugmill treatment	60270	CY	2,312,072	346,811	0	2,658,882	44.12
G _ 5	Haul & Dispose-16 miles	60270	CY	2,792,109	418,816	0	3,210,925	53.28
TOTAL G: Truck-Hg-Buch, PugM,SPSA		60270	CY	6,331,947	949,792	0	7,281,740	120.82
H	H: Truck-Hg-Buch							
H _ 1	Shallow Dredge-to Truck	24450	CY	270,241	40,536	0	310,777	12.71
H _ 2	Deep End Dredge-to Truck	35820	CY	593,100	88,965	0	682,065	19.04
H _ 5	Haul & Dispose-@ Site	60270	CY	557,990	83,698	0	641,688	10.65
TOTAL H: Truck-Hg-Buch		60270	CY	1,421,331	213,200	0	1,634,530	27.12
TOTAL Eliz R, Skfletown Cr Envir Dredg		1.00	EA	34,905,028	5,235,754	0	40,140,78240140782	

Revised EKM 0.4 - 6 deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
A	A: Barge-Craney Is,PugM,SPSA						
A _ 1	Shallow Dredge-to Craney Island	61930 CY	960,964	144,145	0	1,105,109	17.84
A _ 2	Deep end Dredging-to Craney Isla	67750 CY	923,073	138,461	0	1,061,534	15.67
A _ 3	Craney Offload, Haul to Pugmill	129680 CY	386,546	57,982	0	444,528	3.43
A _ 4	Pugmill treatment	129680 CY	4,888,397	733,260	0	5,621,657	43.35
A _ 5	Haul & Dispose-16 miles	129680 CY	6,007,644	901,147	0	6,908,790	53.28
TOTAL	A: Barge-Craney Is,PugM,SPSA	129680 CY	13,166,625	1,974,994	0	15,141,618	116.76
B	B: Barge-Craney Is,SPSA						
B _ 1	Shallow Dredge-to Craney Island	61930 CY	960,964	144,145	0	1,105,109	17.84
B _ 2	Deep end Dredging-to Craney Isla	67750 CY	923,073	138,461	0	1,061,534	15.67
B _ 5	Haul & Dispose-16 miles	129680 CY	6,007,644	901,147	0	6,908,790	53.28
TOTAL	B: Barge-Craney Is,SPSA	129680 CY	7,891,681	1,183,752	0	9,075,433	69.98
C	C: Barge-Higg-Buch,PugM,SPSA						
C _ 1	Shallow Dredge-to Higg-Buch	61930 CY	892,841	133,926	0	1,026,768	16.58
C _ 2	Deep end Dredging-to Higg-Buch	67750 CY	807,898	121,185	0	929,083	13.71
C _ 3	Hg-Buch Offload, Haul to Pugmill	129680 CY	285,478	42,822	0	328,299	2.53
C _ 4	Pugmill treatment	129680 CY	4,888,397	733,260	0	5,621,657	43.35
C _ 5	Haul & Dispose-16 miles	129680 CY	6,007,644	901,147	0	6,908,790	53.28
TOTAL	C: Barge-Higg-Buch,PugM,SPSA	129680 CY	12,882,258	1,932,339	0	14,814,597	114.24
D	D: Barge-Higg-Buch						
D _ 1	Shallow Dredge-to Higg-Buch	61930 CY	892,841	133,926	0	1,026,768	16.58
D _ 2	Deep end Dredging-to Higg-Buch	67750 CY	807,898	121,185	0	929,083	13.71
D _ 3	Hg-Buch Offload, Haul to Disposa	129680 CY	285,478	42,822	0	328,299	2.53
D _ 5	Disposal-Higg-Buch	129680 CY	550,103	82,515	0	632,618	4.88
TOTAL	D: Barge-Higg-Buch	129680 CY	2,536,320	380,448	0	2,916,768	22.49
E	E: Truck-ABEX,PugM,SPSA						
E _ 1	Shallow Dredge-Truck to ABEX	61930 CY	965,062	144,759	0	1,109,821	17.92
E _ 2	Deep End Dredge-Truck to ABEX	67750 CY	1,327,281	199,092	0	1,526,373	22.53
E _ 3	ABEX Offload, Load Pugmill	129680 CY	133,545	20,032	0	153,577	1.18
E _ 4	Pugmill treatment	129680 CY	4,888,397	733,260	0	5,621,657	43.35
E _ 5	Haul & Dispose-13 miles	129680 CY	5,787,603	868,140	0	6,655,743	51.32
TOTAL	E: Truck-ABEX,PugM,SPSA	129680 CY	13,101,888	1,965,283	0	15,067,171	116.19

Revised ERM 0.4 - 6' deep

** PROJECT OWNER SUMMARY - FEATURE **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
F	F: Truck-SPSA							
F _ 1	Shallow Dredge- to Truck	61930	CY	654,411	98,162	0	752,573	12.15
F _ 2	Deep end Dredging-to Truck	67750	CY	987,436	148,115	0	1,135,551	16.76
F _ 5	Haul & Dispose to SPSA-16 miles	129680	CY	5,875,095	881,264	0	6,756,360	52.10
TOTAL F:	Truck-SPSA	129680	CY	7,516,942	1,127,541	0	8,644,483	66.66
G	G: Truck-Hg-Buch, PugM,SPSA							
G _ 1	Shallow Dredge-Truck to Hg-Buch	61930	CY	965,062	144,759	0	1,109,821	17.92
G _ 2	Deep End Dredge-Truck to Hg-Buch	67750	CY	1,327,281	199,092	0	1,526,373	22.53
G _ 3	Hg-Buch Offload, Load Pugmill	129680	CY	133,047	19,957	0	153,004	1.18
G _ 4	Pugmill treatment	129680	CY	4,888,397	733,260	0	5,621,657	43.35
G _ 5	Haul & Dispose-16 miles	129680	CY	6,007,644	901,147	0	6,908,790	53.28
TOTAL G:	Truck-Hg-Buch, PugM,SPSA	129680	CY	13,321,431	1,998,215	0	15,319,645	118.13
H	H: Truck-Hg-Buch							
H _ 1	Shallow Dredge-to Truck	61930	CY	654,411	98,162	0	752,573	12.15
H _ 2	Deep End Dredge-to Truck	67750	CY	987,436	148,115	0	1,135,551	16.76
H _ 5	Haul & Dispose-@ Site	129680	CY	1,200,599	180,090	0	1,380,689	10.65
TOTAL H:	Truck-Hg-Buch	129680	CY	2,842,445	426,367	0	3,268,812	25.21
TOTAL	Eliz R, Skfletown Cr Envir Dredg	1.00	EA	73,259,590	10988939	0	84,248,52984248529	

ATTACHMENT A-2

DETAILED COST ESTIMATES – WETLAND RESTORATION

Elizabeth River Habitat
Crawford Bay
Portsmouth, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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Release 1.2

These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT OWNER SUMMARY - Contract **

	QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Crawford Bay			279,130	27,913	6,141	313,184	
TOTAL Elizabeth River Habitat	1.00	EA	279,130	27,913	6,141	313,184	313184

** PROJECT OWNER SUMMARY - Feature **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Crawford Bay						
5_ 5 Site Prep		25,664	2,566	565	28,795	
5_10 Earthwork		8,535	854	188	9,577	
5_15 Stonework		17,012	1,701	374	19,087	
5_20 Landscaping		71,178	7,118	1,566	79,861	
5_30 Borrow		156,741	15,674	3,448	175,864	
TOTAL Crawford Bay		279,130	27,913	6,141	313,184	
TOTAL Elizabeth River Habitat	1.00 EA	279,130	27,913	6,141	313,184	313184

** PROJECT OWNER SUMMARY - Sub Feat **

		QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5	Crawford Bay						
5_ 5	Site Prep						
5_ 5. 5	Mobilization/dredge/clam shell		12,832	1,283	282	14,398	
5_ 5.30	Demobilization		12,832	1,283	282	14,398	
	TOTAL Site Prep		25,664	2,566	565	28,795	
5_10	Earthwork						
5_10. 5	Excavation/clam shell	929.00 CY	8,535	854	188	9,577	10.31
	TOTAL Earthwork		8,535	854	188	9,577	
5_15	Stonework						
5_15. 5	Place geotextile	1039.00 SY	4,733	473	104	5,310	5.11
5_15.10	Place VDOT Class III stone	426.00 TON	10,960	1,096	241	12,297	28.87
5_15.15	Place riprap	72.00 TON	1,318	132	29	1,479	20.55
	TOTAL Stonework		17,012	1,701	374	19,087	
5_20	Landscaping						
5_20. 5	Topsoil	819.00 CY	23,278	2,328	512	26,118	31.89
5_20.10	Planting	9823.00 SY	25,210	2,521	555	28,285	2.88
5_20.15	Plants-Spartina Alt	28440 EA	16,422	1,642	361	18,426	0.65
5_20.20	Plants-Spartina Pat	10853 EA	6,267	627	138	7,032	0.65
	TOTAL Landscaping		71,178	7,118	1,566	79,861	
5_30	Borrow						
5_30. 5	Select fill	8463.00 CY	153,666	15,367	3,381	172,413	20.37
5_30.10	Excavated material	929.00 CY	3,076	308	68	3,451	3.71
	TOTAL Borrow		156,741	15,674	3,448	175,864	
	TOTAL Crawford Bay		279,130	27,913	6,141	313,184	
	TOTAL Elizabeth River Habitat	1.00 EA	279,130	27,913	6,141	313,184	313184

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Crawford Bay		217,526	10,876	22,840	25,124	2,764	279,130	
Elizabeth River Habitat	1.00 EA	217,526	10,876	22,840	25,124	2,764	279,130	279130
Contingency							27,913	
SUBTOTAL							307,043	
Escalation							6,141	
TOTAL INCL OWNER COSTS							313,184	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Crawford Bay								
5_ 5 Site Prep		20,000	1,000	2,100	2,310	254	25,664	
5_10 Earthwork		6,652	333	698	768	85	8,535	
5_15 Stonework		13,257	663	1,392	1,531	168	17,012	
5_20 Landscaping		55,469	2,773	5,824	6,407	705	71,178	
5_30 Borrow		122,148	6,107	12,826	14,108	1,552	156,741	
TOTAL Crawford Bay		217,526	10,876	22,840	25,124	2,764	279,130	
TOTAL Elizabeth River Habitat	1.00 EA	217,526	10,876	22,840	25,124	2,764	279,130	279130
Contingency							27,913	
SUBTOTAL							307,043	
Escalation							6,141	
TOTAL INCL OWNER COSTS							313,184	

Elizabeth River Habitat
Carolanne Farms
VA Beach, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT OWNER SUMMARY - Contract **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Carolanne Farms		198,905	19,890	4,376	223,171	
TOTAL Elizabeth River Habitat	1.00 EA	198,905	19,890	4,376	223,171	223171

** PROJECT OWNER SUMMARY - Sub Feat **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5	Carolanne Farms							
5_ 5	Site Prep							
5_ 5. 5	Mobilization			1,283	128	28	1,440	
5_ 5.10	Brush clearing	1.00	AC	4,876	488	107	5,471	5471.07
5_ 5.15	Timber matting	133.00	SY	5,120	512	113	5,745	43.19
5_ 5.20	Stone, 6"	200.00	SY	1,843	184	41	2,067	10.34
5_ 5.25	Erosion control	450.00	LF	393	39	9	441	0.98
5_ 5.30	Demob			1,283	128	28	1,440	
	TOTAL Site Prep			14,798	1,480	326	16,603	
5_10	Earthwork							
5_10. 5	Excavation	9248.00	CY	17,326	1,733	381	19,440	2.10
5_10.10	Hauling	8680.00	CY	34,974	3,497	769	39,241	4.52
5_10.15	Disposal of excavated material	8680.00	CY	66,829	6,683	1,470	74,982	8.64
	TOTAL Earthwork			119,129	11,913	2,621	133,663	
5_15	Borrow							
5_20	Landscaping							
5_20. 5	Topsoil	972.00	CY	27,989	2,799	616	31,403	32.31
5_20.10	Planting	9545.00	SY	24,496	2,450	539	27,485	2.88
5_20.15	Plants-Spartina Alt	15737	EA	9,087	909	200	10,196	0.65
5_20.20	Plants-Spartina Pat	3407.00	EA	1,967	197	43	2,207	0.65
5_20.25	Plants-Saltbush	249.00	EA	1,438	144	32	1,613	6.48
	TOTAL Landscaping			64,978	6,498	1,430	72,905	
	TOTAL Carolanne Farms			198,905	19,890	4,376	223,171	
	TOTAL Elizabeth River Habitat	1.00	EA	198,905	19,890	4,376	223,171	223171

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Carolanne Farms		155,006	7,750	16,276	17,903	1,969	198,905	
Elizabeth River Habitat	1.00 EA	155,006	7,750	16,276	17,903	1,969	198,905	198905
Contingency							19,890	
SUBTOTAL							218,795	
Escalation							4,376	
TOTAL INCL OWNER COSTS							223,171	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Carolanne Farms								
5_ 5 Site Prep		11,532	577	1,211	1,332	147	14,798	
5_10 Earthwork		92,837	4,642	9,748	10,723	1,179	119,129	
5_20 Landscaping		50,637	2,532	5,317	5,849	643	64,978	
TOTAL Carolanne Farms		155,006	7,750	16,276	17,903	1,969	198,905	
TOTAL Elizabeth River Habitat	1.00 EA	155,006	7,750	16,276	17,903	1,969	198,905	198905
Contingency							19,890	
SUBTOTAL							218,795	
Escalation							4,376	
TOTAL INCL OWNER COSTS							223,171	

** PROJECT INDIRECT SUMMARY - Sub Feat **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Carolanne Farms								
5_ 5 Site Prep								
5_ 5. 5 Mobilization		1,000	50	105	116	13	1,283	
5_ 5.10 Brush clearing	1.00 AC	3,800	190	399	439	48	4,876	4876.18
5_ 5.15 Timber matting	133.00 SY	3,990	200	419	461	51	5,120	38.50
5_ 5.20 Stone, 6"	200.00 SY	1,436	72	151	166	18	1,843	9.21
5_ 5.25 Erosion control	450.00 LF	306	15	32	35	4	393	0.87
5_ 5.30 Demob		1,000	50	105	116	13	1,283	
TOTAL Site Prep		11,532	577	1,211	1,332	147	14,798	
5_10 Earthwork								
5_10. 5 Excavation	9248.00 CY	13,502	675	1,418	1,559	172	17,326	1.87
5_10.10 Hauling	8680.00 CY	27,255	1,363	2,862	3,148	346	34,974	4.03
5_10.15 Disposal of excavated material	8680.00 CY	52,080	2,604	5,468	6,015	662	66,829	7.70
TOTAL Earthwork		92,837	4,642	9,748	10,723	1,179	119,129	
5_15 Borrow								
5_20 Landscaping								
5_20. 5 Topsoil	972.00 CY	21,812	1,091	2,290	2,519	277	27,989	28.80
5_20.10 Planting	9545.00 SY	19,090	955	2,004	2,205	243	24,496	2.57
5_20.15 Plants-Spartina Alt	15737 EA	7,082	354	744	818	90	9,087	0.58
5_20.20 Plants-Spartina Pat	3407.00 EA	1,533	77	161	177	19	1,967	0.58
5_20.25 Plants-Saltbush	249.00 EA	1,121	56	118	129	14	1,438	5.77
TOTAL Landscaping		50,637	2,532	5,317	5,849	643	64,978	
TOTAL Carolanne Farms		155,006	7,750	16,276	17,903	1,969	198,905	
TOTAL Elizabeth River Habitat	1.00 EA	155,006	7,750	16,276	17,903	1,969	198,905	198905
Contingency							19,890	
SUBTOTAL							218,795	
Escalation							4,376	
TOTAL INCL OWNER COSTS							223,171	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Carolanne Farms								
5_ 5 Site Prep		0	2,588	4,231	2,714	2,000	11,532	
5_10 Earthwork		0	21,076	19,682	0	52,080	92,837	
5_20 Landscaping		0	19,916	14,434	16,287	0	50,637	
TOTAL Carolanne Farms		0	43,579	38,347	19,000	54,080	155,006	
TOTAL Elizabeth River Habitat	1.00 EA	0	43,579	38,347	19,000	54,080	155,006	155006
Prime Contractor's Field Overhead							7,750	
SUBTOTAL							162,757	
Prime's Home Office Expense							16,276	
SUBTOTAL							179,032	
Prime Contractor's Profit							17,903	
SUBTOTAL							196,935	
Prime Contractor's Bond							1,969	
TOTAL INCL INDIRECTS							198,905	
Contingency							19,890	
SUBTOTAL							218,795	
Escalation							4,376	
TOTAL INCL OWNER COSTS							223,171	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Carolanne Farms									
5_ 5 Site Prep									
5_ 5. 5 Mobilization			0	0	0	0	1,000	1,000	
5_ 5.10 Brush clearing	1.00	AC	0	1,025	2,775	0	0	3,800	3800.00
5_ 5.15 Timber matting	133.00	SY	0	1,330	1,330	1,330	0	3,990	30.00
5_ 5.20 Stone, 6"	200.00	SY	0	66	126	1,244	0	1,436	7.18
5_ 5.25 Erosion control	450.00	LF	0	167	0	140	0	306	0.68
5_ 5.30 Demob			0	0	0	0	1,000	1,000	
TOTAL Site Prep			0	2,588	4,231	2,714	2,000	11,532	
5_10 Earthwork									
5_10. 5 Excavation	9248.00	CY	0	9,618	3,884	0	0	13,502	1.46
5_10.10 Hauling	8680.00	CY	0	11,458	15,798	0	0	27,255	3.14
5_10.15 Disposal of excavated material	8680.00	CY	0	0	0	0	52,080	52,080	6.00
TOTAL Earthwork			0	21,076	19,682	0	52,080	92,837	
5_15 Borrow									
5_20 Landscaping									
5_20. 5 Topsoil	972.00	CY	0	826	14,434	6,551	0	21,812	22.44
5_20.10 Planting	9545.00	SY	0	19,090	0	0	0	19,090	2.00
5_20.15 Plants-Spartina Alt	15737	EA	0	0	0	7,082	0	7,082	0.45
5_20.20 Plants-Spartina Pat	3407.00	EA	0	0	0	1,533	0	1,533	0.45
5_20.25 Plants-Saltbush	249.00	EA	0	0	0	1,121	0	1,121	4.50
TOTAL Landscaping			0	19,916	14,434	16,287	0	50,637	
TOTAL Carolanne Farms			0	43,579	38,347	19,000	54,080	155,006	
TOTAL Elizabeth River Habitat	1.00	EA	0	43,579	38,347	19,000	54,080	155,006	155006
Prime Contractor's Field Overhead								7,750	
SUBTOTAL								162,757	
Prime's Home Office Expense								16,276	
SUBTOTAL								179,032	
Prime Contractor's Profit								17,903	
SUBTOTAL								196,935	
Prime Contractor's Bond								1,969	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
TOTAL INCL INDIRECTS								198,905	
Contingency								19,890	
SUBTOTAL								218,795	
Escalation								4,376	
TOTAL INCL OWNER COSTS								223,171	

ODU Drainage Canal Wetland Rest
ODU Drainage Canal
Elizabeth River Envoronmental
Restoration

Designed By:
Estimated By: Norfolk District - Norman Malbon

Prepared By: Norfolk District- Norman Malbon

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00

Sales Tax: 4.5%

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Executive Summary:

Elizabeth River Project, Wetland Restoration Site, ODU Drainage Canal, Norfolk, Va.

Project includes the following:

-wetlands plants
-Breakwater Sill
-Rock-Wier

Assume general contractor is performing all work

Contingency: 10%
Escalation: 1.5%

SUMMARY REPORTS SUMMARY PAGE

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No Backup Reports...

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No errors detected...

* * * END OF ERROR REPORT * * *

** PROJECT OWNER SUMMARY - Scope **

	QUANTITY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST	NOTES
B_ Sitework	1.00	EA	138,236	2,074	14,031	0	154,341	154340.79	
ODU Drainage Canal Wetland Rest	1.00	EA	138,236	2,074	14,031	0	154,341	154340.79	

	QUANTITY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST	NOTES
B_ Sitework									
B_. 5 Site Preparation	1.00	EA	10,306	155	1,046	0	11,507	11507.08	
B_.10 Stonework	1.00	EA	65,231	978	6,621	0	72,830	72829.99	
B_.15 Landscaping	1.00	EA	13,241	199	1,344	0	14,784	14783.94	
B_.20 Earthwork	1.00	EA	49,458	742	5,020	0	55,220	55219.78	
TOTAL Sitework	1.00	EA	138,236	2,074	14,031	0	154,341	154340.79	
TOTAL ODU Drainage Canal Wetland R	1.00	EA	138,236	2,074	14,031	0	154,341	154340.79	

** PROJECT INDIRECT SUMMARY - Scope **

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
B_ Sitework	1.00	EA	107,727	10,773	5,925	12,443	1,369	138,236	138236.27
ODU Drainage Canal Wetland	1.00	EA	107,727	10,773	5,925	12,443	1,369	138,236	138236.27
Escalation								2,074	
SUBTOTAL								140,310	
Contingency								14,031	
TOTAL INCL OWNER COSTS								154,341	

** PROJECT INDIRECT SUMMARY - Facility **

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
B_ Sitework									
B_. 5 Site Preparation	1.00	EA	8,032	803	442	928	102	10,306	10306.38
B_.10 Stonework	1.00	EA	50,834	5,083	2,796	5,871	646	65,231	65230.63
B_.15 Landscaping	1.00	EA	10,319	1,032	568	1,192	131	13,241	13241.33
B_.20 Earthwork	1.00	EA	38,543	3,854	2,120	4,452	490	49,458	49457.93
TOTAL Sitework	1.00	EA	107,727	10,773	5,925	12,443	1,369	138,236	138236.27
TOTAL ODU Drainage Canal Wetla	1.00	EA	107,727	10,773	5,925	12,443	1,369	138,236	138236.27
Escalation								2,074	
SUBTOTAL								140,310	
Contingency								14,031	
TOTAL INCL OWNER COSTS								154,341	

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
B_ Sitework	1.00 EA	53	17,538	10,937	67,053	12,200	107,727	107727.34
TOTAL ODU Drainage Canal Wetland Rest	1.00 EA	53	17,538	10,937	67,053	12,200	107,727	107727.34
Contractor's Overhead							10,773	
SUBTOTAL							118,500	
Home Office Expense							5,925	
SUBTOTAL							124,425	
Contractor's Profit							12,443	
SUBTOTAL							136,868	
Contractor's Bond							1,369	
TOTAL INCL INDIRECTS							138,236	
Escalation							2,074	
SUBTOTAL							140,310	
Contingency							14,031	
TOTAL INCL OWNER COSTS							154,341	

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
B_ Sitework									
B_. 5 Site Preparation	1.00	EA	0	1,685	100	2,247	4,000	8,032	8031.75
B_.10 Stonework	1.00	EA	0	6,203	5,799	33,132	5,700	50,834	50834.14
B_.15 Landscaping	1.00	EA	0	4,770	0	5,549	0	10,319	10318.95
B_.20 Earthwork	1.00	EA	53	4,880	5,038	26,125	2,500	38,543	38542.50
TOTAL Sitework	1.00	EA	53	17,538	10,937	67,053	12,200	107,727	107727.34
TOTAL ODU Drainage Canal Wetland Rest	1.00	EA	53	17,538	10,937	67,053	12,200	107,727	107727.34
Contractor's Overhead								10,773	
SUBTOTAL								118,500	
Home Office Expense								5,925	
SUBTOTAL								124,425	
Contractor's Profit								12,443	
SUBTOTAL								136,868	
Contractor's Bond								1,369	
TOTAL INCL INDIRECTS								138,236	
Escalation								2,074	
SUBTOTAL								140,310	
Contingency								14,031	
TOTAL INCL OWNER COSTS								154,341	

	QUANTITY UOM	** ESC COST ** UNIT	TOTAL
A_ Structures			
A_.06 Gazebo			
A_.06.00 <<< Not Identified >>>	1.00 EA		0
A_.06 Gazebo	1.00 LS		0
A_.07 Long timber Bridge			
A_.07.00 <<< Not Identified >>>	1.00 EA		0
A_.07 Long timber Bridge	1.00 LS		0
A_.08 Short timber bridge			
A_.08.00 <<< Not Identified >>>	1.00 EA		0
A_.08 Short timber bridge	1.00 LS		0
A_.11 Foot Bridge			
A_.11.00 <<< Not Identified >>>	1.00 EA		0
A_.11 Foot Bridge	1.00 LS		0
A_.16 Bench			
A_.16.00 <<< Not Identified >>>	1.00 EA		0
A_.16 Bench	1.00 LS		0
A_.21 Boat Launch			
A_.21.00 <<< Not Identified >>>	1.00 EA		0
A_.21 Boat Launch	1.00 LS		0
A_ Structures	1.00 EA		0
B_ Sitework			
B_. 5 Site Preparation			
B_. 5.00 <<< Not Identified >>>	1.00 EA	10460.98	10,461
B_. 5 Site Preparation	1.00 EA	10460.98	10,461
B_.10 Earthwork			
B_.10.00 <<< Not Identified >>>	1.00 EA	66209.09	66,209
B_.10 Earthwork	1.00 EA	66209.09	66,209
B_.15 Landscaping			
B_.15.00 <<< Not Identified >>>	1.00 EA	13439.95	13,440
B_.15 Landscaping	1.00 EA	13439.95	13,440

	QUANTITY UOM	** ESC COST ** UNIT	TOTAL
B_.20 Storm Drainage			
B_.20.00 <<< Not Identified >>>	1.00 EA	50199.80	50,200
B_.20 Storm Drainage	1.00 EA	50199.80	50,200
B_ Sitework	1.00 EA	140309.81	140,310
Eliz. River Habitat Restoration	1.00 EA	140309.81	140,310

B_. 5. Site Preparation	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
B_. Sitework							
B_. 5. Site Preparation							
USR GC < > Mobilization/Demobilization		0.00	0.00	0.00	0.00	4000.00	4000.00
	1.00 LS	0	0	0	0	4,000	4,000
USR GC < > Timber Matting		0.00	0.75	0.05	1.05	0.00	1.85
	2000.00 BF	0	1,500	100	2,090	0	3,690
USR GC < > Erosion control		0.00	0.37	0.00	0.31	0.00	0.68
	500.00 LF	0	185	0	157	0	342
TOTAL Site Preparation		0	1,685	100	2,247	4,000	8,032
B_.10. Stonework							
USR GC < > Geofabric		0.00	1.30	0.10	1.36	6.00	8.76
	950.00 SY	0	1,235	95	1,291	5,700	8,321
B MIL GC <02232 0012 > Rip Rap Breakwater sill		0.00	6.75	7.75	43.26	0.00	57.76
	680.00 CY	0	4,590	5,270	29,419	0	39,279
B AF GC <02234 0555 > Rip Rap Rock-Wier		0.00	6.75	7.75	43.26	0.00	57.76
	56.00 CY	0	378	434	2,423	0	3,235
TOTAL Stonework		0	6,203	5,799	33,132	5,700	50,834
B_.15. Landscaping							
USR GC < > Spartina Alterniflora		0.00	0.53	0.00	0.62	0.00	1.15
	9000.00 EA	0	4,770	0	5,549	0	10,319
TOTAL Landscaping		0	4,770	0	5,549	0	10,319
B_.20. Earthwork							
USR GC < > Sand fill		0.00	1.00	1.00	8.36	0.00	10.36
	3125.00 CY	0	3,125	3,125	26,125	0	32,375
USR GC < > Misc grass/rip rap repair		0.00	0.00	0.00	0.00	2500.00	2500.00
	1.00 LS	0	0	0	0	2,500	2,500
MIL GC <02215 2370 > Backfill, spread dumped fill, dozer, 12" layers		0.00	0.02	0.03	0.00	0.00	0.05
	75000 SF	53	1,755	1,913	0	0	3,668
TOTAL Earthwork		53	4,880	5,038	26,125	2,500	38,543

B_.20. Earthwork	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Sitework			53	17,538	10,937	67,053	12,200	107,727
TOTAL ODU Drainage Canal Wetland Rest			53	17,538	10,937	67,053	12,200	107,727

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
GC General Contractor											
Contractor's Overhead	S		10.00	5.00							
Home Office Expense			5.00								
Contractor's Profit	S		10.00	10.00							
Contractor's Bond			1.00								
BC Building Contractor											
Contractor's Overhead			10.00								
Home Office Expense			5.00								
Contractor's Profit			10.00								
Contractor's Bond			0.00								

Elizabeth River Habitat
Lancelot Drive
VA Beach, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/22/00
Effective Date of Pricing: 08/22/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT OWNER SUMMARY - Contract **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Lancelot Drive		1,242,463	124,246	27,334	1,394,044	
TOTAL Elizabeth River Habitat	1.00 EA	1,242,463	124,246	27,334	1,394,044	1394044

** PROJECT OWNER SUMMARY - Feature **

	QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Lancelot Drive							
5_ 5 Site Prep			217,408	21,741	4,783	243,932	
5_10 Earthwork			730,718	73,072	16,076	819,866	
5_20 Landscaping			294,336	29,434	6,475	330,245	
5_30 Borrow							
TOTAL Lancelot Drive			1,242,463	124,246	27,334	1,394,044	
TOTAL Elizabeth River Habitat	1.00	EA	1,242,463	124,246	27,334	1,394,044	1394044

** PROJECT OWNER SUMMARY - Sub Feat **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Lancelot Drive						
5_ 5 Site Prep						
5_ 5. 5 Mobilization		1,283	128	28	1,440	
5_ 5.10 Brush clearing	1.00 AC	4,876	488	107	5,471	5471.07
5_ 5.15 Timber matting	1787.00 SY	68,793	6,879	1,513	77,185	43.19
5_ 5.20 Stone, 6"	15653 SY	138,794	13,879	3,053	155,727	9.95
5_ 5.25 Erosion control	2767.00 LF	2,379	238	52	2,669	0.96
5_ 5.30 Demobilization		1,283	128	28	1,440	
TOTAL Site Prep		217,408	21,741	4,783	243,932	
5_10 Earthwork						
5_10. 5 Excavation	23859 CY	44,699	4,470	983	50,153	2.10
5_10.10 Hauling	23859 CY	581,704	58,170	12,797	652,672	27.36
5_10.15 Disposal of excavation	7008.00 CY	104,315	10,432	2,295	117,042	16.70
TOTAL Earthwork		730,718	73,072	16,076	819,866	
5_20 Landscaping						
5_20. 5 Topsoil	3505.00 CY	99,623	9,962	2,192	111,777	31.89
5_20.10 Planting	42064 SY	107,953	10,795	2,375	121,124	2.88
5_20.15 Plants-Spartina Alt	88928 EA	51,351	5,135	1,130	57,616	0.65
5_20.20 Plants-Spartina Pat	31311 EA	18,080	1,808	398	20,286	0.65
5_20.25 Plants-Saltbush	3001.00 EA	17,329	1,733	381	19,443	6.48
TOTAL Landscaping		294,336	29,434	6,475	330,245	
5_30 Borrow						
TOTAL Lancelot Drive		1,242,463	124,246	27,334	1,394,044	
TOTAL Elizabeth River Habitat	1.00 EA	1,242,463	124,246	27,334	1,394,044	1394044

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Lancelot Drive		968,250	48,412	101,666	111,833	12,302	1,242,463	
Elizabeth River Habitat	1.00 EA	968,250	48,412	101,666	111,833	12,302	1,242,463	1242463
Contingency							124,246	
SUBTOTAL							1,366,709	
Escalation							27,334	
TOTAL INCL OWNER COSTS							1,394,044	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Lancelot Drive								
5_ 5 Site Prep		169,426	8,471	17,790	19,569	2,153	217,408	
5_10 Earthwork		569,448	28,472	59,792	65,771	7,235	730,718	
5_20 Landscaping		229,376	11,469	24,084	26,493	2,914	294,336	
5_30 Borrow								
TOTAL Lancelot Drive		968,250	48,412	101,666	111,833	12,302	1,242,463	
TOTAL Elizabeth River Habitat	1.00 EA	968,250	48,412	101,666	111,833	12,302	1,242,463	1242463
Contingency							124,246	
SUBTOTAL							1,366,709	
Escalation							27,334	
TOTAL INCL OWNER COSTS							1,394,044	

** PROJECT INDIRECT SUMMARY - Sub Feat **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Lancelot Drive								
5_ 5 Site Prep								
5_ 5. 5 Mobilization		1,000	50	105	116	13	1,283	
5_ 5.10 Brush clearing	1.00 AC	3,800	190	399	439	48	4,876	4876.18
5_ 5.15 Timber matting	1787.00 SY	53,610	2,681	5,629	6,192	681	68,793	38.50
5_ 5.20 Stone, 6"	15653 SY	108,162	5,408	11,357	12,493	1,374	138,794	8.87
5_ 5.25 Erosion control	2767.00 LF	1,854	93	195	214	24	2,379	0.86
5_ 5.30 Demobilization		1,000	50	105	116	13	1,283	
TOTAL Site Prep		169,426	8,471	17,790	19,569	2,153	217,408	
5_10 Earthwork								
5_10. 5 Excavation	23859 CY	34,834	1,742	3,658	4,023	443	44,699	1.87
5_10.10 Hauling	23859 CY	453,321	22,666	47,599	52,359	5,759	581,704	24.38
5_10.15 Disposal of excavation	7008.00 CY	81,293	4,065	8,536	9,389	1,033	104,315	14.89
TOTAL Earthwork		569,448	28,472	59,792	65,771	7,235	730,718	
5_20 Landscaping								
5_20. 5 Topsoil	3505.00 CY	77,636	3,882	8,152	8,967	986	99,623	28.42
5_20.10 Planting	42064 SY	84,128	4,206	8,833	9,717	1,069	107,953	2.57
5_20.15 Plants-Spartina Alt	88928 EA	40,018	2,001	4,202	4,622	508	51,351	0.58
5_20.20 Plants-Spartina Pat	31311 EA	14,090	704	1,479	1,627	179	18,080	0.58
5_20.25 Plants-Saltbush	3001.00 EA	13,505	675	1,418	1,560	172	17,329	5.77
TOTAL Landscaping		229,376	11,469	24,084	26,493	2,914	294,336	
5_30 Borrow								
TOTAL Lancelot Drive		968,250	48,412	101,666	111,833	12,302	1,242,463	
TOTAL Elizabeth River Habitat	1.00 EA	968,250	48,412	101,666	111,833	12,302	1,242,463	1242463
Contingency							124,246	
SUBTOTAL							1,366,709	
Escalation							27,334	
TOTAL INCL OWNER COSTS							1,394,044	

** PROJECT DIRECT SUMMARY - Contract **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Lancelot Drive		0	288,510	394,393	202,055	83,293	968,250	
TOTAL Elizabeth River Habitat	1.00 EA	0	288,510	394,393	202,055	83,293	968,250	968250
Prime Contractor's Field Overhead							48,412	
SUBTOTAL							1,016,662	
Prime's Home Office Expense							101,666	
SUBTOTAL							1,118,329	
Prime Contractor's Profit							111,833	
SUBTOTAL							1,230,161	
Prime Contractor's Bond							12,302	
TOTAL INCL INDIRECTS							1,242,463	
Contingency							124,246	
SUBTOTAL							1,366,709	
Escalation							27,334	
TOTAL INCL OWNER COSTS							1,394,044	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Lancelot Drive									
5_ 5 Site Prep			0	25,084	30,506	111,835	2,000	169,426	
5_10 Earthwork			0	176,318	311,837	0	81,293	569,448	
5_20 Landscaping			0	87,107	52,049	90,219	0	229,376	
5_30 Borrow									
TOTAL Lancelot Drive			0	288,510	394,393	202,055	83,293	968,250	
TOTAL Elizabeth River Habitat	1.00	EA	0	288,510	394,393	202,055	83,293	968,250	968250
Prime Contractor's Field Overhead								48,412	
SUBTOTAL								1,016,662	
Prime's Home Office Expense								101,666	
SUBTOTAL								1,118,329	
Prime Contractor's Profit								111,833	
SUBTOTAL								1,230,161	
Prime Contractor's Bond								12,302	
TOTAL INCL INDIRECTS								1,242,463	
Contingency								124,246	
SUBTOTAL								1,366,709	
Escalation								27,334	
TOTAL INCL OWNER COSTS								1,394,044	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Lancelot Drive								
5_ 5 Site Prep								
5_ 5. 5 Mobilization		0	0	0	0	1,000	1,000	
5_ 5.10 Brush clearing	1.00 AC	0	1,025	2,775	0	0	3,800	3800.00
5_ 5.15 Timber matting	1787.00 SY	0	17,870	17,870	17,870	0	53,610	30.00
5_ 5.20 Stone, 6"	15653 SY	0	5,165	9,861	93,135	0	108,162	6.91
5_ 5.25 Erosion control	2767.00 LF	0	1,024	0	830	0	1,854	0.67
5_ 5.30 Demobilization		0	0	0	0	1,000	1,000	
TOTAL Site Prep		0	25,084	30,506	111,835	2,000	169,426	
5_10 Earthwork								
5_10. 5 Excavation	23859 CY	0	24,813	10,021	0	0	34,834	1.46
5_10.10 Hauling	23859 CY	0	151,505	301,816	0	0	453,321	19.00
5_10.15 Disposal of excavation	7008.00 CY	0	0	0	0	81,293	81,293	11.60
TOTAL Earthwork		0	176,318	311,837	0	81,293	569,448	
5_20 Landscaping								
5_20. 5 Topsoil	3505.00 CY	0	2,979	52,049	22,607	0	77,636	22.15
5_20.10 Planting	42064 SY	0	84,128	0	0	0	84,128	2.00
5_20.15 Plants-Spartina Alt	88928 EA	0	0	0	40,018	0	40,018	0.45
5_20.20 Plants-Spartina Pat	31311 EA	0	0	0	14,090	0	14,090	0.45
5_20.25 Plants-Saltbush	3001.00 EA	0	0	0	13,505	0	13,505	4.50
TOTAL Landscaping		0	87,107	52,049	90,219	0	229,376	
5_30 Borrow								
TOTAL Lancelot Drive		0	288,510	394,393	202,055	83,293	968,250	
TOTAL Elizabeth River Habitat	1.00 EA	0	288,510	394,393	202,055	83,293	968,250	968250
Prime Contractor's Field Overhead							48,412	
SUBTOTAL							1,016,662	
Prime's Home Office Expense							101,666	
SUBTOTAL							1,118,329	
Prime Contractor's Profit							111,833	
SUBTOTAL							1,230,161	
Prime Contractor's Bond							12,302	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
TOTAL INCL INDIRECTS								1,242,463	
Contingency								124,246	
SUBTOTAL								1,366,709	
Escalation								27,334	
TOTAL INCL OWNER COSTS								1,394,044	

5. Lancelot Drive

5_ 5. Site Prep	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Mobilization			0	0	0	0	1,000	1,000
TOTAL Brush clearing			0	1,025	2,775	0	0	3,800
TOTAL Timber matting			0	17,870	17,870	17,870	0	53,610
TOTAL Stone, 6"			0	5,165	9,861	93,135	0	108,162
TOTAL Erosion control			0	1,024	0	830	0	1,854
TOTAL Demobilization			0	0	0	0	1,000	1,000
TOTAL Site Prep			0	25,084	30,506	111,835	2,000	169,426

5. Lancelot Drive

5_10. Earthwork	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Excavation			0	24,813	10,021	0	0	34,834
TOTAL Hauling			0	151,505	301,816	0	0	453,321
TOTAL Disposal of excavation			0	0	0	0	81,293	81,293
TOTAL Earthwork			0	176,318	311,837	0	81,293	569,448

5. Lancelot Drive

5_20. Landscaping	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Topsoil			0	2,979	52,049	22,607	0	77,636
TOTAL Planting			0	84,128	0	0	0	84,128
TOTAL Plants-Spartina Alt			0	0	0	40,018	0	40,018
TOTAL Plants-Spartina Pat			0	0	0	14,090	0	14,090
TOTAL Plants-Saltbush			0	0	0	13,505	0	13,505
TOTAL Landscaping			0	87,107	52,049	90,219	0	229,376

5. Lancelot Drive

5_30. Borrow	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Borrow			0	0	0	0	0	0
TOTAL Lancelot Drive			0	288,510	394,393	202,055	83,293	968,250
TOTAL Elizabeth River Habitat			0	288,510	394,393	202,055	83,293	968,250

revised

Elizabeth River Habitat
Woodstock Park
VA Beach, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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Release 1.2

These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT OWNER SUMMARY - Contract **

		QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5	Woodstock Park			377,390	37,739	8,303	423,432	
TOTAL	Elizabeth River Habitat	1.00	EA	377,390	37,739	8,303	423,432	423432

** PROJECT OWNER SUMMARY - Feature **

	QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Woodstock Park							
5_ 5 Site Prep			31,326	3,133	689	35,147	
5_10 Earthwork			20,707	2,071	456	23,233	
5_20 Landscaping			77,714	7,771	1,710	87,195	
5_30 Borrow			247,643	24,764	5,448	277,856	
TOTAL Woodstock Park			377,390	37,739	8,303	423,432	
TOTAL Elizabeth River Habitat	1.00	EA	377,390	37,739	8,303	423,432	423432

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Woodstock Park		294,100	14,705	30,880	33,969	3,737	377,390	
TOTAL Elizabeth River Habitat	1.00 EA	294,100	14,705	30,880	33,969	3,737	377,390	377390
Contingency							37,739	
SUBTOTAL							415,129	
Escalation							8,303	
TOTAL INCL OWNER COSTS							423,432	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Woodstock Park								
5_ 5 Site Prep		24,412	1,221	2,563	2,820	310	31,326	
5_10 Earthwork		16,137	807	1,694	1,864	205	20,707	
5_20 Landscaping		60,563	3,028	6,359	6,995	769	77,714	
5_30 Borrow		192,988	9,649	20,264	22,290	2,452	247,643	
TOTAL Woodstock Park		294,100	14,705	30,880	33,969	3,737	377,390	
TOTAL Elizabeth River Habitat	1.00 EA	294,100	14,705	30,880	33,969	3,737	377,390	377390
Contingency							37,739	
SUBTOTAL							415,129	
Escalation							8,303	
TOTAL INCL OWNER COSTS							423,432	

** PROJECT DIRECT SUMMARY - Contract **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Woodstock Park			0	55,796	60,024	178,280	0	294,100	
TOTAL Elizabeth River Habitat	1.00	EA	0	55,796	60,024	178,280	0	294,100	294100
Prime Contractor's Field Overhead								14,705	
SUBTOTAL								308,805	
Prime's Home Office Expense								30,880	
SUBTOTAL								339,685	
Prime Contractor's Profit								33,969	
SUBTOTAL								373,654	
Prime Contractor's Bond								3,737	
TOTAL INCL INDIRECTS								377,390	
Contingency								37,739	
SUBTOTAL								415,129	
Escalation								8,303	
TOTAL INCL OWNER COSTS								423,432	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Woodstock Park									
5_ 5 Site Prep			0	9,358	14,775	279	0	24,412	
5_10 Earthwork			0	9,487	6,650	0	0	16,137	
5_20 Landscaping			0	22,193	13,261	25,109	0	60,563	
5_30 Borrow			0	14,758	25,339	152,892	0	192,988	
TOTAL Woodstock Park			0	55,796	60,024	178,280	0	294,100	
TOTAL Elizabeth River Habitat	1.00	EA	0	55,796	60,024	178,280	0	294,100	294100
Prime Contractor's Field Overhead								14,705	
SUBTOTAL								308,805	
Prime's Home Office Expense								30,880	
SUBTOTAL								339,685	
Prime Contractor's Profit								33,969	
SUBTOTAL								373,654	
Prime Contractor's Bond								3,737	
TOTAL INCL INDIRECTS								377,390	
Contingency								37,739	
SUBTOTAL								415,129	
Escalation								8,303	
TOTAL INCL OWNER COSTS								423,432	

5. Woodstock Park

5_ 5. Site Prep	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Mobilization			0	4,000	6,000	0	0	10,000
TOTAL Brush clearing			0	1,025	2,775	0	0	3,800
TOTAL Erosion control			0	333	0	279	0	612
TOTAL Demobilization			0	4,000	6,000	0	0	10,000
TOTAL Site Prep			0	9,358	14,775	279	0	24,412

5. Woodstock Park

5_10. Earthwork	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Excavation/land based			0	6,476	2,615	0	0	9,091
TOTAL Excavation/marine based			0	3,011	4,034	0	0	7,045
TOTAL Earthwork			0	9,487	6,650	0	0	16,137

5. Woodstock Park

5_20. Landscaping	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Topsoil			0	759	13,261	5,760	0	19,780
TOTAL Planting			0	21,434	0	0	0	21,434
TOTAL Plants-Spartina Alt			0	0	0	15,496	0	15,496
TOTAL Plants-Spartina Pat			0	0	0	3,466	0	3,466
TOTAL Plants-Saltbush			0	0	0	387	0	387
TOTAL Landscaping			0	22,193	13,261	25,109	0	60,563

5. Woodstock Park

5_30. Borrow	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Select fill			0	8,282	19,112	152,892	0	180,285
TOTAL Excavated material			0	6,476	6,227	0	0	12,703
TOTAL Borrow			0	14,758	25,339	152,892	0	192,988
TOTAL Woodstock Park			0	55,796	60,024	178,280	0	294,100
TOTAL Elizabeth River Habitat			0	55,796	60,024	178,280	0	294,100

Elizabeth River Habitat
Scuffeltown Creek
Chesapaeke, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/07/00
Effective Date of Pricing: 08/07/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT OWNER SUMMARY - Contract **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Scuffeltown Creek		54,905	5,491	1,208	61,604	
TOTAL Elizabeth River Habitat	1.00 EA	54,905	5,491	1,208	61,604	61604

** PROJECT OWNER SUMMARY - Feature **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Scuffeltown Creek						
5_ 5 Site Prep		13,485	1,349	297	15,130	
5_10 Earthwork		23,964	2,396	527	26,888	
5_20 Landscaping		17,456	1,746	384	19,585	
TOTAL Scuffeltown Creek		54,905	5,491	1,208	61,604	
TOTAL Elizabeth River Habitat	1.00 EA	54,905	5,491	1,208	61,604	61604

** PROJECT OWNER SUMMARY - Sub Feat **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Scuffeltown Creek						
5_ 5 Site Prep						
5_ 5. 5 Mobilization		1,283	128	28	1,440	
5_ 5.10 Brush clearing	1.00 AC	4,876	488	107	5,471	5471.07
5_ 5.15 Timber matting	112.00 SY	4,312	431	95	4,838	43.19
5_ 5.20 Stone, 6"	150.00 SY	1,382	138	30	1,551	10.34
5_ 5.25 Erosion control	400.00 LF	349	35	8	392	0.98
5_ 5.30 Demob		1,283	128	28	1,440	
TOTAL Site Prep		13,485	1,349	297	15,130	
5_10 Earthwork						
5_10. 5 Excavation	1747.00 CY	3,273	327	72	3,672	2.10
5_10.10 Hauling	1747.00 CY	7,241	724	159	8,124	4.65
5_10.15 Disposal of excavated material	1747.00 CY	13,451	1,345	296	15,092	8.64
TOTAL Earthwork		23,964	2,396	527	26,888	
5_15 Borrow						
5_20 Landscaping						
5_20. 5 Topsoil	162.00 CY	4,605	460	101	5,166	31.89
5_20.10 Planting	2960.00 SY	7,597	760	167	8,523	2.88
5_20.15 Plants-Spartina Alt	7800.00 EA	4,504	450	99	5,054	0.65
5_20.20 Plants-Spartina Pat	780.00 EA	450	45	10	505	0.65
5_20.25 Plants-Saltbush	52.00 EA	300	30	7	337	6.48
TOTAL Landscaping		17,456	1,746	384	19,585	
TOTAL Scuffeltown Creek		54,905	5,491	1,208	61,604	
TOTAL Elizabeth River Habitat	1.00 EA	54,905	5,491	1,208	61,604	61604

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Scuffeltown Creek		42,788	2,139	4,493	4,942	544	54,905	
Elizabeth River Habitat	1.00 EA	42,788	2,139	4,493	4,942	544	54,905	54905
Contingency							5,491	
SUBTOTAL							60,396	
Escalation							1,208	
TOTAL INCL OWNER COSTS							61,604	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Scuffeltown Creek								
5_ 5 Site Prep		10,509	525	1,103	1,214	134	13,485	
5_10 Earthwork		18,675	934	1,961	2,157	237	23,964	
5_20 Landscaping		13,603	680	1,428	1,571	173	17,456	
TOTAL Scuffeltown Creek		42,788	2,139	4,493	4,942	544	54,905	
TOTAL Elizabeth River Habitat	1.00 EA	42,788	2,139	4,493	4,942	544	54,905	54905
Contingency							5,491	
SUBTOTAL							60,396	
Escalation							1,208	
TOTAL INCL OWNER COSTS							61,604	

** PROJECT INDIRECT SUMMARY - Sub Feat **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Scuffeltown Creek								
5_ 5 Site Prep								
5_ 5. 5 Mobilization		1,000	50	105	116	13	1,283	
5_ 5.10 Brush clearing	1.00 AC	3,800	190	399	439	48	4,876	4876.18
5_ 5.15 Timber matting	112.00 SY	3,360	168	353	388	43	4,312	38.50
5_ 5.20 Stone, 6"	150.00 SY	1,077	54	113	124	14	1,382	9.21
5_ 5.25 Erosion control	400.00 LF	272	14	29	31	3	349	0.87
5_ 5.30 Demob		1,000	50	105	116	13	1,283	
TOTAL Site Prep		10,509	525	1,103	1,214	134	13,485	
5_10 Earthwork								
5_10. 5 Excavation	1747.00 CY	2,551	128	268	295	32	3,273	1.87
5_10.10 Hauling	1747.00 CY	5,643	282	592	652	72	7,241	4.14
5_10.15 Disposal of excavated material	1747.00 CY	10,482	524	1,101	1,211	133	13,451	7.70
TOTAL Earthwork		18,675	934	1,961	2,157	237	23,964	
5_15 Borrow								
5_20 Landscaping								
5_20. 5 Topsoil	162.00 CY	3,588	179	377	414	46	4,605	28.42
5_20.10 Planting	2960.00 SY	5,920	296	622	684	75	7,597	2.57
5_20.15 Plants-Spartina Alt	7800.00 EA	3,510	176	369	405	45	4,504	0.58
5_20.20 Plants-Spartina Pat	780.00 EA	351	18	37	41	4	450	0.58
5_20.25 Plants-Saltbush	52.00 EA	234	12	25	27	3	300	5.77
TOTAL Landscaping		13,603	680	1,428	1,571	173	17,456	
TOTAL Scuffeltown Creek		42,788	2,139	4,493	4,942	544	54,905	
TOTAL Elizabeth River Habitat	1.00 EA	42,788	2,139	4,493	4,942	544	54,905	54905
Contingency							5,491	
SUBTOTAL							60,396	
Escalation							1,208	
TOTAL INCL OWNER COSTS							61,604	

** PROJECT DIRECT SUMMARY - Contract **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Scuffeltown Creek		0	12,680	10,308	7,317	12,482	42,788	
TOTAL Elizabeth River Habitat	1.00 EA	0	12,680	10,308	7,317	12,482	42,788	42788
Prime Contractor's Field Overhead							2,139	
SUBTOTAL							44,927	
Prime's Home Office Expense							4,493	
SUBTOTAL							49,420	
Prime Contractor's Profit							4,942	
SUBTOTAL							54,362	
Prime Contractor's Bond							544	
TOTAL INCL INDIRECTS							54,905	
Contingency							5,491	
SUBTOTAL							60,396	
Escalation							1,208	
TOTAL INCL OWNER COSTS							61,604	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Scuffeltown Creek								
5_ 5 Site Prep		0	2,343	3,990	2,177	2,000	10,509	
5_10 Earthwork		0	4,280	3,913	0	10,482	18,675	
5_20 Landscaping		0	6,058	2,406	5,140	0	13,603	
TOTAL Scuffeltown Creek		0	12,680	10,308	7,317	12,482	42,788	
TOTAL Elizabeth River Habitat	1.00 EA	0	12,680	10,308	7,317	12,482	42,788	42788
Prime Contractor's Field Overhead							2,139	
SUBTOTAL							44,927	
Prime's Home Office Expense							4,493	
SUBTOTAL							49,420	
Prime Contractor's Profit							4,942	
SUBTOTAL							54,362	
Prime Contractor's Bond							544	
TOTAL INCL INDIRECTS							54,905	
Contingency							5,491	
SUBTOTAL							60,396	
Escalation							1,208	
TOTAL INCL OWNER COSTS							61,604	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Scuffeltown Creek									
5_ 5 Site Prep									
5_ 5. 5 Mobilization			0	0	0	0	1,000	1,000	
5_ 5.10 Brush clearing	1.00	AC	0	1,025	2,775	0	0	3,800	3800.00
5_ 5.15 Timber matting	112.00	SY	0	1,120	1,120	1,120	0	3,360	30.00
5_ 5.20 Stone, 6"	150.00	SY	0	50	95	933	0	1,077	7.18
5_ 5.25 Erosion control	400.00	LF	0	148	0	124	0	272	0.68
5_ 5.30 Demob			0	0	0	0	1,000	1,000	
TOTAL Site Prep			0	2,343	3,990	2,177	2,000	10,509	
5_10 Earthwork									
5_10. 5 Excavation	1747.00	CY	0	1,817	734	0	0	2,551	1.46
5_10.10 Hauling	1747.00	CY	0	2,463	3,180	0	0	5,643	3.23
5_10.15 Disposal of excavated material	1747.00	CY	0	0	0	0	10,482	10,482	6.00
TOTAL Earthwork			0	4,280	3,913	0	10,482	18,675	
5_15 Borrow									
5_20 Landscaping									
5_20. 5 Topsoil	162.00	CY	0	138	2,406	1,045	0	3,588	22.15
5_20.10 Planting	2960.00	SY	0	5,920	0	0	0	5,920	2.00
5_20.15 Plants-Spartina Alt	7800.00	EA	0	0	0	3,510	0	3,510	0.45
5_20.20 Plants-Spartina Pat	780.00	EA	0	0	0	351	0	351	0.45
5_20.25 Plants-Saltbush	52.00	EA	0	0	0	234	0	234	4.50
TOTAL Landscaping			0	6,058	2,406	5,140	0	13,603	
TOTAL Scuffeltown Creek			0	12,680	10,308	7,317	12,482	42,788	
TOTAL Elizabeth River Habitat	1.00	EA	0	12,680	10,308	7,317	12,482	42,788	42788
Prime Contractor's Field Overhead								2,139	
SUBTOTAL								44,927	
Prime's Home Office Expense								4,493	
SUBTOTAL								49,420	
Prime Contractor's Profit								4,942	
SUBTOTAL								54,362	
Prime Contractor's Bond								544	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
TOTAL INCL INDIRECTS								54,905	
Contingency								5,491	
SUBTOTAL								60,396	
Escalation								1,208	
TOTAL INCL OWNER COSTS								61,604	

Elizabeth River Habitat
Somme Avenue
Norfolk, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Somme Avenue		174,320	8,716	18,304	20,134	2,215	223,688	
Elizabeth River Habitat	1.00 EA	174,320	8,716	18,304	20,134	2,215	223,688	223688
Contingency							22,369	
SUBTOTAL							246,057	
Escalation							4,921	
TOTAL INCL OWNER COSTS							250,978	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Somme Avenue								
5_ 5 Site Prep		24,412	1,221	2,563	2,820	310	31,326	
5_10 Earthwork		74,285	3,714	7,800	8,580	944	95,323	
5_20 Landscaping		24,366	1,218	2,558	2,814	310	31,266	
5_30 Borrow		51,258	2,563	5,382	5,920	651	65,774	
TOTAL Somme Avenue		174,320	8,716	18,304	20,134	2,215	223,688	
TOTAL Elizabeth River Habitat	1.00 EA	174,320	8,716	18,304	20,134	2,215	223,688	223688
Contingency							22,369	
SUBTOTAL							246,057	
Escalation							4,921	
TOTAL INCL OWNER COSTS							250,978	

** PROJECT INDIRECT SUMMARY - Sub Feat **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Somme Avenue								
5_ 5 Site Prep		24,412	1,221	2,563	2,820	310	31,326	
TOTAL Site Prep		24,412	1,221	2,563	2,820	310	31,326	
5_10 Earthwork								
5_10. 5 Excavation	7008.00 CY	10,232	512	1,074	1,182	130	13,129	1.87
5_10.10 Hauling	7008.00 CY	22,005	1,100	2,311	2,542	280	28,237	4.03
5_10.15 Disposal of excavation	7008.00 CY	42,048	2,102	4,415	4,857	534	53,956	7.70
TOTAL Earthwork		74,285	3,714	7,800	8,580	944	95,323	
5_20 Landscaping								
5_20. 5 Topsoil	334.00 CY	7,398	370	777	854	94	9,493	28.42
5_20.10 Planting	4657.00 SY	9,314	466	978	1,076	118	11,952	2.57
5_20.15 Plants-Spartina Alt	10040 EA	4,518	226	474	522	57	5,798	0.58
5_20.20 Plants-Spartina Pat	4268.00 EA	1,921	96	202	222	24	2,465	0.58
5_20.25 Plants-Saltbush	270.00 EA	1,215	61	128	140	15	1,559	5.77
TOTAL Landscaping		24,366	1,218	2,558	2,814	310	31,266	
5_30 Borrow								
5_30. 5 Select fill	3535.00 CY	51,258	2,563	5,382	5,920	651	65,774	18.61
TOTAL Borrow		51,258	2,563	5,382	5,920	651	65,774	
TOTAL Somme Avenue		174,320	8,716	18,304	20,134	2,215	223,688	
TOTAL Elizabeth River Habitat	1.00 EA	174,320	8,716	18,304	20,134	2,215	223,688	223688
Contingency							22,369	
SUBTOTAL							246,057	
Escalation							4,921	
TOTAL INCL OWNER COSTS							250,978	

** PROJECT DIRECT SUMMARY - Contract **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Somme Avenue			0	39,030	40,735	52,507	42,048	174,320	
TOTAL Elizabeth River Habitat	1.00	EA	0	39,030	40,735	52,507	42,048	174,320	174320
Prime Contractor's Field Overhead								8,716	
SUBTOTAL								183,036	
Prime's Home Office Expense								18,304	
SUBTOTAL								201,340	
Prime Contractor's Profit								20,134	
SUBTOTAL								221,474	
Prime Contractor's Bond								2,215	
TOTAL INCL INDIRECTS								223,688	
Contingency								22,369	
SUBTOTAL								246,057	
Escalation								4,921	
TOTAL INCL OWNER COSTS								250,978	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Somme Avenue									
5_ 5 Site Prep			0	9,358	14,775	279	0	24,412	
5_10 Earthwork			0	16,539	15,698	0	42,048	74,285	
5_20 Landscaping			0	9,598	4,960	9,808	0	24,366	
5_30 Borrow			0	3,535	5,303	42,420	0	51,258	
TOTAL Somme Avenue			0	39,030	40,735	52,507	42,048	174,320	
TOTAL Elizabeth River Habitat	1.00	EA	0	39,030	40,735	52,507	42,048	174,320	174320
Prime Contractor's Field Overhead								8,716	
SUBTOTAL								183,036	
Prime's Home Office Expense								18,304	
SUBTOTAL								201,340	
Prime Contractor's Profit								20,134	
SUBTOTAL								221,474	
Prime Contractor's Bond								2,215	
TOTAL INCL INDIRECTS								223,688	
Contingency								22,369	
SUBTOTAL								246,057	
Escalation								4,921	
TOTAL INCL OWNER COSTS								250,978	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Somme Avenue								
5_ 5 Site Prep		0	9,358	14,775	279	0	24,412	
TOTAL Site Prep		0	9,358	14,775	279	0	24,412	
5_10 Earthwork								
5_10. 5 Excavation	7008.00 CY	0	7,288	2,943	0	0	10,232	1.46
5_10.10 Hauling	7008.00 CY	0	9,251	12,755	0	0	22,005	3.14
5_10.15 Disposal of excavation	7008.00 CY	0	0	0	0	42,048	42,048	6.00
TOTAL Earthwork		0	16,539	15,698	0	42,048	74,285	
5_20 Landscaping								
5_20. 5 Topsoil	334.00 CY	0	284	4,960	2,154	0	7,398	22.15
5_20.10 Planting	4657.00 SY	0	9,314	0	0	0	9,314	2.00
5_20.15 Plants-Spartina Alt	10040 EA	0	0	0	4,518	0	4,518	0.45
5_20.20 Plants-Spartina Pat	4268.00 EA	0	0	0	1,921	0	1,921	0.45
5_20.25 Plants-Saltbush	270.00 EA	0	0	0	1,215	0	1,215	4.50
TOTAL Landscaping		0	9,598	4,960	9,808	0	24,366	
5_30 Borrow								
5_30. 5 Select fill	3535.00 CY	0	3,535	5,303	42,420	0	51,258	14.50
TOTAL Borrow		0	3,535	5,303	42,420	0	51,258	
TOTAL Somme Avenue		0	39,030	40,735	52,507	42,048	174,320	
TOTAL Elizabeth River Habitat	1.00 EA	0	39,030	40,735	52,507	42,048	174,320	174320
Prime Contractor's Field Overhead							8,716	
SUBTOTAL							183,036	
Prime's Home Office Expense							18,304	
SUBTOTAL							201,340	
Prime Contractor's Profit							20,134	
SUBTOTAL							221,474	
Prime Contractor's Bond							2,215	
TOTAL INCL INDIRECTS							223,688	
Contingency							22,369	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
SUBTOTAL								246,057	
Escalation								4,921	
TOTAL INCL OWNER COSTS								250,978	

Elizabeth River Habitat
Jordan Bridge
Portsmouth, VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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These are feasibililty level cost estimates to provide budgeting for several areas along the Elizabeth River for habitat restoration.

** PROJECT OWNER SUMMARY - Feature **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Jordan Bridge						
5_ 5 Site Prep		51,328	5,133	1,129	57,590	
5_10 Earthwork		25,055	2,505	551	28,111	
5_15 Stonework		25,560	2,556	562	28,678	
5_20 Landscaping		83,309	8,331	1,833	93,473	
TOTAL Jordan Bridge		185,251	18,525	4,076	207,852	
TOTAL Elizabeth River Habitat	1.00 EA	185,251	18,525	4,076	207,852	207852

** PROJECT OWNER SUMMARY - Sub Feat **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Jordan Bridge						
5_ 5 Site Prep						
5_ 5. 5 Mobilization/dredge/clam shell		25,664	2,566	565	28,795	
5_ 5.30 Demobilization		25,664	2,566	565	28,795	
TOTAL Site Prep		51,328	5,133	1,129	57,590	
5_10 Earthwork						
5_10. 5 Fill/hydraulic dredge	2384.00 CY	25,055	2,505	551	28,111	11.79
TOTAL Earthwork		25,055	2,505	551	28,111	
5_15 Stonework						
5_15. 5 Place geotextile	2000.00 SY	9,111	911	200	10,222	5.11
5_15.10 Place VDOT Class III stone	534.00 TON	13,739	1,374	302	15,415	28.87
5_15.15 Place riprap	148.00 TON	2,710	271	60	3,041	20.55
TOTAL Stonework		25,560	2,556	562	28,678	
5_20 Landscaping						
5_20. 5 Topsoil	954.00 CY	27,471	2,747	604	30,822	32.31
5_20.10 Planting	11451 SY	29,388	2,939	647	32,973	2.88
5_20.15 Plants-Spartina Alt	41510 EA	23,970	2,397	527	26,894	0.65
5_20.20 Plants-Spartina Pat	4296.00 EA	2,481	248	55	2,783	0.65
TOTAL Landscaping		83,309	8,331	1,833	93,473	
TOTAL Jordan Bridge		185,251	18,525	4,076	207,852	
TOTAL Elizabeth River Habitat	1.00 EA	185,251	18,525	4,076	207,852	207852

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Jordan Bridge		144,366	7,218	15,158	16,674	1,834	185,251	
Elizabeth River Habitat	1.00 EA	144,366	7,218	15,158	16,674	1,834	185,251	185251
Contingency							18,525	
SUBTOTAL							203,776	
Escalation							4,076	
TOTAL INCL OWNER COSTS							207,852	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Jordan Bridge								
5_ 5 Site Prep		40,000	2,000	4,200	4,620	508	51,328	
5_10 Earthwork		19,525	976	2,050	2,255	248	25,055	
5_15 Stonework		19,919	996	2,091	2,301	253	25,560	
5_20 Landscaping		64,922	3,246	6,817	7,499	825	83,309	
TOTAL Jordan Bridge		144,366	7,218	15,158	16,674	1,834	185,251	
TOTAL Elizabeth River Habitat	1.00 EA	144,366	7,218	15,158	16,674	1,834	185,251	185251
Contingency							18,525	
SUBTOTAL							203,776	
Escalation							4,076	
TOTAL INCL OWNER COSTS							207,852	

** PROJECT INDIRECT SUMMARY - Sub Feat **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Jordan Bridge								
5_ 5 Site Prep								
5_ 5. 5 Mobilization/dredge/clam shell		20,000	1,000	2,100	2,310	254	25,664	
5_ 5.30 Demobilization		20,000	1,000	2,100	2,310	254	25,664	
TOTAL Site Prep		40,000	2,000	4,200	4,620	508	51,328	
5_10 Earthwork								
5_10. 5 Fill/hydraulic dredge	2384.00 CY	19,525	976	2,050	2,255	248	25,055	10.51
TOTAL Earthwork		19,525	976	2,050	2,255	248	25,055	
5_15 Stonework								
5_15. 5 Place geotextile	2000.00 SY	7,100	355	746	820	90	9,111	4.56
5_15.10 Place VDOT Class III stone	534.00 TON	10,707	535	1,124	1,237	136	13,739	25.73
5_15.15 Place riprap	148.00 TON	2,112	106	222	244	27	2,710	18.31
TOTAL Stonework		19,919	996	2,091	2,301	253	25,560	
5_20 Landscaping								
5_20. 5 Topsoil	954.00 CY	21,408	1,070	2,248	2,473	272	27,471	28.80
5_20.10 Planting	11451 SY	22,902	1,145	2,405	2,645	291	29,388	2.57
5_20.15 Plants-Spartina Alt	41510 EA	18,680	934	1,961	2,157	237	23,970	0.58
5_20.20 Plants-Spartina Pat	4296.00 EA	1,933	97	203	223	25	2,481	0.58
TOTAL Landscaping		64,922	3,246	6,817	7,499	825	83,309	
TOTAL Jordan Bridge		144,366	7,218	15,158	16,674	1,834	185,251	
TOTAL Elizabeth River Habitat	1.00 EA	144,366	7,218	15,158	16,674	1,834	185,251	185251
Contingency							18,525	
SUBTOTAL							203,776	
Escalation							4,076	
TOTAL INCL OWNER COSTS							207,852	

Elizabeth River Habitat
Sugar Hill
Portsmouth,VA

Designed By: Norfolk District, COE
Estimated By: Cost Engineering/VGS

Prepared By: AKE

Preparation Date: 08/09/00
Effective Date of Pricing: 08/09/00
Est Construction Time: 180 Days

Sales Tax: 4.5%

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** PROJECT OWNER SUMMARY - Contract **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Sugar Hill		85,501	8,550	1,881	95,932	
TOTAL Elizabeth River Habitat	1.00 EA	85,501	8,550	1,881	95,932	95932

** PROJECT OWNER SUMMARY - Feature **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Sugar Hill						
5_ 5 Site Prep		14,667	1,467	323	16,456	
5_10 Earthwork		50,900	5,090	1,120	57,110	
5_20 Landscaping		19,934	1,993	439	22,366	
TOTAL Sugar Hill		85,501	8,550	1,881	95,932	
TOTAL Elizabeth River Habitat	1.00 EA	85,501	8,550	1,881	95,932	95932

** PROJECT OWNER SUMMARY - Sub Feat **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT
5 Sugar Hill						
5_ 5 Site Prep						
5_ 5. 5 Mobilization		1,283	128	28	1,440	
5_ 5.10 Brush clearing	1.00 AC	4,876	488	107	5,471	5471.07
5_ 5.15 Timber matting	133.00 SY	5,120	512	113	5,745	43.19
5_ 5.20 Stone, 6"	200.00 SY	1,843	184	41	2,067	10.34
5_ 5.25 Erosion control	300.00 LF	262	26	6	294	0.98
5_ 5.30 Demob		1,283	128	28	1,440	
TOTAL Site Prep		14,667	1,467	323	16,456	
5_10 Earthwork						
5_10. 5 Excavation	4435.00 CY	8,309	831	183	9,323	2.10
5_10.10 Hauling	3596.00 CY	14,905	1,490	328	16,723	4.65
5_10.15 Disposal of excavated material	3596.00 CY	27,686	2,769	609	31,064	8.64
TOTAL Earthwork		50,900	5,090	1,120	57,110	
5_15 Borrow						
5_20 Landscaping						
5_20. 5 Topsoil	262.00 CY	7,544	754	166	8,465	32.31
5_20.10 Planting	3145.00 SY	8,071	807	178	9,056	2.88
5_20.15 Plants-Spartina Alt	7479.00 EA	4,319	432	95	4,846	0.65
TOTAL Landscaping		19,934	1,993	439	22,366	
TOTAL Sugar Hill		85,501	8,550	1,881	95,932	
TOTAL Elizabeth River Habitat	1.00 EA	85,501	8,550	1,881	95,932	95932

** PROJECT INDIRECT SUMMARY - Contract **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Sugar Hill		66,631	3,332	6,996	7,696	847	85,501	
Elizabeth River Habitat	1.00 EA	66,631	3,332	6,996	7,696	847	85,501	85501
Contingency							8,550	
SUBTOTAL							94,051	
Escalation							1,881	
TOTAL INCL OWNER COSTS							95,932	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Sugar Hill								
5_ 5 Site Prep		11,430	572	1,200	1,320	145	14,667	
5_10 Earthwork		39,666	1,983	4,165	4,581	504	50,900	
5_20 Landscaping		15,535	777	1,631	1,794	197	19,934	
TOTAL Sugar Hill		66,631	3,332	6,996	7,696	847	85,501	
TOTAL Elizabeth River Habitat	1.00 EA	66,631	3,332	6,996	7,696	847	85,501	85501
Contingency							8,550	
SUBTOTAL							94,051	
Escalation							1,881	
TOTAL INCL OWNER COSTS							95,932	

** PROJECT INDIRECT SUMMARY - Sub Feat **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 Sugar Hill								
5_ 5 Site Prep								
5_ 5. 5 Mobilization		1,000	50	105	116	13	1,283	
5_ 5.10 Brush clearing	1.00 AC	3,800	190	399	439	48	4,876	4876.18
5_ 5.15 Timber matting	133.00 SY	3,990	200	419	461	51	5,120	38.50
5_ 5.20 Stone, 6"	200.00 SY	1,436	72	151	166	18	1,843	9.21
5_ 5.25 Erosion control	300.00 LF	204	10	21	24	3	262	0.87
5_ 5.30 Demob		1,000	50	105	116	13	1,283	
TOTAL Site Prep		11,430	572	1,200	1,320	145	14,667	
5_10 Earthwork								
5_10. 5 Excavation	4435.00 CY	6,475	324	680	748	82	8,309	1.87
5_10.10 Hauling	3596.00 CY	11,615	581	1,220	1,342	148	14,905	4.14
5_10.15 Disposal of excavated material	3596.00 CY	21,576	1,079	2,265	2,492	274	27,686	7.70
TOTAL Earthwork		39,666	1,983	4,165	4,581	504	50,900	
5_15 Borrow								
5_20 Landscaping								
5_20. 5 Topsoil	262.00 CY	5,879	294	617	679	75	7,544	28.80
5_20.10 Planting	3145.00 SY	6,290	315	660	726	80	8,071	2.57
5_20.15 Plants-Spartina Alt	7479.00 EA	3,366	168	353	389	43	4,319	0.58
TOTAL Landscaping		15,535	777	1,631	1,794	197	19,934	
TOTAL Sugar Hill		66,631	3,332	6,996	7,696	847	85,501	
TOTAL Elizabeth River Habitat	1.00 EA	66,631	3,332	6,996	7,696	847	85,501	85501
Contingency							8,550	
SUBTOTAL							94,051	
Escalation							1,881	
TOTAL INCL OWNER COSTS							95,932	

** PROJECT DIRECT SUMMARY - Contract **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Sugar Hill		0	18,727	16,529	7,798	23,576	66,631	
TOTAL Elizabeth River Habitat	1.00 EA	0	18,727	16,529	7,798	23,576	66,631	66631
Prime Contractor's Field Overhead							3,332	
SUBTOTAL							69,963	
Prime's Home Office Expense							6,996	
SUBTOTAL							76,959	
Prime Contractor's Profit							7,696	
SUBTOTAL							84,655	
Prime Contractor's Bond							847	
TOTAL INCL INDIRECTS							85,501	
Contingency							8,550	
SUBTOTAL							94,051	
Escalation							1,881	
TOTAL INCL OWNER COSTS							95,932	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Sugar Hill									
5_ 5 Site Prep			0	2,532	4,231	2,667	2,000	11,430	
5_10 Earthwork			0	9,683	8,407	0	21,576	39,666	
5_20 Landscaping			0	6,513	3,891	5,131	0	15,535	
TOTAL Sugar Hill			0	18,727	16,529	7,798	23,576	66,631	
TOTAL Elizabeth River Habitat	1.00	EA	0	18,727	16,529	7,798	23,576	66,631	66631
Prime Contractor's Field Overhead								3,332	
SUBTOTAL								69,963	
Prime's Home Office Expense								6,996	
SUBTOTAL								76,959	
Prime Contractor's Profit								7,696	
SUBTOTAL								84,655	
Prime Contractor's Bond								847	
TOTAL INCL INDIRECTS								85,501	
Contingency								8,550	
SUBTOTAL								94,051	
Escalation								1,881	
TOTAL INCL OWNER COSTS								95,932	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 Sugar Hill								
5_ 5 Site Prep								
5_ 5. 5 Mobilization		0	0	0	0	1,000	1,000	
5_ 5.10 Brush clearing	1.00 AC	0	1,025	2,775	0	0	3,800	3800.00
5_ 5.15 Timber matting	133.00 SY	0	1,330	1,330	1,330	0	3,990	30.00
5_ 5.20 Stone, 6"	200.00 SY	0	66	126	1,244	0	1,436	7.18
5_ 5.25 Erosion control	300.00 LF	0	111	0	93	0	204	0.68
5_ 5.30 Demob		0	0	0	0	1,000	1,000	
TOTAL Site Prep		0	2,532	4,231	2,667	2,000	11,430	
5_10 Earthwork								
5_10. 5 Excavation	4435.00 CY	0	4,612	1,863	0	0	6,475	1.46
5_10.10 Hauling	3596.00 CY	0	5,070	6,545	0	0	11,615	3.23
5_10.15 Disposal of excavated material	3596.00 CY	0	0	0	0	21,576	21,576	6.00
TOTAL Earthwork		0	9,683	8,407	0	21,576	39,666	
5_15 Borrow								
5_20 Landscaping								
5_20. 5 Topsoil	262.00 CY	0	223	3,891	1,766	0	5,879	22.44
5_20.10 Planting	3145.00 SY	0	6,290	0	0	0	6,290	2.00
5_20.15 Plants-Spartina Alt	7479.00 EA	0	0	0	3,366	0	3,366	0.45
TOTAL Landscaping		0	6,513	3,891	5,131	0	15,535	
TOTAL Sugar Hill		0	18,727	16,529	7,798	23,576	66,631	
TOTAL Elizabeth River Habitat	1.00 EA	0	18,727	16,529	7,798	23,576	66,631	66631
Prime Contractor's Field Overhead							3,332	
SUBTOTAL							69,963	
Prime's Home Office Expense							6,996	
SUBTOTAL							76,959	
Prime Contractor's Profit							7,696	
SUBTOTAL							84,655	
Prime Contractor's Bond							847	
TOTAL INCL INDIRECTS							85,501	
Contingency							8,550	

** PROJECT DIRECT SUMMARY - Sub Feat **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
SUBTOTAL								94,051	
Escalation								1,881	
TOTAL INCL OWNER COSTS								95,932	

Eliz. River Habitat Restoration
Elizabeth River Habitat
Restoration, Portsmouth City
Park, Western Branch of
Elizabeth River, Portsmouth, VA

Designed By: Norfolk District- Gary Szymanski
Estimated By: Norfolk District - Norman Malbon

Prepared By: Norfolk District- Norman Malbon

Preparation Date: 08/07/00
Effective Date of Pricing: 08/07/00

Sales Tax: 4.5%

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Executive Summary:

Elizabeth River Habitat Restoration, Portsmouth City Park.

Project includes the following:

-Excavation, hauling, and disposal of material.
-Construction of foot bridge
-Construction of gazebo
-Construction of 6' wide walking trail
-sediment trap
-bench
-drainage piping
-wetlands plants
-trees, shrubs, perennials

Assume general contractor is performing all sitework
Subcontractor to construct the Gazebo, bridge, and bench.

Contingency: 10%
Escalation: 1.5%

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	QUANTITY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST	NOTES
A_ Structures	1.00	EA	81,238	1,219	8,246	0	90,702	90701.73	
B_ Sitework	1.00	EA	182,057	2,731	18,479	0	203,267	203266.59	
Eliz. River Habitat Restoration	1.00	EA	263,295	3,949	26,724	0	293,968	293968.31	

	QUANTITY UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST	NOTES
A_ Structures								
A_.06 Gazebo		28,128	422	2,855	0	31,405		
A_.11 Foot Bridge		51,186	768	5,195	0	57,149		
A_.16 Bench		1,924	29	195	0	2,148		
TOTAL Structures	1.00 EA	81,238	1,219	8,246	0	90,702	90701.73	
B_ Sitework								
B_. 5 Site Preparation	1.00 EA	17,454	262	1,772	0	19,488	19487.84	
B_.10 Earthwork	1.00 EA	105,068	1,576	10,664	0	117,309	117308.56	
B_.15 Landscaping	1.00 EA	53,798	807	5,460	0	60,065	60065.47	
B_.20 Storm Drainage	1.00 EA	5,736	86	582	0	6,405	6404.72	
TOTAL Sitework	1.00 EA	182,057	2,731	18,479	0	203,267	203266.59	
TOTAL Eliz. River Habitat Restorat	1.00 EA	263,295	3,949	26,724	0	293,968	293968.31	

** PROJECT INDIRECT SUMMARY - Scope **

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A_ Structures	1.00	EA	63,308	6,331	3,482	7,312	804	81,238	81237.55
B_ Sitework	1.00	EA	141,877	14,188	7,803	16,387	1,803	182,057	182056.95
Eliz. River Habitat Restora	1.00	EA	205,185	20,519	11,285	23,699	2,607	263,295	263294.50
Escalation								3,949	
SUBTOTAL								267,244	
Contingency								26,724	
TOTAL INCL OWNER COSTS								293,968	

	QUANTITY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A_ Structures								
A_.06 Gazebo		21,920	2,192	1,206	2,532	278	28,128	
A_.11 Foot Bridge		39,889	3,989	2,194	4,607	507	51,186	
A_.16 Bench		1,499	150	82	173	19	1,924	
TOTAL Structures	1.00 EA	63,308	6,331	3,482	7,312	804	81,238	81237.55
B_ Sitework								
B_. 5 Site Preparation	1.00 EA	13,602	1,360	748	1,571	173	17,454	17454.40
B_.10 Earthwork	1.00 EA	81,879	8,188	4,503	9,457	1,040	105,068	105068.13
B_.15 Landscaping	1.00 EA	41,925	4,192	2,306	4,842	533	53,798	53798.00
B_.20 Storm Drainage	1.00 EA	4,470	447	246	516	57	5,736	5736.43
TOTAL Sitework	1.00 EA	141,877	14,188	7,803	16,387	1,803	182,057	182056.95
TOTAL Eliz. River Habitat Rest	1.00 EA	205,185	20,519	11,285	23,699	2,607	263,295	263294.50
Escalation							3,949	
SUBTOTAL							267,244	
Contingency							26,724	
TOTAL INCL OWNER COSTS							293,968	

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
A_ Structures	1.00	EA	338	22,184	3,896	33,100	4,129	63,308	63308.32
B_ Sitework	1.00	EA	815	36,667	23,348	32,529	49,332	141,877	141876.75
TOTAL Eliz. River Habitat Restoration	1.00	EA	1,153	58,851	27,244	65,629	53,461	205,185	205185.07
Contractor's Overhead								20,519	
SUBTOTAL								225,704	
Home Office Expense								11,285	
SUBTOTAL								236,989	
Contractor's Profit								23,699	
SUBTOTAL								260,688	
Contractor's Bond								2,607	
TOTAL INCL INDIRECTS								263,295	
Escalation								3,949	
SUBTOTAL								267,244	
Contingency								26,724	
TOTAL INCL OWNER COSTS								293,968	

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
A_ Structures									
A_.06 Gazebo			0	7,687	1,016	13,217	0	21,920	
A_.11 Foot Bridge			331	14,260	2,879	18,938	3,812	39,889	
A_.16 Bench			7	237	0	945	318	1,499	
TOTAL Structures	1.00	EA	338	22,184	3,896	33,100	4,129	63,308	63308.32
B_ Sitework									
B_. 5 Site Preparation	1.00	EA	0	2,875	3,985	3,743	3,000	13,602	13602.19
B_.10 Earthwork	1.00	EA	633	18,262	17,286	0	46,332	81,879	81879.45
B_.15 Landscaping	1.00	EA	136	13,965	1,618	26,342	0	41,925	41924.71
B_.20 Storm Drainage	1.00	EA	46	1,566	460	2,444	0	4,470	4470.39
TOTAL Sitework	1.00	EA	815	36,667	23,348	32,529	49,332	141,877	141876.75
TOTAL Eliz. River Habitat Restoration	1.00	EA	1,153	58,851	27,244	65,629	53,461	205,185	205185.07
Contractor's Overhead								20,519	
SUBTOTAL								225,704	
Home Office Expense								11,285	
SUBTOTAL								236,989	
Contractor's Profit								23,699	
SUBTOTAL								260,688	
Contractor's Bond								2,607	
TOTAL INCL INDIRECTS								263,295	
Escalation								3,949	
SUBTOTAL								267,244	
Contingency								26,724	
TOTAL INCL OWNER COSTS								293,968	

A_.06. Gazebo	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
A_. Structures							
A_.06. Gazebo		** ADJUSTED **					
USR BC < > 21' Hex. Gazebo		0.00	5000.00	800.00	9196.00	0.00	14996.00
	1.00 LS	0	6,353	1,016	11,684	0	19,052
USR BC < > Base Slab		0.00	3.00	0.00	3.45	0.00	6.45
	350.00 SF	0	1,334	0	1,533	0	2,867
TOTAL Gazebo		0	7,687	1,016	13,217	0	21,920
A_.11. Foot Bridge							
B MIL BC <06110 5040 > StringersFraming, beams & girders, triple, 2" x 10"		0.03	1.00	0.00	1.05	0.00	2.04
	520.00 BF	15	661	0	690	0	1,351
B MIL BC <06110 5020 > Timber Bracing, Framing, beams & girders, triple, 2" x 8"		0.03	1.00	0.00	0.84	0.00	1.84
	336.00 BF	10	427	0	357	0	784
B MIL BC <06110 5040 > Pile Caps, 2" x 10"		0.03	1.00	0.00	1.05	0.00	2.04
	280.00 BF	8	356	0	372	0	727
MIL BC <06103 2620 > Blocking, miscellaneous, to wood construction, 2" x 4"		0.05	1.63	0.00	0.62	0.00	2.25
	1000.00 BF	47	2,076	0	783	0	2,860
L RSM BC <06114 2650 > Toe board, rubrail, and handrail, 2" x 4"		0.06	2.00	0.00	0.62	0.00	2.62
	824.00 BF	47	2,094	0	645	0	2,739
B MIL BC <06110 5000 > Bridge Decking, Framing, beams & girders, triple, 2" x 6"		0.03	1.00	0.00	0.78	0.00	1.78
	1664.00 BF	48	2,114	0	1,657	0	3,771
MIL BC <02368 1000 > Pile, wd, 12" butts, 8" pt, trtd, to 30' L, friction/end brg,ASTM B		0.10	3.69	1.83	9.72	0.00	15.24
	700.00 LF	72	3,285	1,627	8,643	0	13,555
MIL BC <02270 1000 > Rip-rap, random pieces, dumped from truck, 3/8 - 1/4 CY		0.51	14.61	4.89	22.74	0.00	42.24
	120.00 CY	62	2,227	746	3,467	0	6,440
USR BC <02368 1000 > Mobilization for driving piles		0.10	3.69	1.83	0.00	3000.00	3005.52
	1.00 LS	0	5	2	0	3,812	3,819
USR BC <02368 1000 > Concrete abutment		2.77	100.00	49.54	130.63	0.00	280.17
	6.00 CY	17	762	378	996	0	2,136
USR BC <02368 1000 > Misc bolts, washers, hardware		5.54	200.00	99.08	1045.00	0.00	1344.09
	1.00 LS	6	254	126	1,328	0	1,708
TOTAL Foot Bridge		331	14,260	2,879	18,938	3,812	39,889

A_.16. Bench		QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
A_.16. Bench									
CIV BC <02871 0710 >	Benches, permanent, stl supports, w/back wood slats, 6' long	1.00	EA	3.56 4	93.27 118	0.00 0	743.52 945	0.00 0	836.79 1,063
USR BC <02871 0710 >	Concrete Base	1.00	LS	3.56 4	93.27 118	0.00 0	0.00 0	250.00 318	343.27 436
TOTAL	Bench			7	237	0	945	318	1,499
TOTAL	Structures			338	22,184	3,896	33,100	4,129	63,308

B_.15. Landscaping		QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
MIL GC <02954 3850 >	Shrubs, 3' to 4' high, in place,			0.41	10.99	0.00	12.56	0.00	23.55
	Pampas grass	92.00	EA	38	1,011	0	1,156	0	2,167
MIL GC <02947 0100 >	General planting, local			0.38	10.49	4.51	3.92	0.00	18.92
	varieties, 12" spread, hedge plants	141.00	EA	53	1,479	636	553	0	2,668
TOTAL	Landscaping			136	13,965	1,618	26,342	0	41,925
B_.20. Storm Drainage									
USR GC <	> 12" RCP			0.00	6.28	0.49	9.95	0.00	16.72
		40.00	LF	0	251	20	398	0	669
MIL GC <02270 1000 >	Rip-rap, random pieces, dumped			0.51	14.61	4.89	22.74	0.00	42.24
	from truck, 3/8 - 1/4 CY	90.00	CY	46	1,315	440	2,047	0	3,802
TOTAL	Storm Drainage			46	1,566	460	2,444	0	4,470
TOTAL	Sitework			815	36,667	23,348	32,529	49,332	141,877
TOTAL	Eliz. River Habitat Restoration			1,153	58,851	27,244	65,629	53,461	205,185

No errors detected...

* * * END OF ERROR REPORT * * *

Eliz. River Proj, Grandy Village
Elizabeth River Project
Wetland Restoration Site
Grandy Village
Norfolk, Virginia

Designed By: Norfolk District- Gary Szymanski
Estimated By: Norfolk District - Norman Malbon

Prepared By: Norfolk District- Norman Malbon

Preparation Date: 08/07/00
Effective Date of Pricing: 01/01/00

Sales Tax: 4.5%

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Executive Summary:

Elizabeth River Project, Wetland Restoration Site, Grandy Village, Norfolk, Va

Project includes the following:

-Excavation, hauling, and disposal of material.
-Construction of foot bridge
-Construction of two gazebos
-Construction of small boat launch.
-Construction of 6' wide walking trail
-benches
-wetlands plants
-trees, shrubs, perennials

-Assume excavate and dispose of top 2' of material on entire site as it contains debris.

Assume general contractor is performing all sitework
Subcontractor to construct the Gazebos, bridge, and benches.

Contingency: 10%
Escalation: 1.5%

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	QUANTITY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST	NOTES
A_ Structures	1.00	EA	281,436	4,222	28,566	0	314,223	314222.98	
B_ Sitework	1.00	EA	498,395	7,476	50,587	0	556,458	556457.67	
Eliz. River Proj, Grandy Villag	1.00	EA	779,830	11,697	79,153	0	870,681	870680.65	

	QUANTITY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST	NOTES
A_ Structures									
A_.06 Gazebos (2)			76,564	1,148	7,771	0	85,484		
A_.07 Long timber Bridge			47,993	720	4,871	0	53,584		
A_.08 Short timber bridge			25,325	380	2,570	0	28,275		
A_.11 Pre-engineered Foot Bridge			113,388	1,701	11,509	0	126,598		
A_.16 Benches			5,509	83	559	0	6,151		
A_.21 Boat Launch			12,656	190	1,285	0	14,130		
TOTAL Structures	1.00	EA	281,436	4,222	28,566	0	314,223	314222.98	
B_ Sitework									
B_. 5 Site Preparation	1.00	EA	32,808	492	3,330	0	36,631	36630.52	
B_.10 Earthwork	1.00	EA	378,583	5,679	38,426	0	422,688	422687.54	
B_.15 Landscaping	1.00	EA	87,004	1,305	8,831	0	97,140	97139.61	
TOTAL Sitework	1.00	EA	498,395	7,476	50,587	0	556,458	556457.67	
TOTAL Eliz. River Proj, Grandy Vil	1.00	EA	779,830	11,697	79,153	0	870,681	870680.65	

** PROJECT INDIRECT SUMMARY - Scope **

	QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A_ Structures	1.00	EA	229,297	11,958	12,063	25,332	2,786	281,436	281435.72
B_ Sitework	1.00	EA	388,398	38,840	21,362	44,860	4,935	498,395	498394.69
Eliz. River Proj, Grandy Vi	1.00	EA	617,695	50,798	33,425	70,192	7,721	779,830	779830.41
Escalation								11,697	
SUBTOTAL								791,528	
Contingency								79,153	
TOTAL INCL OWNER COSTS								870,681	

** PROJECT INDIRECT SUMMARY - Facility **

	QUANTITY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A_ Structures								
A_.06 Gazebos (2)		62,508	3,125	3,282	6,891	758	76,564	
A_.07 Long timber Bridge		39,182	1,959	2,057	4,320	475	47,993	
A_.08 Short timber bridge		20,676	1,034	1,085	2,279	251	25,325	
A_.11 Pre-engineered Foot Brid		92,571	4,629	4,860	10,206	1,123	113,388	
A_.16 Benches		4,498	225	236	496	55	5,509	
A_.21 Boat Launch		9,863	986	542	1,139	125	12,656	
TOTAL Structures	1.00 EA	229,297	11,958	12,063	25,332	2,786	281,436	281435.72
B_ Sitework								
B_. 5 Site Preparation	1.00 EA	25,568	2,557	1,406	2,953	325	32,808	32808.34
B_.10 Earthwork	1.00 EA	295,029	29,503	16,227	34,076	3,748	378,583	378582.66
B_.15 Landscaping	1.00 EA	67,802	6,780	3,729	7,831	861	87,004	87003.68
TOTAL Sitework	1.00 EA	388,398	38,840	21,362	44,860	4,935	498,395	498394.69
TOTAL Eliz. River Proj, Grandy	1.00 EA	617,695	50,798	33,425	70,192	7,721	779,830	779830.41
Escalation							11,697	
SUBTOTAL							791,528	
Contingency							79,153	
TOTAL INCL OWNER COSTS							870,681	

** PROJECT DIRECT SUMMARY - Scope **

	QUANTITY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
A_ Structures	1.00 EA	1,985	56,702	21,109	139,909	11,576	229,297	229296.77
B_ Sitework	1.00 EA	2,332	87,853	65,538	83,808	151,200	388,398	388398.34
TOTAL Eliz. River Proj, Grandy Village	1.00 EA	4,317	144,555	86,647	223,717	162,776	617,695	617695.11
Contractor's Overhead							50,798	
SUBTOTAL							668,493	
Home Office Expense							33,425	
SUBTOTAL							701,918	
Contractor's Profit							70,192	
SUBTOTAL							772,109	
Contractor's Bond							7,721	
TOTAL INCL INDIRECTS							779,830	
Escalation							11,697	
SUBTOTAL							791,528	
Contingency							79,153	
TOTAL INCL OWNER COSTS							870,681	

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
A_ Structures									
A_.06 Gazebos (2)			0	17,419	2,033	43,056	0	62,508	
A_.07 Long timber Bridge			313	13,465	2,838	19,067	3,812	39,182	
A_.08 Short timber bridge			145	6,231	1,419	9,215	3,812	20,676	
A_.11 Pre-engineered Foot Bridge			149	15,726	14,794	62,050	0	92,571	
A_.16 Benches			21	711	0	2,834	953	4,498	
A_.21 Boat Launch			1,357	3,150	26	3,687	3,000	9,863	
TOTAL Structures	1.00	EA	1,985	56,702	21,109	139,909	11,576	229,297	229296.77
B_ Sitework									
B_. 5 Site Preparation	1.00	EA	0	3,425	5,035	14,108	3,000	25,568	25567.50
B_.10 Earthwork	1.00	EA	2,151	62,413	58,291	26,125	148,200	295,029	295028.98
B_.15 Landscaping	1.00	EA	181	22,015	2,212	43,575	0	67,802	67801.86
TOTAL Sitework	1.00	EA	2,332	87,853	65,538	83,808	151,200	388,398	388398.34
TOTAL Eliz. River Proj, Grandy Village	1.00	EA	4,317	144,555	86,647	223,717	162,776	617,695	617695.11
Contractor's Overhead								50,798	
SUBTOTAL								668,493	
Home Office Expense								33,425	
SUBTOTAL								701,918	
Contractor's Profit								70,192	
SUBTOTAL								772,109	
Contractor's Bond								7,721	
TOTAL INCL INDIRECTS								779,830	
Escalation								11,697	
SUBTOTAL								791,528	
Contingency								79,153	
TOTAL INCL OWNER COSTS								870,681	

	QUANTITY UOM	** ESC COST ** UNIT	TOTAL
A_ Structures			
A_.06 Gazebo			
A_.06.00 <<< Not Identified >>>	1.00 EA	77712.83	77,713
A_.06 Gazebo	1.00 LS	77712.83	77,713
A_.07 Long timber Bridge			
A_.07.00 <<< Not Identified >>>	1.00 EA	48713.14	48,713
A_.07 Long timber Bridge	1.00 LS	48713.14	48,713
A_.08 Short timber bridge			
A_.08.00 <<< Not Identified >>>	1.00 EA	25704.91	25,705
A_.08 Short timber bridge	1.00 LS	25704.91	25,705
A_.11 Foot Bridge			
A_.11.00 <<< Not Identified >>>	1.00 EA	115088.91	115,089
A_.11 Foot Bridge	1.00 LS	115088.91	115,089
A_.16 Bench			
A_.16.00 <<< Not Identified >>>	1.00 EA	5591.87	5,592
A_.16 Bench	1.00 LS	5591.87	5,592
A_.21 Boat Launch			
A_.21.00 <<< Not Identified >>>	1.00 EA	12845.59	12,846
A_.21 Boat Launch	1.00 LS	12845.59	12,846
A_ Structures	1.00 EA	285657.26	285,657
B_ Sitework			
B_. 5 Site Preparation			
B_. 5.00 <<< Not Identified >>>	1.00 EA	33300.47	33,300
B_. 5 Site Preparation	1.00 EA	33300.47	33,300
B_.10 Earthwork			
B_.10.00 <<< Not Identified >>>	1.00 EA	384261.40	384,261
B_.10 Earthwork	1.00 EA	384261.40	384,261
B_.15 Landscaping			
B_.15.00 <<< Not Identified >>>	1.00 EA	88308.74	88,309
B_.15 Landscaping	1.00 EA	88308.74	88,309

	QUANTITY UOM	** ESC COST ** UNIT	TOTAL
B_.20 Storm Drainage			
B_.20.00 <<< Not Identified >>>	1.00 EA		0
B_.20 Storm Drainage	1.00 EA		0
B_ Sitework	1.00 EA	505870.61	505,871
Eliz. River Habitat Restoration	1.00 EA	791527.87	791,528

** LABOR COST TO PRIME SUMMARY **

SRC	LABOR ID	DESCRIPTION	TYPE	*** DATABASE *** HOURS	RATE	TOTAL	*** TO PRIME *** RATE	TOTAL
MIL	B-CARPNTER	Carpenters	Laborer	227.14	34.73	7888.12	44.12	10021.86
MIL	B-CEMTFINR	Cement Finishers	Laborer	37.07	31.34	1161.70	31.34	1161.70
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	Laborer	468.32	36.51	17098.49	38.05	17820.60
MIL	B-EQOPRLT	Equip. Operators, Light	Laborer	36.87	32.59	1201.67	32.59	1201.67
MIL	B-EQOPRMED	Equip. Operators, Medium	Laborer	0.48	34.25	16.44	34.25	16.44
MIL	B-EQOPROIL	Equip. Operators, Oilers	Laborer	416.37	28.75	11972.00	29.15	12136.68
MIL	B-LABORER	Laborers, (Semi-Skilled)	Foreman	60.50	27.23	1647.46	30.98	1874.12
			Laborer	265.05	26.23	6952.84	29.27	7759.21
MIL	B-PILEDRVR	Pile Drivers	Foreman	21.17	38.16	807.94	48.48	1026.49
			Laborer	84.70	37.16	3147.06	47.21	3998.34
MIL	B-TRKDVRHV	Truck Drivers, Heavy	Laborer	1272.03	26.41	33599.42	26.41	33599.42
			Total	2889.70				90616.53

A_.06. Gazebos (2)	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
A_. Structures							
A_.06. Gazebos (2)							
USR BC < > 30' Hex. Gazebo		0.00	6000.00	800.00	15675.00	0.00	22475.00
	2.00 LS	0	15,246	2,033	39,830	0	57,109
USR BC < > Base Slab		0.00	1.90	0.00	2.82	0.00	4.72
	900.00 SF	0	2,173	0	3,226	0	5,399
TOTAL Gazebos (2)		0	17,419	2,033	43,056	0	62,508
A_.07. Long timber Bridge							
B MIL BC <06110 5040 > StringersFraming, beams &		0.03	1.00	0.00	1.05	0.00	2.04
girders, triple, 2" x 10"	480.00 BF	14	610	0	637	0	1,247
B MIL BC <06110 5020 > Timber Bracing, Framing, beams &		0.03	1.00	0.00	0.84	0.00	1.84
girders, triple, 2" x 8"	288.00 BF	8	366	0	306	0	672
B MIL BC <06110 5040 > Pile Caps, 2" x 10"		0.03	1.00	0.00	1.05	0.00	2.04
	240.00 BF	7	305	0	319	0	624
MIL BC <06103 2620 > Blocking, miscellaneous, to wood		0.05	1.63	0.00	0.62	0.00	2.25
construction, 2" x 4"	1000.00 BF	47	2,076	0	783	0	2,860
L RSM BC <06114 2650 > Toe board, rubrail, and		0.06	2.00	0.00	0.62	0.00	2.62
handrail, 2" x 4"	720.00 BF	41	1,829	0	564	0	2,393
B MIL BC <06110 5000 > Bridge Decking, Framing, beams &		0.03	1.00	0.00	0.78	0.00	1.78
girders, triple, 2" x 6"	1440.00 BF	41	1,829	0	1,434	0	3,263
MIL BC <02368 1000 > Pile, wd, 12" butts, 8" pt,		0.10	3.69	1.83	9.72	0.00	15.24
trtd, to 30' L, friction/end	600.00 LF	61	2,816	1,395	7,408	0	11,619
brg,ASTM B							
MIL BC <02270 1000 > Rip-rap, random pieces, dumped		0.51	14.61	4.89	22.74	0.00	42.24
from truck, 3/8 - 1/4 CY	120.00 CY	62	2,227	746	3,467	0	6,440
USR BC <02368 1000 > Mobilization for driving piles		0.10	3.69	1.83	0.00	3000.00	3005.52
	1.00 LS	0	5	2	0	3,812	3,819
USR BC <02368 1000 > Concrete abutment		2.77	100.00	49.54	130.63	0.00	280.17
	9.00 CY	25	1,143	566	1,494	0	3,204
USR BC <02368 1000 > Misc bolts, washers, hardware		5.54	200.00	99.08	1045.00	0.00	1344.09
	1.00 LS	6	254	126	1,328	0	1,708
USR BC <02368 1000 > Misc painting/staining deck		0.10	3.69	1.83	1045.00	0.00	1050.52
	1.00 LS	0	5	2	1,328	0	1,335

A_.07. Long timber Bridge	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
TOTAL Long timber Bridge			313	13,465	2,838	19,067	3,812	39,182
A_.08. Short timber bridge								
B MIL BC <06110 5040 > StringersFraming, beams &			0.03	1.00	0.00	1.05	0.00	2.04
girders, triple, 2" x 10"	120.00	BF	3	152	0	159	0	312
B MIL BC <06110 5020 > Timber Bracing, Framing, beams &			0.03	1.00	0.00	0.84	0.00	1.84
girders, triple, 2" x 8"	72.00	BF	2	91	0	76	0	168
B MIL BC <06110 5040 > Pile Caps, 2" x 10"			0.03	1.00	0.00	1.05	0.00	2.04
	60.00	BF	2	76	0	80	0	156
MIL BC <06103 2620 > Blocking, miscellaneous, to wood			0.05	1.63	0.00	0.62	0.00	2.25
construction, 2" x 4"	1000.00	BF	47	2,076	0	783	0	2,860
L RSM BC <06114 2650 > Toe board, rubrail, and			0.06	2.00	0.00	0.62	0.00	2.62
handrail, 2" x 4"	80.00	BF	5	203	0	63	0	266
B MIL BC <06110 5000 > Bridge Decking, Framing, beams &			0.03	1.00	0.00	0.78	0.00	1.78
girders, triple, 2" x 6"	320.00	BF	9	407	0	319	0	725
MIL BC <02368 1000 > Pile, wd, 12" butts, 8" pt,			0.10	3.69	1.83	9.72	0.00	15.24
trtd, to 30' L, friction/end	150.00	LF	15	704	349	1,852	0	2,905
brg,ASTM B								
MIL BC <02270 1000 > Rip-rap, random pieces, dumped			0.51	14.61	4.89	22.74	0.00	42.24
from truck, 3/8 - 1/4 CY	60.00	CY	31	1,114	373	1,733	0	3,220
USR BC <02368 1000 > Mobilization for driving piles			0.10	3.69	1.83	0.00	3000.00	3005.52
	1.00	LS	0	5	2	0	3,812	3,819
USR BC <02368 1000 > Concrete abutment			2.77	100.00	49.54	130.63	0.00	280.17
	9.00	CY	25	1,143	566	1,494	0	3,204
USR BC <02368 1000 > Misc bolts, washers, hardware			5.54	200.00	99.08	1045.00	0.00	1344.09
	1.00	LS	6	254	126	1,328	0	1,708
USR BC <02368 1000 > Misc painting/staining deck			0.10	3.69	1.83	1045.00	0.00	1050.52
	1.00	LS	0	5	2	1,328	0	1,335
TOTAL Short timber bridge			145	6,231	1,419	9,215	3,812	20,676

A_.11. Pre-engineered Foot Bridge		QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
A_.11. Pre-engineered Foot Bridge									
MIL BC <02270 1000 >	Rip-rap, random pieces, dumped			0.51	14.61	4.89	22.74	0.00	42.24
	from truck, 3/8 - 1/4 CY	120.00	CY	62	2,227	746	3,467	0	6,440
USR BC <02368 1000 >	Concrete abutment			3.47	125.00	61.93	130.63	0.00	317.55
		9.00	CY	31	1,429	708	1,494	0	3,631
USR BC <02368 1000 >	Pre-engineered bridge			0.00	6500.00	9500.00	43890.00	0.00	59890.00
		1.00	LS	0	8,258	12,070	55,762	0	76,090
USR BC <02368 1000 >	Misc painting/staining deck			55.94	3000.00	1000.00	1045.00	0.00	5045.00
		1.00	LS	56	3,812	1,271	1,328	0	6,410
TOTAL	Pre-engineered Foot Bridge			149	15,726	14,794	62,050	0	92,571
A_.16. Benches									
CIV BC <02871 0710 >	Benches, permanent, stl			3.56	93.27	0.00	743.52	0.00	836.79
	supports, w/back wood slats, 6' long	3.00	EA	11	355	0	2,834	0	3,189
USR BC <02871 0710 >	Concrete Base			3.56	93.27	0.00	0.00	250.00	343.27
		3.00	LS	11	355	0	0	953	1,308
TOTAL	Benches			21	711	0	2,834	953	4,498
A_.21. Boat Launch									
MIL GC <02244 0100 >	Base course, compacted to 6"			0.01	0.25	0.26	4.21	0.00	4.72
	deep, crushed 3/4" stone, large areas	100.00	SY	1	25	26	421	0	472
B MIL GC <03330 3600 >	Concrete in place,dir chute,			4.45	125.00	0.00	130.63	0.00	255.62
	500psi, incl forms,reinf, flexural on grade	25.00	CY	111	3,125	0	3,266	0	6,391
USR GC <03330 3600 >	Earthwork excavation			4.45	0.00	0.00	0.00	20.00	20.00
		20.00	CY	89	0	0	0	400	400
USR GC <03330 3600 >	Articulated (Cable) Block Slab			4.45	0.00	0.00	0.00	10.00	10.00
		260.00	SF	1,157	0	0	0	2,600	2,600
TOTAL	Boat Launch			1,357	3,150	26	3,687	3,000	9,863
TOTAL	Structures			1,985	56,702	21,109	139,909	11,576	229,297

B_. 5. Site Preparation	QUANTY UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
B_. Sitework							
B_. 5. Site Preparation							
USR GC < > Mobilization		0.00	0.00	0.00	0.00	1500.00	1500.00
	1.00 LS	0	0	0	0	1,500	1,500
USR GC < > Brush clearing		0.00	1025.00	2775.00	0.00	0.00	3800.00
	1.00 AC	0	1,025	2,775	0	0	3,800
USR GC < > Timber Matting		0.00	10.00	10.00	10.45	0.00	30.45
	100.00 SY	0	1,000	1,000	1,045	0	3,045
USR GC < > Stone 6" deep		0.00	0.33	0.63	6.22	0.00	7.18
	2000.00 SY	0	660	1,260	12,436	0	14,356
USR GC < > Erosion control		0.00	0.37	0.00	0.31	0.00	0.68
	2000.00 LF	0	740	0	627	0	1,367
USR GC < > Demobilization		0.00	0.00	0.00	0.00	1500.00	1500.00
	1.00 LS	0	0	0	0	1,500	1,500
TOTAL Site Preparation		0	3,425	5,035	14,108	3,000	25,568
B_.10. Earthwork							
USR GC < > Disposal of Excavation		0.00	0.00	0.00	0.00	6.00	6.00
	24700 CY	0	0	0	0	148,200	148,200
MIL GC <02232 0012 > Excavate & load, hydr excavator, 3/4 CY, light matl		0.03	1.04	0.42	0.00	0.00	1.46
	24700 CY	790	25,792	10,327	0	0	36,119
AF GC <02234 0555 > Hauling, hwy haulers, 12 CY, 12 mile round trip @ base wide rate		0.05	1.32	1.82	0.00	0.00	3.14
	24700 CY	1,235	32,621	44,964	0	0	77,585
B MIL GC <02215 2370 > Spread Topsoil		0.01	0.20	0.15	1.31	0.00	1.66
	20000 SY	126	4,000	3,000	26,125	0	33,125
TOTAL Earthwork		2,151	62,413	58,291	26,125	148,200	295,029
B_.15. Landscaping							
USR GC < > Topsoil		0.00	0.85	14.85	6.74	0.00	22.44
	30.00 CY	0	26	446	202	0	673
USR GC < > Wetlands Grasses		0.00	1.70	0.00	3.66	0.00	5.36
	10000 SY	0	17,000	0	36,575	0	53,575

B_.15. Landscaping		QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
RSM GC <02957 0800 >	Trees, deciduous, in beds, B&B,			1.60	44.59	19.16	88.82	0.00	152.57
	Elm, 8'-10'	59.00	EA	94	2,631	1,130	5,241	0	9,002
MIL GC <02954 3850 >	Shrubs, 3' to 4' high, in place,			0.41	10.99	0.00	12.56	0.00	23.55
		80.00	EA	33	879	0	1,005	0	1,884
MIL GC <02947 0100 >	General planting, local			0.38	10.49	4.51	3.92	0.00	18.92
	varieties, 12" spread, hedge plants	141.00	EA	53	1,479	636	553	0	2,668
TOTAL	Landscaping			181	22,015	2,212	43,575	0	67,802
TOTAL	Sitework			2,332	87,853	65,538	83,808	151,200	388,398
TOTAL	Eliz. River Proj, Grandy Village			4,317	144,555	86,647	223,717	162,776	617,695

** PROJECT SETTINGS **

ESTIMATE TYPE : A-Crews with Auto Reprice

SALES TAX : 4.5%

DATE OF ESCALATION SCHEDULE : 08/07/00

PROJECT DIRECT COST COLUMNS

Col Type	H	L	E	M	U
Rep Width	8	9	9	9	8
Title	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER

PROJECT INDIRECT COST COLUMNS

Col Type	O	U	P	B	X
Rep Width	12	12	12	12	0
Title	OVERHEAD	HOME OFC	PROFIT	BOND	(Unused)

PROJECT OWNER COST COLUMNS

Col Type	E	C	U	X	X
Rep Width	12	12	12	0	0
Title	ESCALATN	CONTINGN	SIOH	(Unused)	(Unused)

PROJECT BREAKDOWN

PROJECT ID	Length	Trail Sep	Level Title	2nd View Order
Level 1 ID :	2	.	Scope	1
Level 2 ID :	2	.	Facility	2
Level 3 ID :	2	.	System	3
Level 4 ID :	2	.	SubSystm	0
Level 5 ID :	2	.	Assm Cat	0
Level 6 ID :	2	.	Assembly	0

Owner Cost Level : 1

** PROJECT SETTINGS **

2ND VIEW COLUMNS

Quantity Column Width : 10

Col Type	E	X	X	X	X
Rep Width	25	0	0	0	0
Title	ESC COST	(Unused)	(Unused)	(Unused)	(Unused)
Shadow	L	X	X	X	X

DETAIL REPORT FORMATTING

PAGE OPTIONS
Page Break Levels : 1
Table of Contents Levels : 6

0 1 2 3 4 5 6 7

ROW OPTIONS
Print Titles at Levels : Y Y Y Y Y Y
Print Totals at Levels : Y Y Y Y Y Y
Print Notes at Levels : Y Y Y Y Y Y Y Y
Print Unit Cost Row : Y
Print Page Footer : Y
Show Cost Codes : Y

COLUMNS OPTIONS
Print Crew Id : N
Crew Output : N
Unit Cost : N

UPB TITLES
No. of Levels to Print : 0
Bracket Titles With : N N
Include titles Notes : N

** PROJECT SETTINGS **

OTHER REPORT FORMATTING

COLUMN TITLES FOR SUMMARY REPORTS

Column 1 OVERHEAD : Contractor's Overhead
Column 2 HOME OFC : Home Office Expense
Column 3 PROFIT : Contractor's Profit
Column 4 BOND : Contractor's Bond
Column 5 (Unused) :

Column 1 ESCALATN : Escalation
Column 2 CONTINGN : Contingency
Column 3 SIOH : Supervision, Inspection, and Overhead
Column 4 (Unused) : (Unused)
Column 5 (Unused) : (Unused)

STANDARD COLUMN WIDTHS SUMMARY FEATURES

Quantity Columns : 10 Round Totals Column : N-None
Total cost Columns : 12 Contingency Notes : Yes
Unit Cost Columns : 10 Show Project Totals : Yes

SPECIAL REPORT FORMATTING OPTIONS

First Alternate ID : (None)
Show Markup at Level : 0
Display Indirect/Owner Markup as : A - Unit Costs Only
CSI Sort at Level : (None)

** PROJECT SETTINGS **

REPORT SELECTION

Project Settings :	Y	Profit Guidelines : Y	
Contractor Settings :	Y		
Link Listing :	N	Measurement Units : Original	

	REPORT FORMAT TYPE			FOR LEVEL (S)						
	Direct	Indirect	Owner	0	1	2	3	4	5	6
Detail :	Y									
Project :	Y	Y	Y	Y	Y	Y	N	N	N	
Contractor :	N	N		N	N	N	N	N	N	N
Division :	N	N	N	N	N	N	N	N	N	N
System :	N	N	N	N	N	N	N	N	N	N
2nd View :	Y									
Crew :	N			N	N	N	N	N	N	N
Labor :	N									
Equipment :	N									
Prime Labor Cost Level :	0									

** OWNER, OVERTIME, AND ADJUSTMENTS SETTINGS **

				ESCALATN DATE		*ESCALATN INDEX*	
		AMOUNT	PERCENT	BEGIN	END	BEGIN	END
A_ Structures							
	Escalation	P	1.50				
	Contingency	P	10.00				
	Supervision, Inspection, and Overhead	P	0.00				
B_ Sitework							
	Escalation	P	1.50				
	Contingency	P	10.00				
	Supervision, Inspection, and Overhead	P	0.00				

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
GC General Contractor											
Contractor's Overhead	S		10.00	5.00							
Home Office Expense			5.00								
Contractor's Profit	S		10.00	10.00							
Contractor's Bond			1.00								
BC Building Contractor											
Contractor's Overhead			10.00								
Home Office Expense			5.00								
Contractor's Profit			10.00								
Contractor's Bond			0.00								

No errors detected...

* * * END OF ERROR REPORT * * *

ATTACHMENT B

WETLAND SITES DESIGN AND DRAWINGS

General Vegetation Planting Scheme

Plantings for Salt Marsh Restoration

Common Name	Scientific Name	Elevation	Sprig or Container Stock	Spacing
Saltmarsh Cordgrass	*Spartina alterniflora*	Low Marsh	Sprig	18" centers, offset
Saltmeadow Hay	*Spartina patens*	Intermediate Marsh	Sprig	18" centers, offset
Saltbush (Wax Myrtle)	*Myrica cerifera*	Upper High Marsh	Container	6 ft. centers, offset
Saltbush (Groundsel Tree)	*Baccharis halimifolia*	Middle High Marsh	Container	6 ft. centers, offset
Saltbush (Marsh Elder)	*Iva frutescens*	Lower High Marsh	Container	6 ft. centers, offset

Salt Marsh Design/Construction

Grade: Anything from MHW to Mean water level (1/2 tide) should support *Spartina alterniflora*. It will grow from just above MHW to below Mid tide. It does best in a range below MHW and above mid tide. Use a biological benchmark, if available.

- To preclude *Phragmites* (common reed grass invasion), it's best not to set the grade close to MHW, but stay within the above range. Studies have shown that salinity is more critical than inundation at precluding *Phragmites*. Salinity stresses the *Phragmites*.
- The grade should be slightly sloped so the water completely drains on low tides.
- *Spartina alterniflora* in pockets of standing water and above the MHW mark tend not to do well. Small drainage ditches (~a shovel width or more) that dewater ponded areas would be effective. Small drainages are natural features in tidal marshes.

Planting: Natural revegetation doesn't work well for *Spartina alterniflora* areas. Planting is important. For erosion prevention, 12"-18" centers are best. For general revegetation, 2 ft. centers are acceptable. *Spartina alterniflora* seeds are not highly viable and do not revegetate well, taking much longer than the 2' center planting method. Most reproduction is vegetative so again the planting is important. Most recommend the use of slow release fertilizer placed in the hole with the plants. 1/2 ounce for sprigs and 1/2 to 1 ounce for baseball sized clumps. Good coverage should be reached in 2-3 growing seasons.

Elizabeth River Environmental Restoration
Wetland Restoration Site Descriptions and Design Investigations

General Project Description

The Elizabeth River is located approximately 135 miles southeast of Washington, D.C., at the junction of Hampton Roads and the Chesapeake Bay. The river is a tidal estuary that runs through the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach, and drains into the Chesapeake Bay. It is the economic mainstay of the Hampton Roads community, providing navigable waters for commercial, industrial, recreational, and defense use. The Elizabeth River watershed consists of approximately 300 square miles (Elizabeth River = approximately 164 square miles, Dismal Swamp = approximately 240 square miles, about half of which drains into Elizabeth River), of which approximately 145 square miles is tidally influenced. Population and economic growth along the Elizabeth River have created many environmental problems within the river basin. Stormwater runoff, point source discharges, and spills from commercial, industrial, and military sources over several hundred years have reduced water quality and have contaminated river sediments. Industrial and urban development and associated fill activities have destroyed many of the wetland habitats that once existed along the river, which has had and adverse effect on the ecosystem.

The Norfolk District U.S. Army Corps of Engineers (USACE), the Commonwealth of Virginia, the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach have entered into a Feasibility Cost Sharing Agreement (FCSA) to implement a Feasibility Study for the environmental restoration of sediment and wetlands within the Elizabeth River Basin. The Feasibility Study represents the second phase of the two phase USACE process consisting of the Reconnaissance and Feasibility phases. In support of the FCSA, the Norfolk District USACE, in conjunction with the other sponsors, prepared the July 1998 Project Study Plan (PSP) for the Elizabeth River Environmental Restoration - Feasibility Investigation, which details the work scope, schedule, and budget for the Feasibility Study. The PSP was coordinated with all Norfolk District USACE elements and the non-federal sponsors and reflects the requirements, desires, and interests of all parties involved. The purpose of the Feasibility Study is to ensure the timely and economical completion of a quality Feasibility Study Report that is expected to recommend habitat restoration as an implementable solution to the loss of wetlands and degradation of sediments in the Elizabeth River Basin. The Feasibility Study shall serve as the basis for formulating projects and developing a decision-making document to determine whether projects should proceed to construction.

Based on the conclusions obtained from the Reconnaissance phase, the two primary alternatives to be evaluated under the Feasibility Study for habitat restoration are sediment remediation and wetland restoration. A Steering Committee, comprised of representatives from USACE and other non-federal sponsors, selected fourteen (14) candidate sites to be evaluated for wetland restoration under the Feasibility Study. As part of the wetland restoration initiative, the GeoEnvironmental Engineering (GeoE) Section of the Norfolk District USACE was tasked by the Environmental Analysis Branch of the Norfolk District USACE to assist in the Wetlands Restoration Evaluation of the Elizabeth River Environmental Restoration - Feasibility Study. The GeoE Section was tasked to perform a Wetlands Subsurface Investigation to evaluate the Hazardous, Toxic, and Radioactive Waste (HTRW) potential of the following six (6) candidate sites on the Elizabeth River watershed in Virginia:

Grandy Village, Norfolk, Virginia.
Portsmouth City Park, Portsmouth, Virginia.
Carolanne Farms, Virginia Beach, Virginia.
Somme Avenue, Norfolk, Virginia.
Sugar Hill (Scotts Creek), Portsmouth, Virginia.
Swimming Point (Crawford Bay), Portsmouth, Virginia.

Virginia Geotechnical Services, P.C. was tasked to complete preliminary design for wetland restoration at eight sites within the Elizabeth River Basin. These sites are:

- Carolanne Farms, Virginia Beach, Virginia
- Crawford Bay (Swimming Point), Portsmouth, Virginia
- Jordan Bridge, Chesapeake, Virginia
- Lancelot Drive, Virginia Beach, Virginia
- Scuffletown Creek, , Virginia
- Somme Avenue, Norfolk, Virginia
- Sugar Hill (Scotts Creek), Portsmouth, Virginia
- Woodstock Neighborhood Park, Virginia Beach, Virginia

The Norfolk District Corps of Engineers, Engineering Division, was tasked to complete preliminary design for wetland restoration at three sites within the Elizabeth River Basin. These sites are:

- Grandy Village
- Portsmouth City Park
- Old Dominion University Drainage Canal

Site Descriptions and Restoration Design Concepts

1. Carolanne Farms, Virginia Beach, Virginia

Information Obtained from USACE, 2000. Analytical Results, Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia: USACE Norfolk District, 803 Front Street, Norfolk, VA 23510-1096, Report date 15 May 2000, 49p.

A 1937 aerial photograph indicates that the site was upland and apparently used for agricultural purposes. Portions of the site were developed in the 1960s as a privately operated wastewater treatment facility for the adjoining subdivision. The City of Virginia Beach acquired the site in 1982 when the treatment plant was closed. The site was subsequently developed into a neighborhood park. Two mounds in the vicinity of the site contain structures associated with the former treatement plant. These structures can be seen in a 1985 aerial photograph, but subsequently the City has covered the structures with earthen material. Adjacent to and west of the site, the City has constructed a canoe launch. A hiking trail connects the neighborhood to the canoe launch through the site. The trail is surfaced with hardwood mulch. The western margin of the site has been used by local school group(s) for decorative tree planting.

USACE personnel conducted a field investigation of the site in November 1999. They completed five soil borings and collected two (2) soil samples for chemical analysis. The borings encountered apparently original wetland soils at depths ranging from two (2) to four (4) feet below ground surface. The stratigraphy appeared to be consistent between the five soil borings. Chemical analytical results for soil samples collected at the site suggest that arsenic and mercury compounds may be contaminants of concern at the site.

Existing Topographic Data

Site topography was provided by the Corps. Surveying was performed June 7 and 8, 1999 by the Norfolk District, Corps of Engineers. The assumed base low marsh elevation is approximately -0.5 feet (MSL). The top elevation of the low marsh is about elevation +2.0 feet. The assumed top elevation of the high marsh is about 4.0 feet.

Restoration Design Concept

Wetland restoration at the Carolanne Farms site will consist of excavation and regrading with suitable soils to design elevations shown on drawing. The excavation concept will create a bowl-shaped depression draining into a tidal estuary into the

middle of the site. The estuary will provide some open-water habitat surrounded by high quality low-marsh. The regarding concept minimizes disturbance in and around the mounds covering the former sewage treatment structures. Excavated soils will be used onsite to create a pedestrian walkway connecting hiking trails and observation stations along the existing mounds.

We anticipate that excavation will require utilization of temporary timber matting and placement of stone to provide a suitable bearing surface for excavation equipment. All materials excavated will be placed in a regulated landfill and landfill owners will report discharges in accordance with permit regulations.

Restoration Budget Estimate

The restoration budget estimate for this site is $248,631. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

2. Crawford Bay, Portsmouth, Virginia

Information Obtained from USACE, 2000. Analytical Results, Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia: USACE Norfolk District, 803 Front Street, Norfolk, VA 23510-1096, Report date 15 May 2000, 49p.

A 1913 map indicates that this site was a tidal creek with associates salt marshes. The historic creek has had several aliases: Church Creek, Tar Creek, and Buck Creek. A 1937 aerial photograph shows that this site had undergone partial filling, mainly at the headwaters of the historic tidal creek. A 1940s aerial photograph suggests the site had converted almost entirely to upland with scrub/shrub vegetation present. Existing and historic adjacent land use has been residential, commercial (Portsmouth Naval Hospital), and industrial (a manufactured gas plant). The former Portsmouth Gas Company was located to the southwest of the site and operated from 1856 to 1956. In 1992, the Virginia Department of Environmental Quality received Phase I and Phase II Environmental Assessments prepared in connection with the sale of the Patio Plaza Apartments, which occupies part of the original MGP site. Petroleum hydrocarbons and semivolatile organic compounds were detected in soil samples collected from borings advanced on the apartment complex property. Several incidents of a petroleum sheen on water discharging from a stormwater outfall pipe into the Elizabeth River at Swimming Point have been documented. In April 1995, a recovery well was installed at the old MGP site to remove the presence of phase separated

hydrocarbons from the groundwater. An October 20, 1998 progress report states that about 460 gallons of product had been removed from the subsurface and product thickness in one monitoring well was 4.83 feet.

USACE Personnel conducted a field investigation at the site in November 1999. Allard Environmental performed two (2) test pit excavations at locations selected by the Corps. Field personnel collected two (2) soil samples for chemical analysis. Test pit excavations indicated that subsoils in the site area contain visible petroleum hydrocarbon compounds.

The stratigraphy appeared consistent between the two test pit excavations. Fill materials extended to an average depth of about 3.25 feet. Chemical analytical results and risk screening indicate that PAH compounds typically associated with coal tar residuals, arsenic, lead, and mercury are contaminants of concern at this site.

Existing Topographic Data

Glenn and Sadler, Inc., completed topographic and hydrographic survey of the site in January 2000. Survey data indicate that the site generally slopes from a high elevation of about +2 ft in the southwest corner to the northeast. The survey data indicates an enclosed depression with a bottom elevation of about -12 feet about 420 feet northeast of the southwest corner of the site area.

The site is bordered along the west and south by a concrete bulkhead. A City of Portsmouth storm sewer outfall discharges to the northeast in the southwest corner of the site. The outfall drains the adjacent residential area to the south of the site.

Mean low water elevation at the site is about -1.22 feet. Mean high water is about elevation +1.58 feet. We estimate that the base low marsh elevation is about -1.0 feet and the top of the low marsh is at about elevation +2.0 feet. There is no existing wetland vegetation at the site.

The southwest corner of the site is currently a collection area for windswept debris. A significant fetch across Crawford Bay creates a relatively high-energy environment in this area.

Restoration Design Concept

Restoration of this site will be primarily through filling to create a "wetland shelf" to the west and east of the discharge from the stormwater outfall. The outward (leading) edges of the shelf system will be protected from wave and wind erosion using a rip-rap groin. Additionally, the discharge system for the stormwater outfall will be

improved by excavation of a northeastward oriented trough towards the topographic depression.

Restoration Budget Estimate

Costs associated with restoration of the Crawford Bay Site is $348,913. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

3. Jordan Bridge, Chesapeake, Virginia

This site is located on the north side of the northwest end of the Jordan Bridge. The site is proximal to both the former Wycoff Creosoting operation and Atlantic Wood Industries. Both of these facilities caused creosote-laden runoff which has contaminated sediments in the site area.

Existing Topographic Data

Glenn and Sadler, Inc., completed a topographic and hydrographic survey of the site in January 2000.

The western portion of the site is elongate west-east and parallel to the Jordan Bridge. The site widens to the east as it merges into the Elizabeth River channel. Pilings from an old railroad pier are aligned generally west-east through the site. We estimate that the elevation of the base of the low marsh at this site is about -0.5 feet. We estimate that the elevation of the top of the low marsh is about +2.0 feet. We estimate that the elevation of the top of the high marsh is about +3.0 feet.

Restoration Design Concept

Restoration of this site will consist of creation of a saltmarsh "shelf." The eastern margin of the shelf will be armored with a rip-rap groin to protect the wetland from wind and wave erosion. The shelf will be graded to permit surface water drainage from the peripheral western shoreline.

Restoration Budget Estimate

The restoration budget estimate for this site is $231,564. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

4. Lancelot Drive, Virginia Beach, Virginia

The Lancelot Drive site contains about 15 acres of moderate quality low marsh. Invasive species such as *Phragmites* have invaded the system and degraded the quality of the ecosystem. The Corps has not successfully negotiated access agreements with the current owner, consequently, field work for this site has not been completed.

Existing Topographic Data

Detailed site survey information is not available. The Corps of Engineers was provided a copy of a portion of a topographic map constructed by the City of Virginia Beach showing spot elevations across the site. Virginia Geotechnical Services (VGS) digitized the site features and spot elevations shown on the map and approximated the property boundary through discussions with the Corps. VGS used the commercially available mapping program, Surfer, to construct a topographic map of the site. VGS then used aerial photography dated August 1985 to estimate the portions of the site with the heaviest infestations of *Phragmites*.

Restoration Design Concept

We have planned regrading of the site to eliminate those portions of the site infested with *Phragmites* with minimal disturbance of remaining portions of the site.

Restoration Budget Estimate

The restoration budget estimate for this site is $1,553,079. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

5. Scuffletown Creek, Chesapeake, Virginia

The site is along the north shore of Scuffletown Creek near its confluence with the Elizabeth River. The shoreline has received random deposits of debris and rubble.

Existing Topographic Data

Glenn and Sadler, Inc. completed site topographic mapping in January 2000. The site generally slopes southward to the Creek. The western margin of the site is bordered by a Colonial Pipeline easement. The western creek bank is armored with rip-rap. Reference marsh elevations are difficult to discern at this site. The northern extent of the site is bounded by a relatively steep slope to upland vegetation, trees, and grasses. The site itself contains "soils" generally unsuitable for the propagation of wetland vegetation. We have estimated marsh bounding elevations based on low and high tidal elevations.

We estimate the basal low marsh elevation is about -0.25 feet. We estimate that the elevation of the top of the low marsh is about +1.75 feet. We estimate the elevation of the top of the high marsh is about +3.0. There are stands of *Phragmites* to about elevation +5.0 north of the site boundary.

Restoration Design Concept

Restoration of the Scuffletown Creek Site will consist of excavation of rubble and debris deposited along the creek bank and replacement with soils suitable for supporting wetland vegetation. We have included a limited area in the eastern portion of the site for open-water habitat development. We estimate that excavation will average about 2 feet across the site, however, the rubble and debris fill materials may extend to greater depths necessitating additional excavation and replacement All materials excavated will be placed in a regulated landfill and landfill owners will report discharges in accordance with permit regulations.

Restoration Budget Estimate

The restoration budget estimate for this site is $68,631. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

6. Somme Avenue, Norfolk, Virginia

Information Obtained from USACE, 2000. Analytical Results, Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia: USACE Norfolk District, 803 Front Street, Norfolk, VA 23510-1096, Report date 15 May 2000, 49p.

Historical aerial photographs indicate that this site was a tidal saltmarsh as late as 1956. Ms. Margaret Arnold of 2607 Somme Avenue, whose property is on and adjacent ot the site, stated that the site was filled around 1960 with debris from road construction on 26th and 27th Streets in Norfolk. 1974 Aerial photographs show the site continually being filled, but the photographs are inconclusive for determining the type of fill material. Field observations suggest that the majority of the fill material is debris from road reconstruction specifically, concrete, granite, and asphalt slabs. A few gravel piles are present. Post fill vegetative growth does not appear to be stressed and no soil staining has been detected. Adjacent land use is mostly residential with the exception of a gas station to the northwest of the site, across a small tidal creek. Potential contaminant source: asphalt, concrete.

Field activities at this candidate site were conducted on 16 November 1999. Sampling personnel consisted of Mr. James E. Demby and Mr. David Byeong W. Kang, both of the GeoE Section. Test pit excavation services were provided by Allard Environmental.

A total of four (4) test pits were excavated at the site. Sampling personnel collected two (2) soil samples for chemical analysis. Chemical analytical test results indicate the presence of PAH compounds, metals, and diesel-range petroleum compounds. Following qualitative risk analysis completed by GeoE, benzo(a)pyrene, benzo(g,h,I)perylene, dinenz(a,h)anthracene, phenanthrene, arsenic, mercury, and TPH-DRO are considered contaminants of concern at this site. Additional testing for RCRA waste characteristics indicates that the soils are not likely to classify as a RCRA hazardous waste. The maximum detected concentration of TPH-DRO in soils exceeded the VDEQ release reporting requirement of 100,000 ug/kg. The GeoE Section has recommended the owner/operator report a release to the VDEQ. Potential risks to human health associated with mercury may warrant a site-specific study of risks.

The stratigraphy appeared to be fairly consistent between the three test pits. Suspected fill material primarily consisted of silty sand intermixed with debris consisting of bricks, cobblestones, concrete, curbing, gravel, and terra cotta piping. Suspected fill material was encountered at the surface and extended down to an average depth of

about 7.2 feet below ground surface (range from 5 to 10 feet). Suspected in-situ material primarily consisted of gray clay with vegetation and roots.

Existing Topographic Data

Site topography was provided by the Corps. Surveying was performed by the City of Norfolk Department of Public Works, September 1999. Based on apparent in-situ conditions peripheral to the site, the assumed reference high marsh elevation is approximately 2.0 feet (MSL). The seaward edge of the low marsh is about elevation -1.1 feet. The average low marsh midpoint is at elevation +0.3±. We assumed a reference low marsh elevation at about -0.5 ft (MSL), about midway between these elevations.

Restoration Design Concept

Wetland restoration at the Somme Avenue site will consist of excavation of unsuitable debris fill material and regrading with suitable soils to design elevations. We anticipate that excavation will require utilization of temporary timber matting and placement of stone to provide a suitable bearing surface for excavation equipment. All materials excavated will be placed in a regulated landfill and landfill owners will report discharges in accordance with permit regulations.

Restoration Budget Estimate

The restoration budget estimate for this site is $250,978. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

7. Sugar Hill (Scotts Creek), Portsmouth, Virginia

Information Obtained from USACE, 2000. Analytical Results, Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia: USACE Norfolk District, 803 Front Street, Norfolk, VA 23510-1096, Report date 15 May 2000, 49p.

The 1940 aerial photographs show that this area was a tidal creek with associated saltmarshes. Filling activities have bifurcated the original marsh/creek and subsequently created the present day peninsula. Sometime between the 1940s and

1985 the site was filled. Known previous land use activities include storage/staging area for box containers from the nearby Portsmouth Marine Terminal, as can be seen in 1985 aerial photographs. Portsmouth Port Industrial Commission (property owners) stated that unauthorized dumping activities became problematic in the late 1980s, and they then fenced and gated the property. Currently the site is not in use. Field observations indicate a broad range of fill material. Filled material includes, but may not be limited to, tires, shingles, smelting byproduct debris, and household trash. Adjacent land use is residential and commercial port facilities.

The western margin of the site is bordered by Quebec Street. The Quebec Street corridor has been proposed for reconstruction during development of the Pinner's Point Bridge and will be the location of a ramp serving the bridge.

Existing Topographic Data

Topographic mapping of this site was completed for the Corps of Engineers by Myles Pocta. The site slopes from west to east. The western portion of the site is generally open and unvegetated. The eastern portion of the site is covered by a vigorous stand of saltbush. The northern and southern margins of the site are bordered by existing marsh habitat. Scott's Creek borders the site to the north.

We assume that the basal low marsh elevation at this site is about -1.5 feet. We assume the top of the low marsh is about +2.0 feet and the top of the high marsh is about +3.5 feet. An infestation of *Phragmites* in the southwestern corner of the site extends to about elevation +4.5 feet.

Wetland Design Concept

The eastern portion of the site contains a healthy stand of saltbush and will not be disturbed. The western margin of the site will be impacted by construction of ramps for the Pinner's Point Bridge. We have superimposed the planned construction scheme for the bridge system and show this as a uniform slope oriented generally north-south across the western third of the site. Please note that the Pinner's Point Bridge plans are still preliminary and subject to change. Also, the plans available to us were not surveyed drawings; some nominal error in compilation should be assumed.

Restoration of this site will consist of creation of a channel bisecting the site north-south. This will separate runoff and slopewash from the Pinner's Point Bridge system from the marsh habitat, allow cyclic flushing of the system through tidal action, and create the moderately drained habitat favored by *Spartina alterniflora*.

All materials excavated will be placed in a regulated landfill and landfill owners will report discharges in accordance with permit regulations.

Restoration Budget Estimate

The restoration budget estimate for this site is $106,876. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

8. Woodstock Neighborhood Park, Virginia Beach, Virginia

The Woodstock Neighborhood Park site is a sand and gravel pit that was used probably during construction of the Interstate 64 system. The pit was allowed to flood and is connected to the Elizabeth River through a narrow cut along the western margin. The Woodstock neighborhood, including a small recreational park, borders the flooded pit. Homes along the pit include docks with boats and have access to the river system through the cut.

Existing Topographic Data

Topographic data for this site was completed in May and June 1999 by the Corps of Engineers. The park area is generally flat at about elevation +10. The park area has a steep slope down to the pond elevation (about +0.0 feet) and the bottom elevations of the pond slope southward at about 1:6 to about -5.0 feet. The basal elevation of the low marsh is about +0.0 feet. The top of the low marsh is about +3.0 feet and the top of the high marsh is about +5.0 feet. The southwestern corner of the park area extends westward as a narrow peninsula separating an existing marsh habitat to the north from the current open-water environment to the south. Along the southern margin of the park area, at the top of the slope above the open-water, we identified an abandoned 4-inch pipe.

Wetland Design Concept

Restoration at this site will consist of creation of a wetland shelf in the current open water environment. We will reduce the slope from the park area and remove the southwestern peninsula. The soils removed will be augmented by offsite borrow to

create a wetland bench. The bench will remain separated from the current park area by a narrow channel to prevent stagnation and promote moderate draining. Construction equipment access to the site is limited by the surrounding neighborhood. Access for construction equipment will necessarily be by barge through the current channel. The probable borrow source will be from other areas of the bottom of the existing pond, excavated by dredge.

Restoration Budget Estimate

The restoration budget estimate for this site is $471,738. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area. If not used on the site, all materials excavated will be placed in a regulated landfill and landfill owners will report discharges in accordance with permit regulations.

9. Old Dominion University Drainage Canal, Norfolk, Virginia

The site is located on the west side of the ODU adjacent to the sailing center on the main stem of the Elizabeth River. The canal is approximately 1,000 feet long and is a part of an outfall system that drains a large portion of the campus. The entire canal is tidally influenced and has some flow at low tide.

Existing Topographic Data

Glen & Sadler Associates completed a topographic and hydrographic survey of the site in January 2000. The project site is adjacent to a landfill on City of Norfolk property and Old Dominion University property. The existing shoreline is covered with rubble concrete to the top of the bank at elevation 10 feet. The invert elevation of the 78-inch diameter pipe discharging into the canal is –2.49 feet.

Wetland Design Concept

The concept design for this site consists of a vegetated wetland fringe in the intertidal zone where the canal discharges into the Elizabeth River. Components of the project include a rock weir for low-water flow dissipation(discharge from the canal), sand fill for

proper elevation of wetland plants and a low-crested rock sill for river generated wave dissipation. The proposed area of vegetated wetland is approximately 0.6 acres.

Restoration Budget

The budget for this wetland creation project is approximately $172,795. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

10. Portsmouth City Park, Portsmouth, Virginia

Information obtained from USACE, 2000 Analytical Results, Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia: USACE Norfolk District, 803 Front St., Norfolk, VA 23510-1096, May 15,2000, 49p

The Portsmouth City Park site is located on Bailey's Creek on the Western Branch of the Elizabeth River. A swale marks the location of the proposed wetland restoration at City Park. Aerial photography from the late 1930's indicates that the swale was formerly a tidal creek, and that a fringe marsh once existed where erosion is now attacking the bank. The wetlands were reportedly filled with debris resulting from road work, which is confirmed by the existence of asphalt debris, concrete, brick, and granite pieces and slabs. The eroded shoreline has outcroppings of the various fill materials and the shoreline is littered with the aforementioned debris. The adjacent land uses are recreation and residential.

A site investigation was accomplished on 11 & 12 November 1999 by members of the USACE Geo-environmental Section, Allard Environmental, and Fishburne Drilling. A total of (4) test pits and (4) borings were conducted during the sub-surface investigation of this site. No RCRA hazardous waste or petroleum contaminated waste are anticipated at this site based on the investigation results. Potential risks to human health associated with mercury may warrant a site-specific study.

Existing Topographic Data

Site Topography was provided by the Corps of Engineers, *Survey of June 1999, Portsmouth City Park.* Horizontal Datum is the Virginia State Grid (South Zone) which is based on the North American Datum of 1983, 1986 adjustment. Mean Low Water corresponds to Elevation –1.2 and Mean High Water is determined at Elevation +1.6, for a tide range of 2.8'. The existing *Spartina* range is from approximate elevation +0.4 to +2.2, but the range does vary along the stretch of shoreline.

Restoration Design Concept

The proposed wetland restoration design for City Park will consist of a excavated inlet that results in a shallow wetland pocket and a much expanded wetland panting area. The wetland will include a sediment trap for capturing sediment laden runoff from nearby parking areas. A stone check dam will filter runoff into the wetland, while the new wetland plant regime will further enhance water quality. Existing, mature trees will be protected, and augmented with additional tree varieties.

A large *Spartina* wetland fringe will be created by expanding the area set at between elevation +0.5 to 2.4 within the wetland pocket. Areas of *Spartina patens* will be planted at slightly higher elevations, and an upland bench will surround the wetland. The upland bench will provide a protective buffer of saltbush and other shrubs that will prevent erosion and provide a more diversified habitat. The dominant tree species that exist on site include Pines, Hackberry, and Cypress. Low maintenance flowering trees consisting of crepe myrtle and eastern redbud will be added for interest and to provide seasonal color to the park setting.

Public access and appreciation of the wetland will be gained through use of the proposed trail and foot bridge that will traverse the wetland. The trail will incorporate benches for relaxation, and will link the existing gazebos and other public use areas.

All materials excavated will be placed in a regulated landfill and landfill owners will report discharges in accordance with permit regulations.

Restoration Budget Estimate

The total restoration cost estimate is $329,119. This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level, design data furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for the construction of similar projects in the general area.

These do not include any special disposal costs.

11. Grandy Village, Norfolk, Virginia

Grandy Village is named for the nearby Public Housing Complex, and is situated on the north shore of the Eastern Branch of the Elizabeth River. Historic photographs indicate that this site was a series of small tidal creeks and associated saltmarshes as late as 1949. A 1909 city base map indicates that this site was actually open surface water with a more undulating shoreline, contrary to the current linear condition.

The Grandy Village housing complex was constructed in the early 1950's on presumably high grounds and fill material within the saltmarsh. Aerial photographs from 1974 show

extensive marsh filling activities on the site, with dump trucks and bulldozers spreading the material. Recent field observations suggest that the fill material consists of asphalt, concrete, sand, and miscellaneous debris. The site is dominated by post-fill vegetation; however, two areas have sparse to no vegetation with sandy and silty soils. The adjacent land uses are residential, multifamily and single family homes with some open park area.

USACE personnel, assisted by technical service contractors, conducted a field investigation of this site on 9 & 10 November 1999. A total of (7) test pits and (4) soil borings were excavated and advanced during the subsurface investigation of this candidate site. Summary findings of the investigation indicate the presence of Total Petroleum Hydrocarbons-Diesel Range Organics (TPH-DRO) in the drainage area behind the Grandy Village housing complex. The report also indicated that potential risks to human health associated with the detected compounds and analytes are not anticipated at this site.

Existing Topographic Data

Site Topography was provided by the City of Norfolk, and was titled *Topographic Survey of Property South of Grandy Village, Div. of Surveying, Dept of Public Works,* dated 8/25-99. Horizontal datum is the Virginia State Plane, South Zone, NAD83 (1993). Vertical datum is NAVD 88 (NGS Monument C 307). Average mean low water is at elevation –1.4, with the fringe of the *Spartina alterniflora* low marsh ranging from –0.7 to +1.1. The high marsh boundary at elevation +1.1 extends to elevation 2.71.

Restoration Design Concept

The wetland restoration concept for this site will in essence consist of returning the shoreline to a more irregular and undulating configuration which existed prior to the deposition of massive fill material. This concept will require excavation and removal of large quantities of material to create several low marsh areas while increasing the available shoreline for new plantings. Ideally these areas will be constructed at desired points which will allow for tidal inflow cuts to be made without destroying significant amounts of existing *Spartina* marsh. An effort has been made in the preliminary plans to design around existing stands of vegetation and tree growth on the site. A conceptual rendering of the site shows how the created marsh areas will be linked with elevated, pedestrian walkways and bridges to allow the public limited access to the site.

A total, site planting plan will provide a variety of planting areas, with low-marsh sprigs in the range from –0.7 to +1.1 and high marsh varieties from 1.1 to 2.7 ft. Marsh areas will be screened with upland benches planted with saltbush and other varieties. Larger trees suitable for bayscaping will be added to complement the existing pines, cedars, and willow on the site.

The City of Norfolk is working with a consultant, Siska Aurand, to develop an integrated use plan for the area that compliments the housing community nearby. Those conceptual plans must be coordinated in the future to insure a project that is acceptable to all interests.

Restoration Budget Estimate

The Restoration Cost Estimate is $989,410 . This estimate was prepared by the Norfolk District Corps of Engineers based on the conceptual level design information furnished and includes a 25% contingency. Cost for material and equipment are based on historical data for similar construction projects in the general area.

These cost do not include special disposal costs.

General Vegetation Planting Scheme

Plantings for Salt Marsh Restoration

Common Name	Scientific Name	Elevation	Sprig or Container Stock	Spacing
Saltmarsh Cordgrass	*Spartina alterniflora*	Low Marsh	Sprig	18" centers, offset
Saltmeadow Hay	*Spartina patens*	Intermediate Marsh	Sprig	18" centers, offset
Saltbush (Wax Myrtle)	*Myrica cerifera*	Upper High Marsh	Container	6 ft. centers, offset
Saltbush (Groundsel Tree)	*Baccharis halimifolia*	Middle High Marsh	Container	6 ft. centers, offset
Saltbush (Marsh Elder)	*Iva frutescens*	Lower High Marsh	Container	6 ft. centers, offset

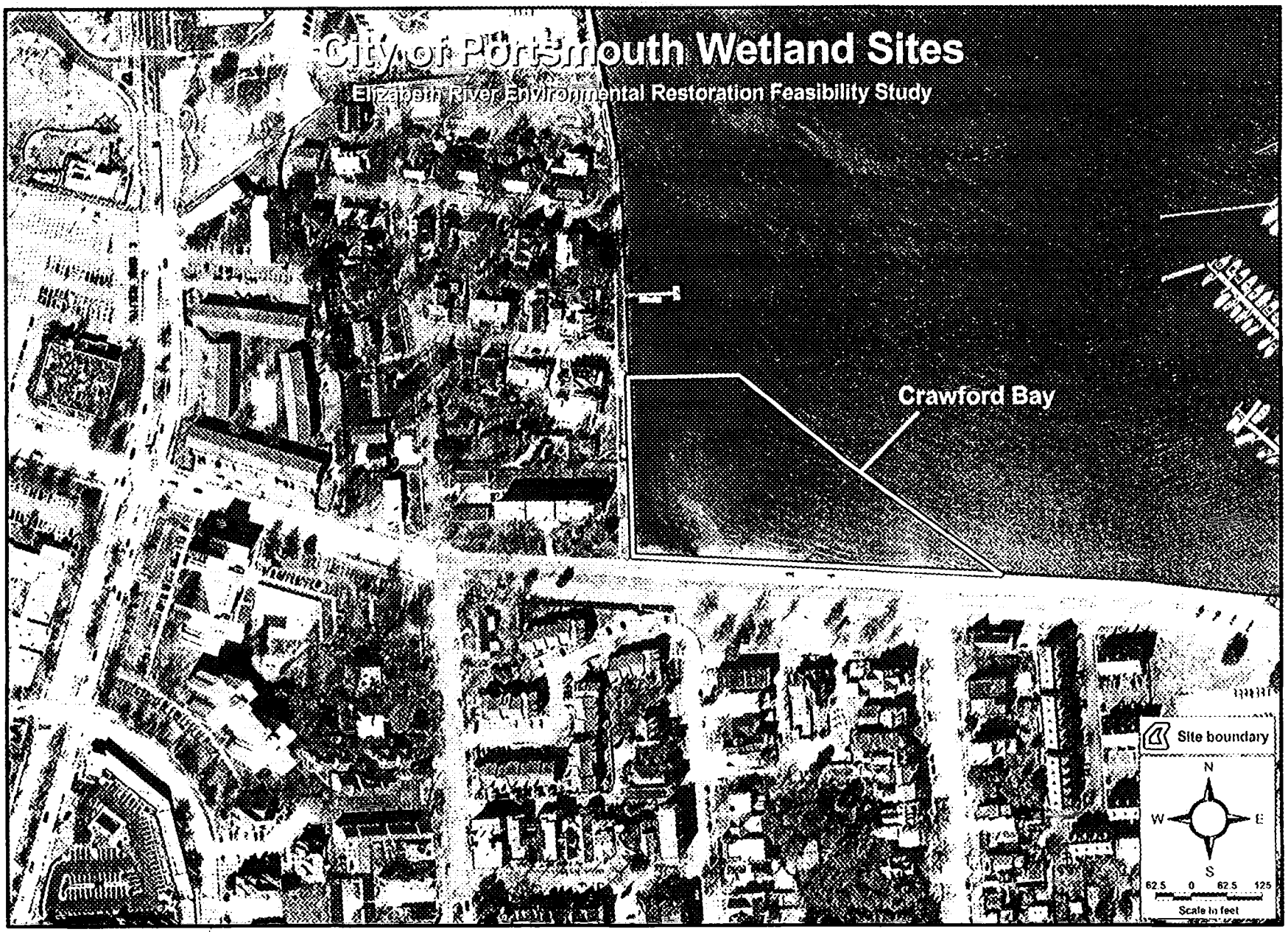
Salt Marsh Design/Construction

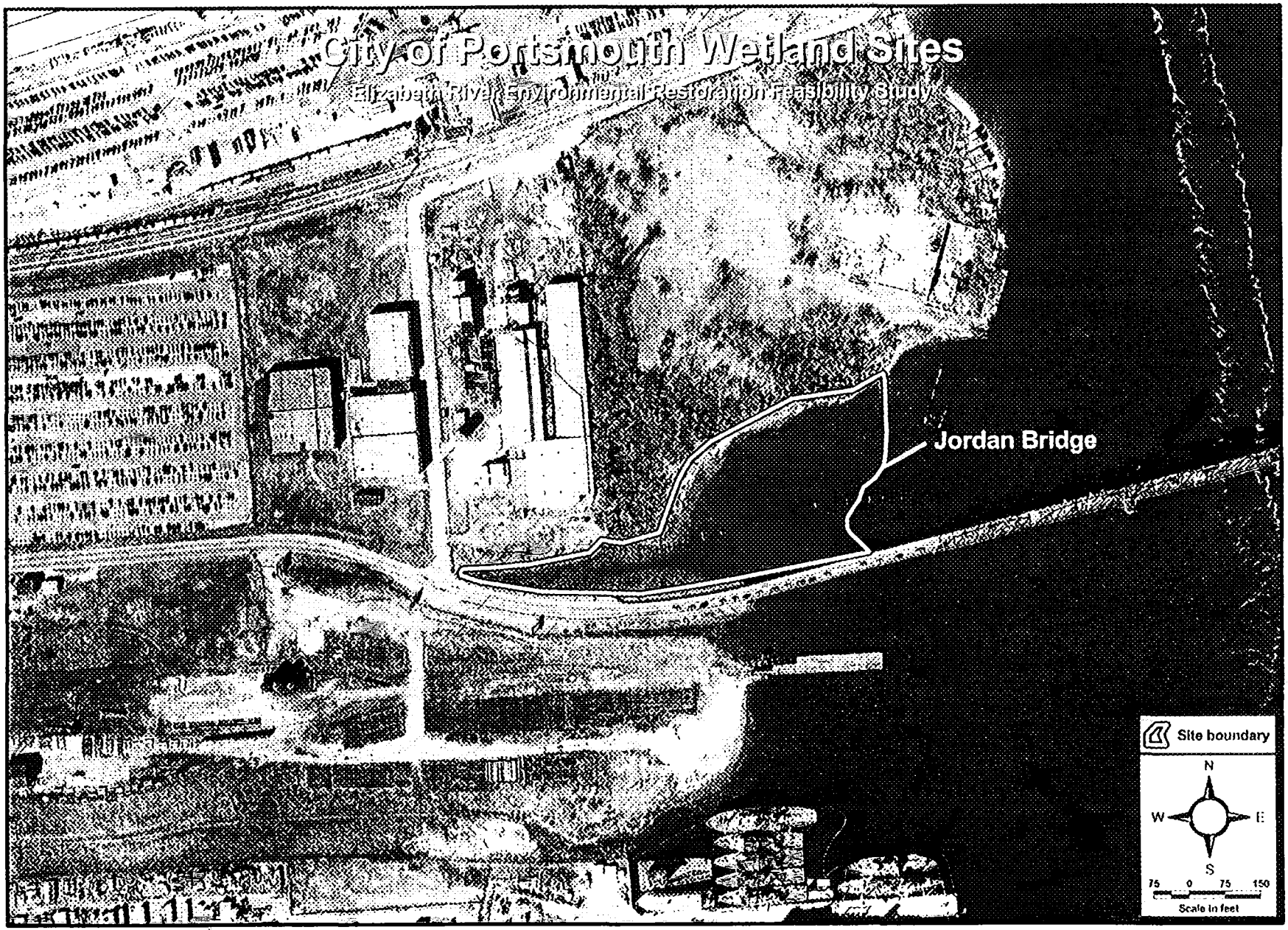
Grade: Anything from MHW to Mean water level (1/2 tide) should support *Spartina alterniflora*. It will grow from just above MHW to below Mid tide. It does best in a range below MHW and above mid tide. Use a biological benchmark, if available.

- To preclude *Phragmites* (common reed grass invasion), it's best not to set the grade close to MHW, but stay within the above range. Studies have shown that salinity is more critical than inundation at precluding *Phragmites*. Salinity stresses the *Phragmites*.
- The grade should be slightly sloped so the water completely drains on low tides.
- *Spartina alterniflora* in pockets of standing water and above the MHW mark tend not to do well. Small drainage ditches (~a shovel width or more) that dewater ponded areas would be effective. Small drainages are natural features in tidal marshes.

Planting: Natural revegetation doesn't work well for *Spartina alterniflora* areas. Planting is important. For erosion prevention, 12"-18" centers are best. For general revegetation, 2 ft. centers are acceptable. *Spartina alterniflora* seeds are not highly viable and do not revegetate well, taking much longer than the 2' center planting method. Most reproduction is vegetative so again the planting is important. Most recommend the use of slow release fertilizer placed in the hole with the plants. 1/2 ounce for sprigs and 1/2 to 1 ounce for baseball sized clumps. Good coverage should be reached in 2-3 growing seasons.

City of Virginia Beach Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Lancelot Drive
Carolanne Farms
Woodstock Neighborhood Park
Site boundary
N
W
E
S
200 0 200 400
Scale in feet


City of Portsmouth Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Crawford Bay
Site boundary
N
W
E
S
62.5 0 62.5 125
Scale in feet


City of Portsmouth Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Jordan Bridge
Site boundary
N
W
E
S
75 0 75 150
Scale in feet

City of Chesapeake Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Scuffletown Creek
Site boundary
N
W
E
S
75 0 75 150
Scale in feet

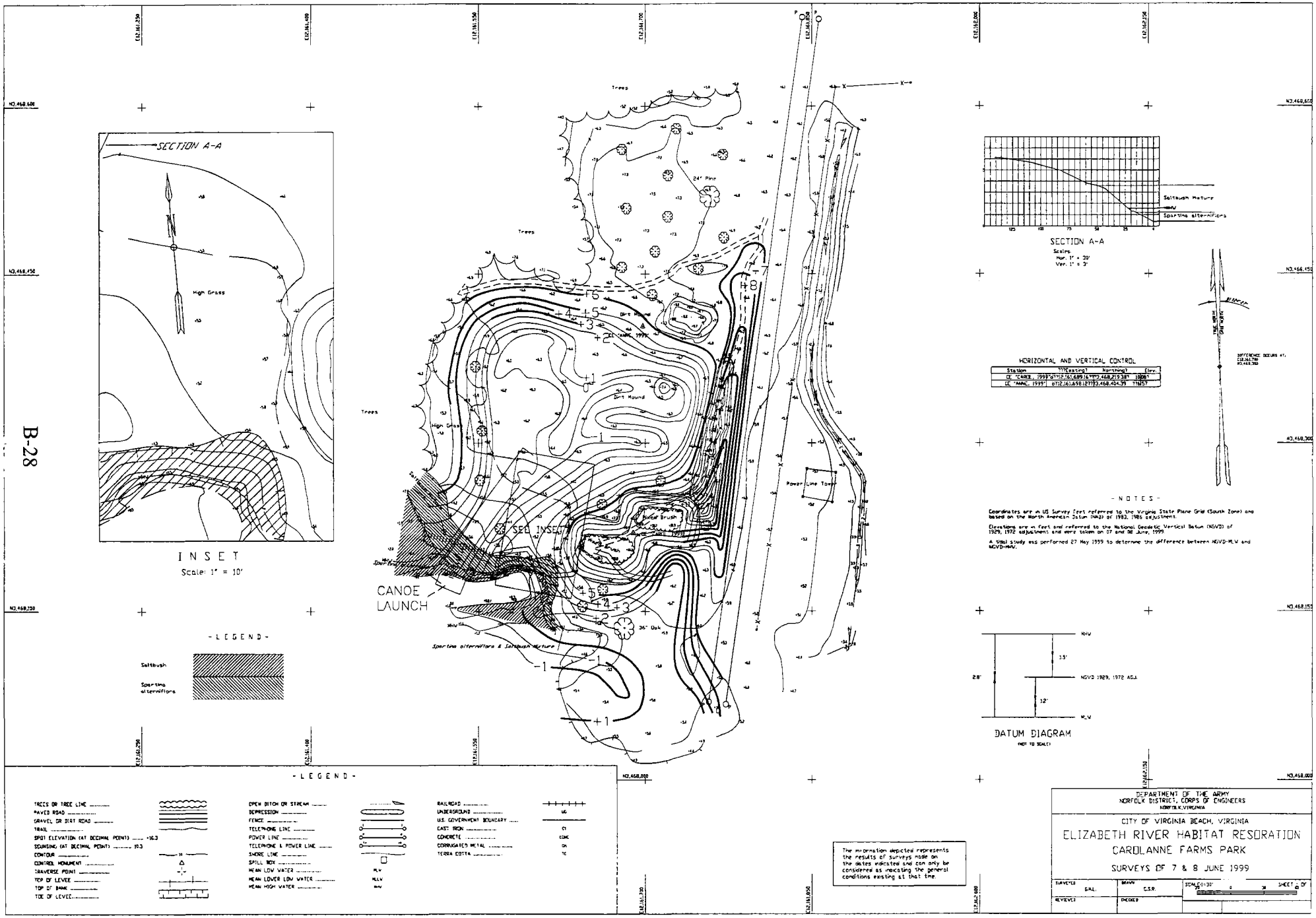
City of Norfolk Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Somme Avenue
Site boundary
N
W
E
S
75 0 75 150
Scale in feet

City of Portsmouth Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Sugar Hill
Site boundary
N
W
E
S
75 0 75 150
Scale in feet

City of Norfolk Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
ODU Drainage Canal
Site boundary
N
W
E
S
75 0 75 150
Scale in feet

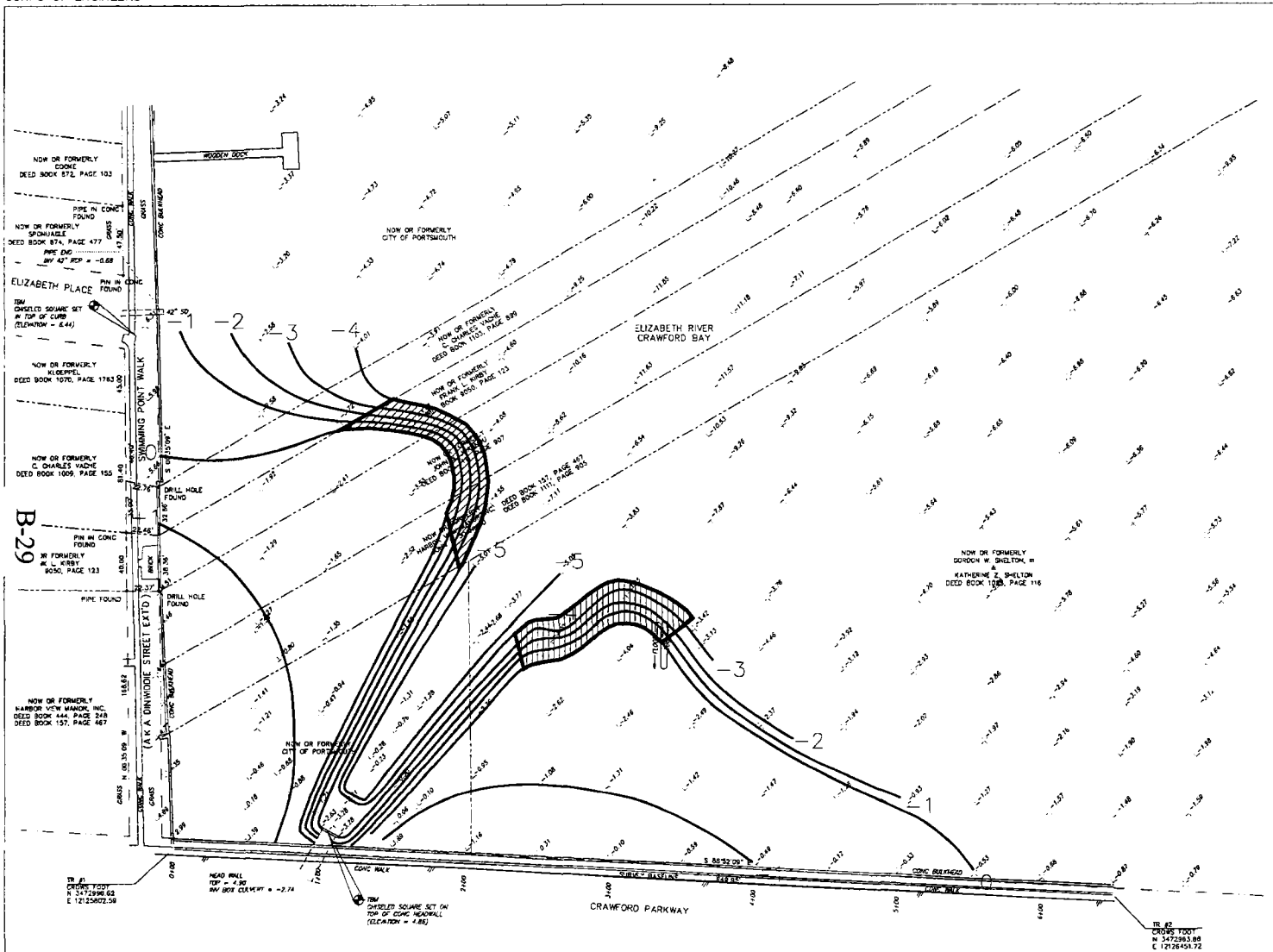
City of Portsmouth Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Portsmouth City Park
Site boundary
N
W
E
S
75 0 75 150
Scale in feet

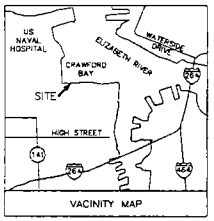
City of Norfolk Wetland Sites
Elizabeth River Environmental Restoration Feasibility Study
Grandy Village
Site boundary
N
W
E
S
75 0 75 150
Scale in feet


SECTION A-A
High Grass
INSET
Scale: 1" = 10'
Trees
24" Pine
Dirt Mound
High Grass
Power Line Tower
SEE INSET
CANOE LAUNCH
36" Oak
Spartina alterniflora & Saltbush Mixture
- LEGEND -
Saltbush
Spartina alterniflora
SECTION A-A
Scales
Hor. 1" = 30'
Ver. 1" = 3'
Saltbush Mixture
Spartina alterniflora
HORIZONTAL AND VERTICAL CONTROL
Station ??? Easting? Northing? Elev.
CE "CAROL, 1999" a?12,161,689.16??? 3,468,219.38? 10.08?
CE "ANNC, 1999" a?12,161,698.12??? 3,468,404.39 ??6.57
- NOTES -
Coordinates are in US Survey feet referred to the Virginia State Plane Grid (South Zone) and based on the North American Datum (NAD) of 1983, 1986 adjustment.
Elevations are in feet and referred to the National Geodetic Vertical Datum (NGVD) of 1929, 1972 adjustment and were taken on 07 and 08 June, 1999.
A tidal study was performed 27 May 1999 to determine the difference between NGVD-MLW and NGVD-MHW.
NHW
NGVD 1929, 1972 ADJ.
MLW
DATUM DIAGRAM
(NOT TO SCALE)
- LEGEND -
TREES OR TREE LINE
PAVED ROAD
GRAVEL OR DIRT ROAD
TRAIL
SPOT ELEVATION (AT DECIMAL POINT) -16.3
SOUNDING (AT DECIMAL POINT) 10.3
CONTOUR
CONTROL MONUMENT
TRAVERSE POINT
TOP OF LEVEE
TOP OF BANK
TOE OF LEVEE
OPEN DITCH OR STREAM
DEPRESSION
FENCE
TELEPHONE LINE
POWER LINE
TELEPHONE & POWER LINE
SHORE LINE
SPILL BOX
MEAN LOW WATER MLW
MEAN LOWER LOW WATER MLLW
MEAN HIGH WATER MHW
RAILROAD
UNDERGROUND UG
U.S. GOVERNMENT BOUNDARY
CAST IRON CI
CONCRETE CONC
CORRUGATED METAL CM
TERRA COTTA TC
The information depicted represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.
DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
NORFOLK, VIRGINIA
CITY OF VIRGINIA BEACH, VIRGINIA
ELIZABETH RIVER HABITAT RESORATION
CAROLANNE FARMS PARK
SURVEYS OF 7 & 8 JUNE 1999
SURVEYED G.M.L.
DRAWN C.S.R.
REVIEWED
CHECKED
SHEET OF

CORPS OF ENGINEERS

U. S. ARMY





VIRGINIA STATE PLANE SOUTH ZONE

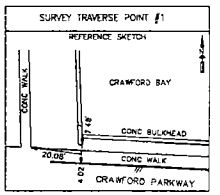
LEGEND

SPOT ELEVATION
MAJOR CONTOUR
MINOR CONTOUR
MEAN HIGH WATER CONTOUR
MEAN LOW WATER CONTOUR
BITUMINOUS PAVEMENT
CONC CURB
STORM DRAIN (SD)
TOE OF SLOPE
PROPERTY LINE
RIGHT OF WAY LINE
BENCH MARK
SURVEY CONTROL POINT
TIDAL FLOW

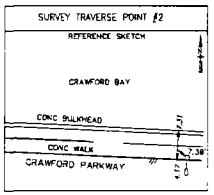
SURVEY NOTES:

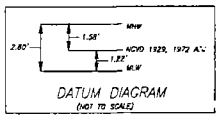
1. TOPOGRAPHIC SURVEY PREPARED BY GLENN & SADLER ASSOCIATES, INC., FROM FIELD DATA COLLECTED IN JANUARY 2000.
2. THIS SURVEY DOES NOT GUARANTEE THE EXISTENCE OR NONEXISTENCE, SIZE, TYPE, DEPTH, MATERIAL OR LOCATION OF ANY UNDERGROUND UTILITIES. ALL UTILITIES SHOWN ARE BASED ON ABOVEGROUND UTILITY STRUCTURES, AVAILABLE UTILITY MAPS AND SITE PLANS. THE CONTRACTOR SHALL HAVE ALL EXISTING SITE UTILITIES VERIFIED PRIOR TO ANY EXCAVATION.
3. ELEVATIONS SHOWN HEREON ARE IN FEET AND REFER TO THE NATIONAL GEODETIC VERTICAL DATUM 1929 (1972 ADJUSTMENT). ELEVATIONS WERE ESTABLISHED FROM THE CITY OF PORTSMOUTH ALUMINUM BENCHMARK DISK "46", ELEVATION = 7.197'.
4. HORIZONTAL COORDINATES SHOWN HEREON ARE IN FEET AND REFER TO THE VIRGINIA STATE PLANE COORDINATE SYSTEM – SOUTH ZONE – NAD83 (1988 ADJUSTMENT).
5. MEAN HIGH WATER (MHW) AND MEAN LOW WATER (MLW) ELEVATIONS WERE DERIVED FROM WATER LEVEL DATA PUBLISHED BY N.O.A.A./N.O.S. OCEANOGRAPHIC PRODUCTS AND SERVICES DIVISION. REFERENCE TIDAL BENCH MARK FOR THIS SITE IS PORTSMOUTH NAVAL SHIPYARD 883 8660.
6. THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND MAY NOT SHOW ANY OR ALL EASEMENTS, RESTRICTIONS OR ENCUMBRANCES WHICH MAY EFFECT THE SAID PROPERTY AS SHOWN.

SURVEY TRAVERSE POINT #1



SURVEY TRAVERSE POINT #2





REFERENCES

DEED BOOK 1070, PAGE 1783
DEED BOOK 1025, PAGE 117
DEED BOOK 1009, PAGE 155
DEED BOOK 874, PAGE 477
DEED BOOK 872, PAGE 103
DEED BOOK 444, PAGE 248
DEED BOOK 157, PAGE 22
DEED BOOK 189, PAGE 388
DEED BOOK 157, PAGE 467
MAP BOOK 4, PAGE 84
MAP BOOK 1, PAGE 42
CITY OF PORTSMOUTH TAX PLATE NUMBER 10

GLENN & SADLER

GRAPHIC SCALE

1"=30' 0' 30' 60' 90' 120' 150'

NO.	DATE	DESCRIPTION	BY	APP

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
NORFOLK, VA.

DESIGNED	XXX
DRAWN	XXX
CHECKED	XXX
SUBMITTED	XXX
SCALE	AS SHOWN
DATE	JANUARY 2000

BOUNDARY AND TOPOGRAPHIC SURVEY
OF THE WETLAND RESTORATION SITE
CRAWFORD BAY SITE
ELIZABETH RIVER ENVIRONMENTAL RESTORATION STUDY
PORTSMOUTH, VIRGINIA

TOPOGRAPHIC SURVEY, NOTES AND LEGEND

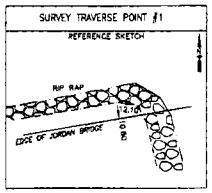
NO ASSIGNMENT SPECIFICATION NO.	PROJECT NO. XXX	SHEET NO. C-1
XXX	DRAWING NO. XXX	

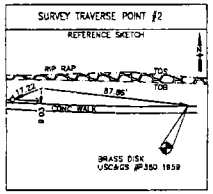
9809.10

CORPS OF ENGINEERS

U. S. ARMY

B-30





LEGEND

SPOT ELEVATION

MAJOR CONTOUR

MINOR CONTOUR

MEAN HIGH WATER CONTOUR

MEAN LOW WATER CONTOUR

BUILDING

RIP RAP

SPARTINA ALTERNIFLORA

SPARTINA PATENS

STORM DRAIN (SD)

TOP OF BANK

TOE OF SLOPE

PROPERTY LINE

RIGHT OF WAY

FENCE

HEDGE/EDGE OF WOODS

LIGHT POLE

GUY WIRE

BENCH MARK

SURVEY CONTROL POINT

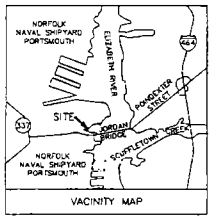
BOUNDARY PIN/PIPE/AXLE

TIDAL FLOW

SURVEY NOTES:

1. TOPOGRAPHIC SURVEY PREPARED BY GLENN & SADLER ASSOCIATES, INC., FROM FIELD DATA COLLECTED IN JANUARY 2000.
2. THIS SURVEY DOES NOT GUARANTEE THE EXISTENCE OR NONEXISTENCE, SIZE, TYPE, DEPTH, MATERIAL OR LOCATION OF ANY UNDERGROUND UTILITIES. ALL UTILITIES SHOWN ARE BASED ON ABOVEGROUND UTILITY STRUCTURES, AVAILABLE UTILITY MAPS AND SITE PLANS. THE CONTRACTOR SHALL HAVE ALL EXISTING SITE UTILITIES VERIFIED PRIOR TO ANY EXCAVATION.
3. ELLEVATIONS SHOWN HEREON ARE IN FEET AND REFER TO THE NATIONAL GEODETIC VERTICAL DATUM 1929 (1972 ADJUSTMENT). ELEVATIONS WERE ESTABLISHED FROM USC&GS DISK #P380 1959.
4. HORIZONTAL COORDINATES SHOWN HEREON ARE IN FEET AND REFER TO THE VIRGINIA STATE PLANE COORDINATE SYSTEM – SOUTH ZONE – NAD83 (1986 ADJUSTMENT).
5. MEAN HIGH WATER (MHW) AND MEAN LOW WATER (MLW) ELEVATIONS WERE DERIVED FROM WATER LEVEL DATA PUBLISHED BY N.O.A.A./N.O.S. OCEANOGRAPHIC PRODUCTS AND SERVICES DIVISION. REFERENCE TIDAL BENCH MARK FOR THIS SITE IS PORTSMOUTH NAVAL SHIPYARD 863 8560.
6. THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND MAY NOT SHOW ANY OR ALL EASEMENTS, RESTRICTIONS OR ENCUMBRANCES WHICH MAY EFFECT THE SAID PROPERTY AS SHOWN.

VIRGINIA STATE PLANE SOUTH ZONE



VICINITY MAP

APPROXIMATE LOCATION OF BUILDING

APPROXIMATE LOCATION OF TREELINE

6' CHAIN LINK FENCE W/ 3 STRANDS OF BARBED WIRE

NOW OR FORMERLY
PORTSMOUTH PORT AND INDUSTRIAL COMMISSION
DEED BOOK 815, PAGE 509

NOW OR FORMERLY
WHOBLARE, LLC
DEED BOOK 1211, PAGE 1379

OLD RAILROAD PIER

ELIZABETH RIVER SOUTHERN BRANCH

WEINER ROAD 60.0' R/W

ELM AVENUE ROUTE 337
VARIABLE WIDTH R/W

NOW OR FORMERLY
SOUTH NORFOLK BRIDGE COMMISSION, INC.
DEED BOOK 7776, PAGE 128

SURVEY BASELINE

TRAV #2
CHISELED SQUARE IN TOP OF CURB
(ELEVATION = 5.03)

TRAV #1
CHISELED SQUARE IN TOP OF CURB
(ELEVATION = 5.03)

TBM #2 PIN & CAP
N 3461126.81
E 1212842.96

TBM #1
USC&GS BRASS DISK
#P380 1959
(ELEVATION = 8.13)

TP #1 PIN & CAP
N 3461150.94
E 1212892.08

PIN FOUND

PIN FOUND ON LINE

INV 15" RCP = 1.66

INV 15" TC = 9.20

673.26' (TIE)

S 85°46'33" E 522.02'

N 85°46'33" W 715.53' (TIE)

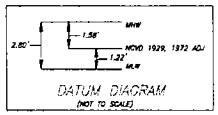
N 10°11'27" E 708.14'

S 04°13'27" E 714.90'

151.24'

REFERENCES

DEED BOOK 845 PAGE 371
DEED BOOK 815 PAGE 509
DEED BOOK 1179 PAGE 308
DEED BOOK 1776 PAGE 126
MAP BOOK 83 PAGE 17



DATUM DIAGRAM
(NOT TO SCALE)

GLENN & SADLER

GRAPHIC SCALE

HORIZ: 1"=30'

0' 30' 60' 90' 120' 150'

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
NORFOLK, VA.

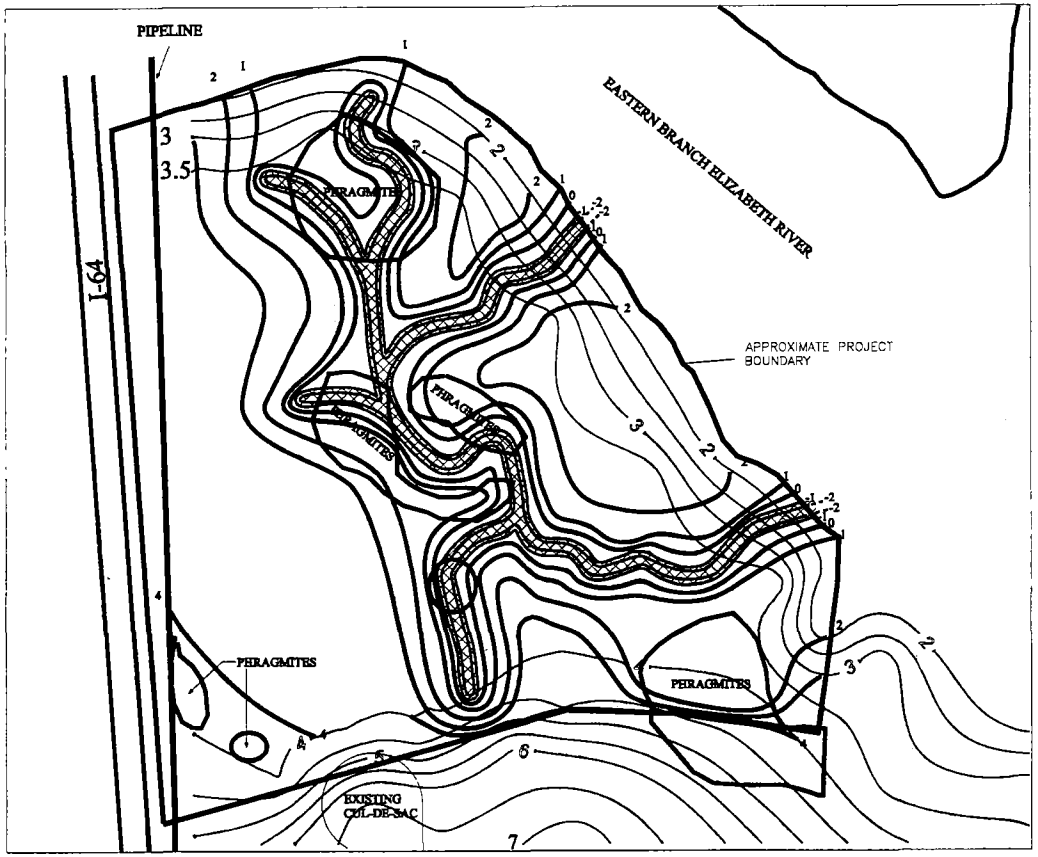
DESIGNED	XXX
DRAWN	XXX
CHECKED	XXX
SUBMITTED	XXX

BOUNDARY AND TOPOGRAPHIC SURVEY
OF THE WETLAND RESTORATION SITE
JORDAN BRIDGE SITE
ELIZABETH RIVER ENVIRONMENTAL RESTORATION STUDY
PORTSMOUTH, VIRGINIA

TOPOGRAPHIC SURVEY, NOTES AND LEGEND

SCALE: AS SHOWN	10 ACCEPT SPECIFICATION NO.	PROJECT NO. XXX	SHEET NO. C-1
DATE: JANUARY 2000	XXX	DRAWING NO. XXX	

9909.10



APPROXIMATE GRAPHIC SCALE (FEET)

0 50 100

SITE BOUNDARIES, PHRAGMITES LOCATIONS, AND TOPOGRAPHIC ELEVATIONS APPROXIMATED FROM SPOT ELEVATIONS FROM 1986 PHOTOGRAMMETRIC SURVEY DATA

DEPARTMENT OF THE ARMY

BOUNDARY AND TOPOGRAPHIC SURVEY
OF THE WETLAND RESTORATION SITE
LANCELOT DRIVE SITE
ELIZABETH RIVER ENVIRONMENTAL RESTORATION STUDY
VIRGINIA BEACH, VIRGINIA

TOPOGRAPHIC SURVEY, NOTES AND LEGEND

DESIGNED	XXX
DRAWN	XXX
CHECKED	XXX
SUBMITTED	XXX
SCALE	1"=50'
DATE	JANUARY 2000
TO ACCOMPANY SPECIFICATION NO.	XXX
PROJECT NO.	XXX
DRAWING NO.	C-1

VACINITY MAP

LEGEND

- SPOT ELEVATION
- MAJOR CONTOUR
- MINOR CONTOUR
- MEAN HIGH WATER CONTOUR — MHW 1.58
- MEAN LOW WATER CONTOUR — MLW -1.22
- BUILDING
- RIP RAP
- MIXED PHRAGMITES
- SPARTINA PATENS
- SPARTINA ALTERNIFLORA
- TOP OF BANK — TOB
- TOE OF SLOPE — TOS
- EASEMENTS
- PROPERTY LINE
- FENCE
- HEDGE/EDGE OF WOODS
- TREE — 6" CEDAR
- SATELLITE DISH
- GUY WIRE
- BENCH MARK
- SURVEY CONTROL POINT
- FLAG
- TIDAL FLOW — EBB / FLOOD

SURVEY NOTES:

1. TOPOGRAPHIC SURVEY PREPARED BY GLENN & SADLER ASSOCIATES, INC. FROM FIELD DATA COLLECTED IN JANUARY 2000.
2. THIS SURVEY DOES NOT GUARANTEE THE EXISTENCE OR NONEXISTENCE, SIZE, TYPE, DEPTH, MATERIAL OR LOCATION OF ANY UNDERGROUND UTILITIES. ALL UTILITIES SHOWN ARE BASED ON ABOVEGROUND UTILITY STRUCTURES, AVAILABLE UTILITY MAPS AND SITE PLANS. THE CONTRACTOR SHALL HAVE ALL EXISTING SITE UTILITIES VERIFIED PRIOR TO ANY EXCAVATION.
3. ELEVATIONS SHOWN HEREON ARE IN FEET AND REFER TO THE NATIONAL GEODETIC VERTICAL DATUM 1929 (1972 ADJUSTMENT). ELEVATIONS WERE ESTABLISHED FROM USC&GS DISK #P380 1959.
4. HORIZONTAL COORDINATES SHOWN HEREON ARE IN FEET AND REFER TO THE VIRGINIA STATE PLANE COORDINATE SYSTEM – SOUTH ZONE – NAD83 (1986 ADJUSTMENT).
5. MEAN HIGH WATER (MHW) AND MEAN LOW WATER (MLW) ELEVATIONS WERE DERIVED FROM WATER LEVEL DATA PUBLISHED BY N.O.A.A./N.O.S. OCEANOGRAPHIC PRODUCTS AND SERVICES DIVISION. REFERENCE TIDAL BENCHMARK FOR THIS SITE IS PORTSMOUTH NAVAL SHIPYARD 863 8660.
6. THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND MAY NOT SHOW ANY OR ALL EASEMENTS, RESTRICTIONS OR ENCUMBRANCES WHICH MAY EFFECT THE SAID PROPERTY AS SHOWN.

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DATUM DIAGRAM
(NOT TO SCALE)

REFERENCES
DEED BOOK 1776, PAGE 126
DEED BOOK 2814, PAGE 053
MAP BOOK 53, PAGE 17
MAP BOOK 76, PAGE 17

GLENN & SADLER

GRAPHIC SCALE

HORIZ: 1"=30' — 0' 30' 60' 90' 120' 150'

REV.	DATE	DESCRIPTION	BY	APP.

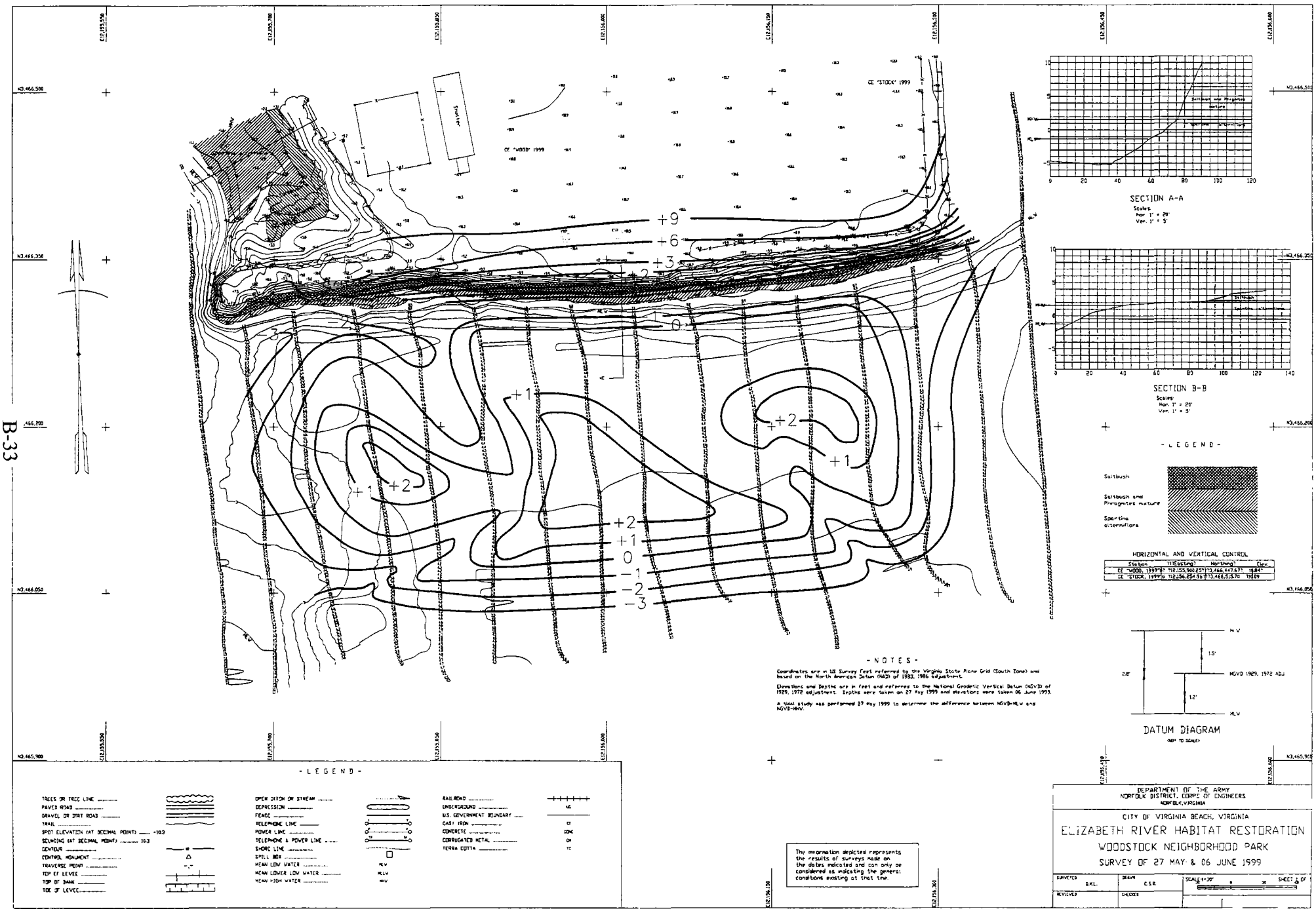
DEPARTMENT OF THE ARMY

BOUNDARY AND TOPOGRAPHIC SURVEY
OF THE WETLAND RESTORATION SITE
SCUFFLETOWN CREEK SITE
ELIZABETH RIVER ENVIRONMENTAL RESTORATION STUDY
CHESAPEAKE, VIRGINIA

TOPOGRAPHIC SURVEY, NOTES AND LEGEND

DESIGNED:	XXX
DRAWN:	XXX
CHECKED:	XXX
SUBMITTED:	XXX
SCALE:	AS SHOWN
DATE:	JANUARY 2000
TO ACCOMPANY SPECIFICATION	XXX
PROJECT	XXX
DRAWING	XXX
SHEET	C–1

96096.10

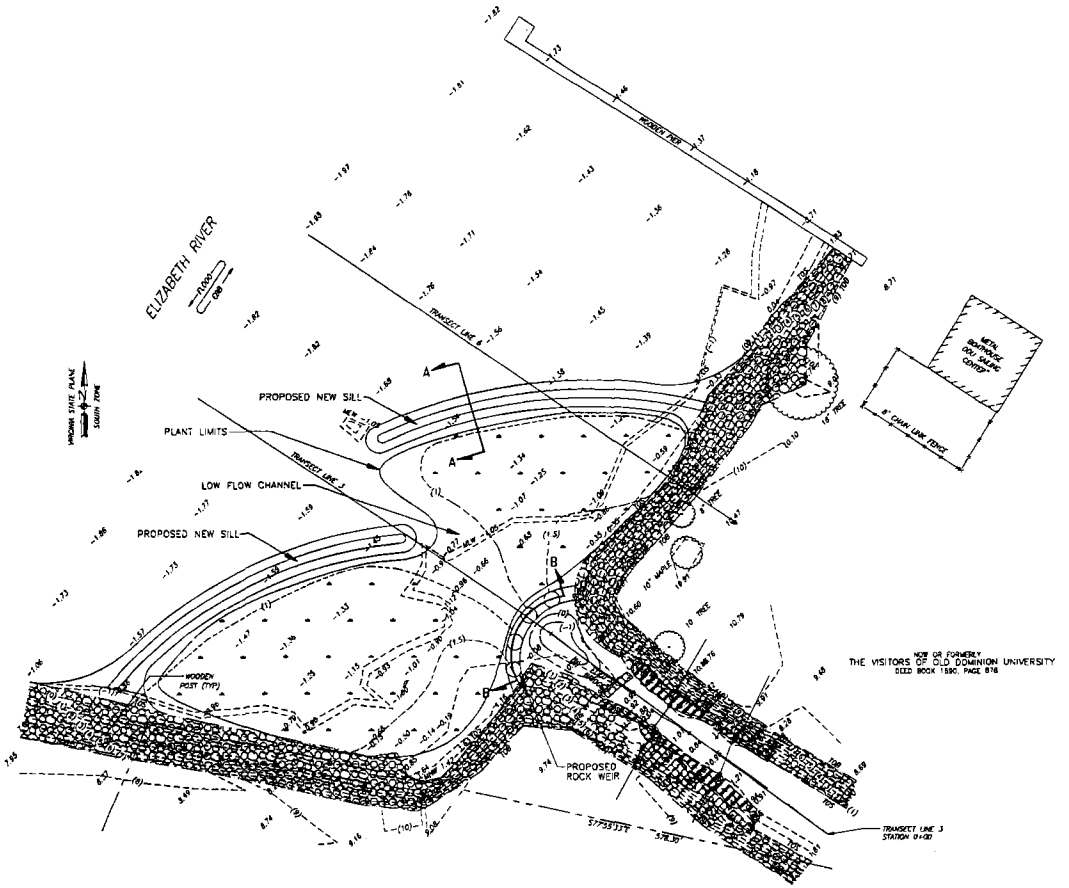


CE 'WOOD' 1999
CE 'STOCK' 1999
Shelter
+9
+6
+3
+2
+1
0
-1
-2
-3
SECTION A-A
Scales
Hor. 1" = 20'
Ver. 1" = 5'
SECTION B-B
Scales
Hor. 1" = 20'
Ver. 1" = 5'
- L E G E N D -
Saltbush
Saltbush and Phragmites mixture
Spartina alterniflora
HORIZONTAL AND VERTICAL CONTROL
Station | Easting | Northing | Elev.
CE 'WOOD, 1999' | 712,155,900.25' | 713,466,447.67' | 18.84'
CE 'STOCK, 1999' | 712,156,254.96' | 713,466,515.70 | 710.09
- N O T E S -
Coordinates are in US Survey Feet referred to the Virginia State Plane Grid (South Zone) and based on the North American Datum (NAD) of 1983, 1986 adjustment.
Elevations and Depths are in feet and referred to the National Geodetic Vertical Datum (NGVD) of 1929, 1972 adjustment. Depths were taken on 27 May 1999 and elevations were taken 06 June 1999.
A tidal study was performed 27 May 1999 to determine the difference between NGVD=MLW and NGVD=MHW.
MHW
1.5'
2.8'
NGVD 1929, 1972 ADJ.
1.2'
MLW
DATUM DIAGRAM
(NOT TO SCALE)
- L E G E N D -
TREES OR TREE LINE
PAVED ROAD
GRAVEL OR DIRT ROAD
TRAIL
SPOT ELEVATION (AT DECIMAL POINT) 10.3
SOUNDING (AT DECIMAL POINT) 10.3
CONTOUR
CONTROL MONUMENT
TRAVERSE POINT
TOP OF LEVEE
TOP OF BANK
TOE OF LEVEE
OPEN DITCH OR STREAM
DEPRESSION
FENCE
TELEPHONE LINE
POWER LINE
TELEPHONE & POWER LINE
SHORE LINE
SPILL BOX
MEAN LOW WATER MLW
MEAN LOWER LOW WATER MLLW
MEAN HIGH WATER MHW
RAILROAD
UNDERGROUND UG
U.S. GOVERNMENT BOUNDARY
CAST IRON CI
CONCRETE CONC
CORRUGATED METAL CM
TERRA COTTA TC
The information depicted represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.
DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
NORFOLK, VIRGINIA
CITY OF VIRGINIA BEACH, VIRGINIA
ELIZABETH RIVER HABITAT RESTORATION
WOODSTOCK NEIGHBORHOOD PARK
SURVEY OF 27 MAY & 06 JUNE 1999
SURVEYED D.K.L.
DRAWN C.S.R.
REVIEWED
CHECKED
SCALE 1"=30'
SHEET 1 OF 1

CORPS OF ENGINEERS

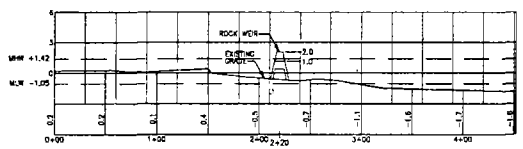
U. S. ARMY

B-34



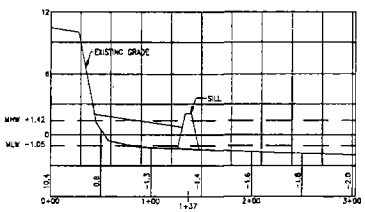
PROPOSED VEGETATED WETLAND AREA = 0.6 ACRES

SCALE: 1" = 30'



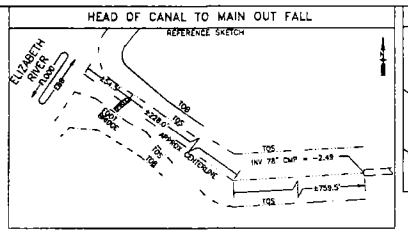
TRANSECT PROFILE BASELINE 3

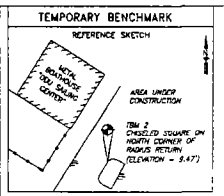
HORIZ. SCALE: 1"=50'

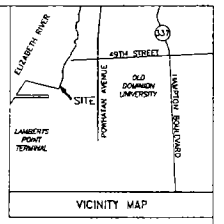


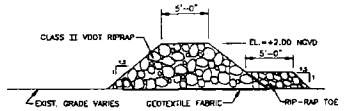
TRANSECT PROFILE BASELINE 6

HORIZ. SCALE: 1"=50'



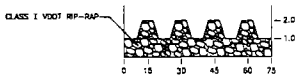






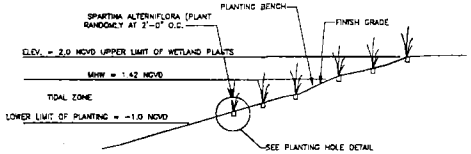
SECTION A-A: BREAKWATER SILL

NOT TO SCALE



SECTION B-B: ROCK-WEIR

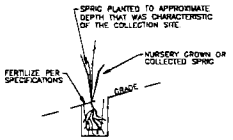
NOT TO SCALE



SECTION - PROPOSED MARSH GRASS PLANTING

PLANTING DETAIL

NOT TO SCALE



PLANTING HOLE DETAIL

NOT TO SCALE

LEGEND

SPOT ELEVATION

MAJOR CONTOUR (10)

MINOR CONTOUR (9)

MEAN HIGH WATER MHW 1.42

MEAN LOW WATER MLW -1.05

BUILDING

RIP RAP

SALT BUSH

SALT BUSH & SPARTINA ALTERNIFLORA

STORM DRAIN (SD) 18" SD

DITCH/SWALE/EDGE OF WATER

TOP OF BANK TOB

TOE OF SLOPE TOS

PROPERTY LINE

FENCE

TREE

SURVEY CONTROL POINT

BENCH MARK

FLAG

TIDAL FLOW EBB FLOOD

SURVEY NOTES:

1. TOPOGRAPHIC SURVEY PREPARED BY CLOWN & SADLER ASSOCIATES, INC., FROM FIELD DATA COLLECTED IN JANUARY 2000.
2. THIS SURVEY DOES NOT GUARANTEE THE EXISTENCE OR NONEXISTENCE, SIZE, TYPE, DEPTH, MATERIAL OR LOCATION OF ANY UNDERGROUND UTILITIES. ALL UTILITIES SHOWN ARE BASED ON ABOVEGROUND UTILITY STRUCTURES, AVAILABLE UTILITY MAPS AND SITE PLANS. THE CONTRACTOR SHALL HAVE ALL EXISTING SITE UTILITIES VERIFIED PRIOR TO ANY EXCAVATION.
3. ELEVATIONS SHOWN HEREON ARE IN FEET AND REFER TO THE NATIONAL GEODETIC VERTICAL DATUM 1929 (1972 ADJUSTMENT). ELEVATIONS WERE ESTABLISHED FROM U.S. ARMY CORPS OF ENGINEER DISK STAMPED "J-4 1943" ELEVATION = 8.07'.
4. HORIZONTAL COORDINATES SHOWN HEREON ARE IN FEET AND REFER TO THE VIRGINIA STATE PLANE COORDINATE SYSTEM - SOUTH ZONE - NAD83 (1986 ADJUSTMENT).
5. MEAN HIGH WATER (MHW) AND MEAN LOW WATER (MLW) ELEVATIONS WERE DERIVED FROM WATER LEVEL DATA PUBLISHED BY N.O.A.A./N.O.S. OCEANOGRAPHIC PRODUCTS AND SERVICES DIVISION. REFERENCE TIDE STATION FOR THIS SITE IS Sewells Point 865 6610.
6. THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND MAY NOT SHOW ANY OR ALL EASEMENTS, RESTRICTIONS OR ENCUMBRANCES WHICH MAY EFFECT THE SAID PROPERTY AS SHOWN.

PLANTING NOTES:

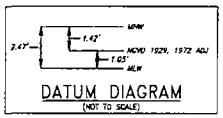
1. THE CONTRACTOR IS RESPONSIBLE FOR PLANTING AND FURNISHING MARSH GRASS PLANTS.
2. THE CONTRACTOR IS RESPONSIBLE FOR PREPARING ALL PLANT BENCHES AND BEDS TO THE SLOPES SHOWN USING APPROVED SELECT MATERIALS.
3. THE CONTRACTOR SHALL NOTIFY THE C.O.R. WHEN AREAS ARE READY FOR PLANTING.
4. ALL UPLAND AREAS DISTURBED BY CONSTRUCTION SHALL BY CONSTRUCTION SHALL BE TOPSOILED AND SEEDED PER SPECIFICATIONS.

HORIZ: 1"=30' 0' 30' 60' 90' 120' 150'

HORIZ: 1"=50' 0' 25' 50' 100' 150'

REFERENCES

DEED BOOK 1680 PAGE 876
DEED BOOK 267 B PAGE 271
DEED BOOK 1414 PAGE 379 (PARCEL 5)
DEED BOOK 422 PAGE 275
MAP BOOK 38 PAGE 127
MAP BOOK 4 PAGE 133
CITY OF NORFOLK MAP 4638
CITY OF NORFOLK MAP 4872
CITY OF NORFOLK DEED 5426



DATUM DIAGRAM

(NOT TO SCALE)

REV.	DATE	DESCRIPTION	BY	APP.

DEPARTMENT OF THE ARMY

NORFOLK DISTRICT, CORPS OF ENGINEERS

NORFOLK, VA.

DESIGNED	MH
DRAWN	Nita
CHECKED	MH
SUBMITTED	XXX
SCALE	AS SHOWN
DATE	JANUARY 2000

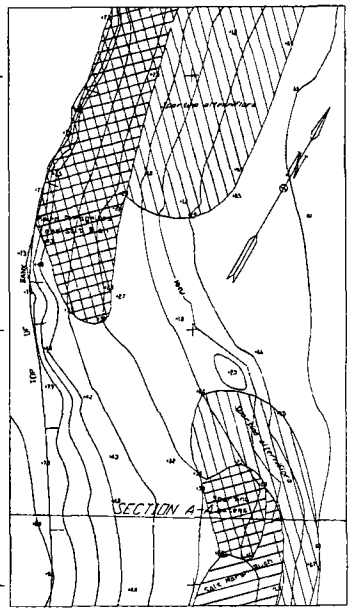
BOUNDARY AND TOPOGRAPHIC SURVEY OF THE WETLAND RESTORATION SITE O.D.U. DRAINAGE CANAL ELIZABETH RIVER ENVIRONMENTAL RESTORATION STUDY NORFOLK, VIRGINIA

ODU DRAINAGE CANAL

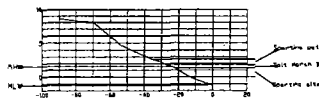
TO ACCOMPANY SPECIFICATION NO.	PROJECT NO. XXX	SHEET NO. C-1
PLOT SCALE: 1:1 FILE LOCATION:	DRAWING NO. XXX	

C-1

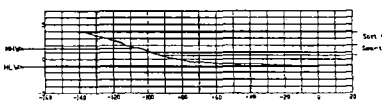
B-35



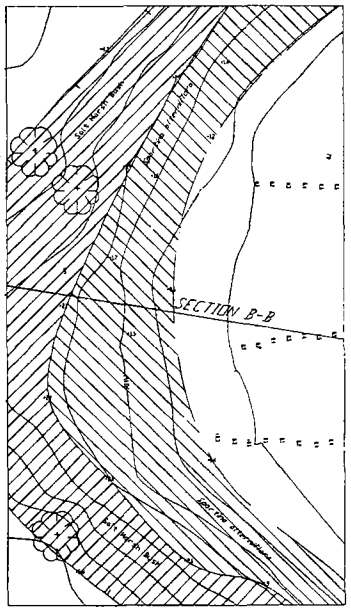
INSET A
Scale: 1" = 10'



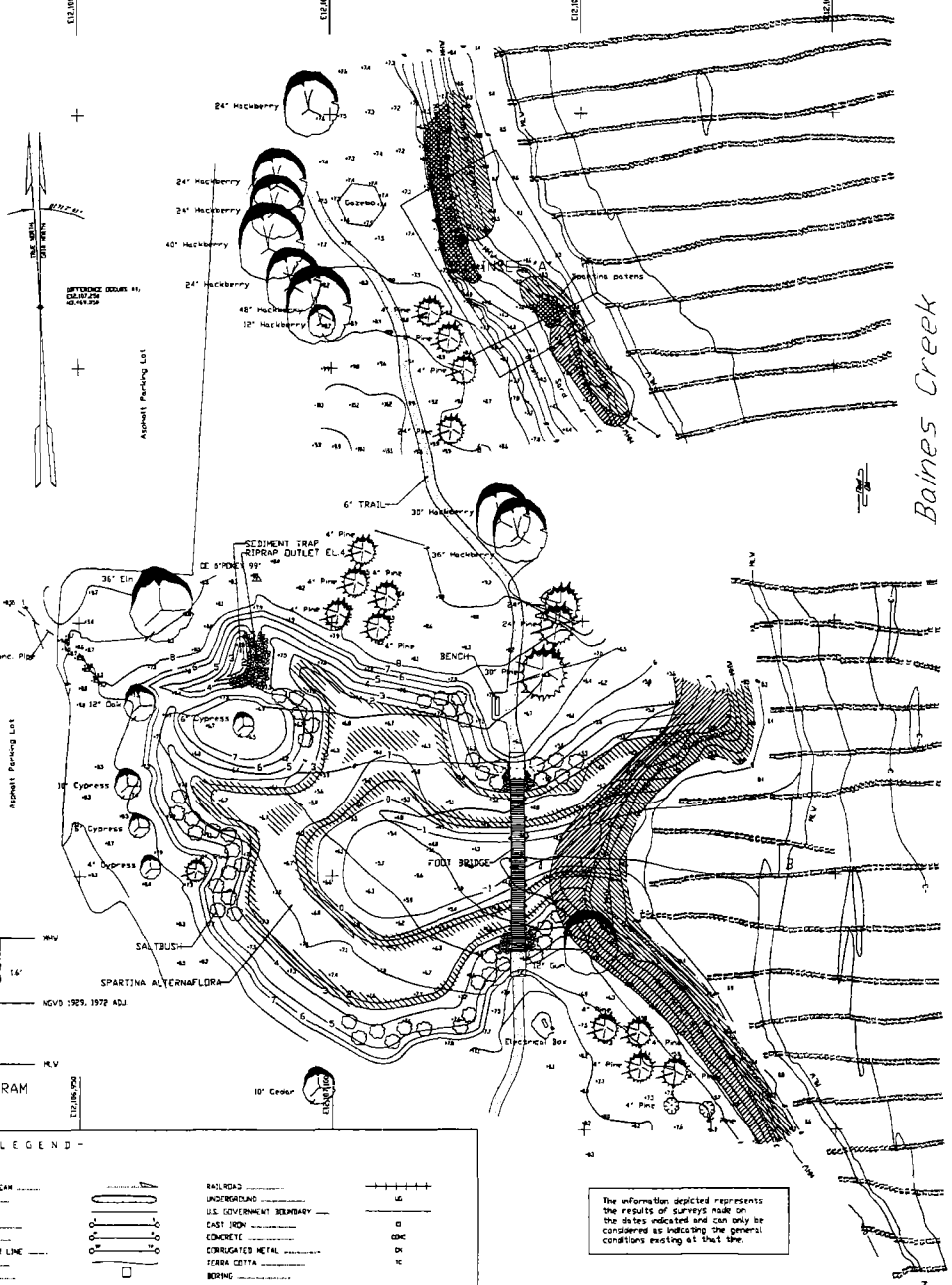
SECTION A-A
Scales:
Hor. 1" = 20'
Ver. 1" = 5'



SECTION B-B
Scales:
Hor. 1" = 20'
Ver. 1" = 5'



INSET B
Scale: 1" = 10'



- NOTES -

Coordinates are based on U.S. Survey Feet and referred to the Virginia State Grid (South Zone) which is based on the North American Datum of 1983, 1986 adjustment.

Elevations and Depths are based on the National Geodetic Vertical Datum (NGVD) of 1929, 1972 adjustment. Depths were taken on 02 & 10 June 1999 and elevations were taken on 01 June 1999.

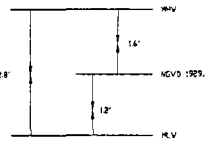
Mean Low Water (MLW) and Mean High Water (MHW) lines were determined by using information provided by the National Ocean Service at Norfolk Naval Shipyard. The difference between NGVD-MLW and NGVD-MHW at Norfolk Naval Shipyard was used at Portsmouth City Park to plot the MLW and MHW lines.

HORIZONTAL AND VERTICAL CONTROL

Station	Y?Easting?	Northing?	Elev.
CE 6'SMOKEY 99'	12,107,055.43'	13,469,379.86'	18.05'
CE 8'SMOKEY 99'	12,107,291.48'	13,469,345.79'	18.45'

- LEGEND -

Mixed Phragmites and Salt Bush
Spartina patens
Saltbush
Spartina alterniflora



DATUM DIAGRAM
(NOT TO SCALE)

- LEGEND -

TREES OR TREE LINE
PAVED ROAD
GRAVEL OR DIRT ROAD
TRAIL
SPOT ELEVATION (AT DECIMAL POINT)
SOUNDING (AT DECIMAL POINT)
CONTOUR
CONTROL MONUMENT
TRAVERSE POINT
TOP OF LEVEE
TOP OF BANK
TOE OF LEVEE

OPEN DITCH OR STREAM
DEPRESSION
FENCE
TELEPHONE LINE
POWER LINE
TELEPHONE & POWER LINE
SHORE LINE
SPILL BOX
MEAN LOW WATER
MEAN LOWER LOW WATER
MEAN HIGH WATER

RAILROAD
UNDERGROUND
U.S. GOVERNMENT BOUNDARY
CAST IRON
CONCRETE
CORRUGATED METAL
TERRA COTTA
BORING

The information depicted represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

CE 8'SMOKEY 99'

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
NORFOLK, VIRGINIA

CITY OF PORTSMOUTH, VIRGINIA

ELIZABETH RIVER HABITAT RESTORATION
PORTSMOUTH CITY PARK
SURVEY OF JUNE 1999

SURVEYED	DRAWN	SCALE (1"=30')	SHEET 6 OF
D.N.L.	C.S.R.		
REVIEWED	CHECKED		

GRANDY VILLAGE SITE PLAN

SCALE: 1"=50'

US Army Corps of Engineers
Norfolk District

NORFOLK DISTRICT
CORPS OF ENGINEERS
NORFOLK, VIRGINIA

DESIGNED CS
DRAWN CS
CHECKED BDT
QUANTITIES CJS
DATE JULY 2000
SCALE AS NOTED
PROJECT NO
DRAWING NO
Plot date: Dec 99
Plot Scale = 1:1
File name: /proj/pgs/grandy.dwg

ELIZABETH RIVER SITES
WETLAND RESTORATION

PROPOSED PLAN
GRANDY VILLAGE

C-1

B-36

ATTACHMENT C

SUBSURFACE SOILS INVESTIGATIONS - WETLANDS

EXECUTIVE SUMMARY

The GeoEnvironmental Engineering (GeoE) Section of the Norfolk District U.S. Army Corps of Engineers (USACE) was tasked by the Environmental Analysis Branch of the Norfolk District USACE to assist in the Wetlands Restoration Evaluation of the Elizabeth River Environmental Restoration - Feasibility Study. The GeoE Section was tasked to perform a Wetlands Subsurface Investigation to evaluate the Hazardous, Toxic, and Radioactive Waste (HTRW) potential of the following six (6) candidate sites on the Elizabeth River watershed in Virginia:

1. Site 4 - Grandy Village, Norfolk, Virginia.
2. Site 6 - Portsmouth City Park, Portsmouth, Virginia
3. Site 11 - Carolanne Farms, Virginia Beach, Virginia
4 Site 3 - Somme Avenue, Norfolk, Virginia.
5. Site 10a - Swimming Point (Crawford Bay), Portsmouth, Virginia
6. Site 9a - Sugar Hill (Scotts Creek), Portsmouth, Virginia.

The primary objective of the Elizabeth River Wetlands Subsurface Investigation was to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites Physical and chemical characterization was accomplished through the use of test pits, soil borings, and laboratory analyses of samples representative of distinct subsurface strata.

Field activities commenced on 9 November 1999 and extended through 18 November 1999. The complete set of analytical results was received on 31 January 2000. All analytical data were independently validated to ensure that data of sufficient quality were generated.

The GeoE Section performed a thorough evaluation of the results of the Elizabeth River Wetlands Subsurface Investigation to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Physical characterization includes identification and classification of distinct subsurface strata and approximating the vertical extent of the strata based on soil boring and test pit logs Chemical characterization includes identification of potential contaminants of concern (COCs) within the distinct subsurface strata, based on the chemical analyses of samples representative of the distinct subsurface strata.

A brief summary of the GeoE Section's Conclusions and Recommendations for each of the six (6) candidate sites is presented below:

1. Site 4 - Grandy Village, Norfolk, Virginia.
   - Potential risks to human health associated with the detected compounds and analytes are not anticipated at this site
   - Resource Conservation and Recovery Act (RCRA) hazardous wastes are not anticipated at this site.
   - The GeoE Section recommends the owner/operator report to the Tidewater Regional Office of the Virginia Department of Environmental Quality (VaDEQ) the presence of Total Petroleum Hydrocarbons-Diesel Range Organics (TPH-DRO) in excess of 100,000 micrograms per kilogram (ug/kg) in the drainage area behind the Grandy Village housing complex Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2 7 of the VaDEQ *Storage Tank Program Technical Manual.*

2 Site 6 - Portsmouth City Park, Portsmouth, Virginia
   - Potential risks to human health associated with mercury may warrant a site-specific study of risks.
   - RCRA hazardous wastes are not anticipated at this site.
   - Petroleum contaminated wastes are not anticipated at this site.

3. Site 11 - Carolanne Farms, Virginia Beach, Virginia

- Potential risks to human health associated with mercury may warrant a site-specific study of risks.
- RCRA hazardous wastes are not anticipated at this site.
- Petroleum contaminated wastes are not anticipated at this site.

4. Site 3 - Somme Avenue, Norfolk, Virginia.
   - Potential risks to human health associated with mercury may warrant a site-specific study of risks.
   - RCRA hazardous wastes are not anticipated at this site.
   - The GeoE Section recommends the owner/operator report to the Tidewater Regional Office of the VaDEQ the presence of TPH-DRO in excess of 100,000 ug/kg. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VaDEQ *Storage Tank Program Technical Manual.*

5. Site 10a - Swimming Point (Crawford Bay), Portsmouth, Virginia
   - Potential risks to human health associated with mercury may warrant a site-specific study of risks
   - RCRA hazardous wastes are not anticipated at this site
   - The GeoE Section recommends the owner/operator report to the Tidewater Regional Office of the VaDEQ the presence of TPH-DRO in excess of 100,000 ug/kg. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VaDEQ *Storage Tank Program Technical Manual.*

6. Site 9a - Sugar Hill (Scotts Creek), Portsmouth, Virginia.
   - Potential risks to human health associated with mercury may warrant a site-specific study of risks.
   - RCRA hazardous wastes are not anticipated at this site.
   - Petroleum contaminated wastes are not anticipated at this site.

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Attachment D. Field Documentation - Logbook Entries, Site Diagrams, Test Pit/Soil Boring Logs, and Photographs.

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1. PROJECT DESCRIPTION.

1.1. Background.

The Elizabeth River is located approximately 135 miles southeast of Washington, D.C., at the junction of Hampton Roads and the Chesapeake Bay. The river is a tidal estuary that runs through the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach, and drains into the Chesapeake Bay. It is the economic mainstay of the Hampton Roads community, providing navigable waters for commercial, industrial, recreational, and defense use The Elizabeth River watershed consists of approximately 300 square miles, of which approximately 145 square miles is tidally influenced Population and economic growth along the Elizabeth River have created many environmental problems within the river basin. Stormwater runoff, point source discharges, and spills from commercial, industrial, and military sources over several hundred years have reduced water quality and have contaminated river sediments. Industrial and urban development and associated fill activities have destroyed many of the wetland habitats that once existed along the river, which has had and adverse effect on the ecosystem.

The Norfolk District U.S. Army Corps of Engineers (USACE), the Commonwealth of Virginia, the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach have entered into a Feasibility Cost Sharing Agreement (FCSA) to implement a Feasibility Study for the environmental restoration of sediment and wetlands within the Elizabeth River Basin. The Feasibility Study represents the second phase of the two-phase USACE process consisting of the Reconnaissance and Feasibility phases. In support of the FCSA, the Norfolk District USACE, in conjunction with the other sponsors, prepared the July 1998 *Project Study Plan (PSP) for the Elizabeth River Environmental Restoration - Feasibility Investigation*, which details the work scope, schedule, and budget for the Feasibility Study The *PSP* was coordinated with all Norfolk District USACE elements and the non-federal sponsors and reflects the requirements, desires, and interests of all parties involved. The purpose of the Feasibility Study is to ensure the timely and economical completion of a quality Feasibility Study Report that is expected to recommend habitat restoration as an implementable solution to the loss of wetlands and degradation of sediments in the Elizabeth River Basin. The Feasibility Study shall serve as the basis for formulating projects and developing a decision-making document to determine whether projects should proceed to construction

Based on the conclusions obtained from the Reconnaissance phase, the two primary alternatives to be evaluated under the Feasibility Study for habitat restoration are sediment remediation and wetland restoration. A Steering Committee, comprised of representatives from USACE and other non-federal sponsors, selected fourteen (14) candidate sites to be evaluated for wetland restoration under the Feasibility Study. As part of the wetland restoration initiative, the GeoEnvironmental Engineering (GeoE) Section of the Norfolk District USACE was tasked by the Environmental Analysis Branch of the Norfolk District USACE to assist in the Wetlands Restoration Evaluation of the Elizabeth River Environmental Restoration - Feasibility Study. The GeoE Section was tasked to perform a Wetlands Subsurface Investigation to evaluate the Hazardous, Toxic, and Radioactive Waste (HTRW) potential of the following six (6) candidate sites on the Elizabeth River watershed in Virginia:

7. Site 4 - Grandy Village, Norfolk, Virginia
8. Site 6 - Portsmouth City Park, Portsmouth, Virginia.
9. Site 11 - Carolanne Farms, Virginia Beach, Virginia
10. Site 3 - Somme Avenue, Norfolk, Virginia.
11. Site 9a - Sugar Hill (Scotts Creek), Portsmouth, Virginia.
12. Site 10a - Swimming Point (Crawford Bay), Portsmouth, Virginia.

A site map of the Elizabeth River depicting the approximate locations of each candidate site is shown in Attachment B and site maps of each of the six (6) candidate sites are provided in Attachment C. A brief site history is provided for each of the six (6) candidate sites in the following paragraphs:

1.1.1. Site 4, Grandy Village, Norfolk, Virginia.

Historical photographic analyses indicate that this site was a series of small tidal creeks and associated saltmarshes as late as 1949. A 1909 city base map indicates that this site was actually open surface water with a more undulated coastline contrary to the current linear shoreline. The

Grandy Village housing complex was built in the early 1950s, on presumably natural high grounds and fill material within the historical saltmarsh. 1974 aerial photographs show extensive marsh filling activities via dump trucks and bulldozers spreading the material. Field observations suggest that the fill material consists of asphalt, concrete, sand, and miscellaneous debris (e.g. car parts, household garbage). Post-fill vegetation does not appear to be stressed; however, two localized areas have sparse to no vegetation with sandy to silty soils Adjacent land use is residential. Potential contaminant sources: asphalt, concrete, miscellaneous fill material

1.1.2. Site 6, Portsmouth City Park, Portsmouth, Virginia.

A 1937 aerial photograph indicates that a tidal creek and associated saltmarsh existed in the swale area proposed for restoration and a fringe marsh existed along the eroded Bailey's Creek shoreline of the park. Paul Forehand of Portsmouth's Park and Recreation stated that these sites were filled with debris from the resurfacing of Turnpike Boulevard in the 1940s. Field observations reveal asphalt, concrete, brick, and granite pieces and slabs. The eroded shoreline has outcroppings of the various fill materials and the shoreline is littered with the aforementioned debris. Hand augers revealed a petroleum-like odor of the subsurface material in the swale area. Adjacent land use is recreational. Potential contaminant sources: asphalt, concrete, miscellaneous fill material.

1.1.3. Site 11, Carolanne Farms, Virginia Beach, Virginia.

A 1937 aerial photograph indicates that the proposed site was upland and apparently used for agricultural purposes The City of Virginia Beach acquired the site in 1982 when an old sewage treatment plant built in the early 1960s, serving the subdivision, was closed. The site was subsequently developed into a neighborhood park. The existing two mounds in the vicinity of the site contain structures associated with the privately run sewage treatment plant. These structures can be seen in a 1985 aerial photograph, but subsequently the city has covered the mounds with earthen material. Potential contaminant sources. agricultural practices, sewage treatment plant.

1.1.4. Site 3, Somme Avenue, Norfolk, Virginia.

Historical aerial photographs indicate that this site was a tidal saltmarsh as late as 1956. Ms. Margaret Arnold of 2607 Somme Avenue, whose property is on and adjacent to the site, stated that the site was filled between around 1960 with debris from road construction on 26th and 27th streets in Norfolk. 1974 aerial photographs show the site continually being filled, but the photographs are inconclusive for determining the type of fill material. Field observations suggest that the majority of the fill material is debris from road reconstruction specifically, concrete, granite, and asphalt slabs A few gravel piles are present. Post fill vegetative growth does not appear to be stressed and no soil staining has been detected. Adjacent land use is mostly residential with the exception of a gas station to the northwest of the site, across a small tidal creek. Potential contaminant source: asphalt, concrete.

1.1.5. Site 10a, Swimming Point (Crawford Bay), Portsmouth, Virginia.

A 1913 map indicates that this site was a tidal creek with associated salt marshes. The historic creek has had several aliases Church Creek, Tar Creek, and Buck Creek. A 1937 aerial photograph reveals that this site had undergone partial filling, mainly at the headwaters of the historic tidal creek A 1940s aerial photograph suggests the site had converted almost entirely to upland with scrub/shrub vegetation present Existing and historic adjacent land use has been residential, commercial (Portsmouth Naval Hospital), and industrial (a manufactured gas plant (MGP)). The former Portsmouth Gas Company, which was located to the southwest of the site, operated the MGP from 1856 to 1956. In 1992, the Virginia Department of Environmental Quality (VaDEQ) received Phase I and Phase II Environmental Assessments prepared in connection with the sale of the Patio Plaza Apartments, which occupies part of the original MGP site. Petroleum hydrocarbons and semivolatile organic compounds were detected in soil sample collected from bore holes advanced on the apartment complex property. Several incidents of a petroleum sheen on water discharging from a stormwater outfall pipe into the Elizabeth River at Swimming Point have been documented. In April 1995, a recovery well was installed at the old MGP site to remove the presence of phase separated hydrocarbons from the groundwater. An 20 October 1998 progress report states that 459.18 gallons of product have been removed from the subsurface and product thickness in one monitoring well was

4.83 feet. A 31 July 1995 summary from the environmental consultant stated that "concentrations detected in Monitoring Wells MW-7A and MW-8A have decreased or remained non-detected, confirming that groundwater degradation is not extensive in the shallow water-table aquifer north and northeast of the MGP site." In December 1997, the Naval Regional Medical Center in Portsmouth, which is immediately north of the proposed wetland restoration candidate site, reported to the VaDEQ the discovery of subsurface petroleum contamination during the installation of a property fence, which abuts the study area. The VaDEQ believes the contamination encountered with the fence installation is attributable to historical petroleum releases associated with the former MGP. Potential Contamination Sources: contaminant plume associated with the historic Portsmouth Gas Company's MGP, miscellaneous fill material.

1.1.6. Site 9a, Sugar Hill (Scotts Creek), Portsmouth, Virginia.

1940 aerial photographs reveal that this area was a tidal creek with associated saltmarshes Filling activities have bifurcated the original marsh/creek and subsequently created the present day peninsula. Sometime between the 1940s and 1985 the site was filled. Known previous land use activities include storage/staging area for box containers from the nearby Portsmouth Marine Terminal, as can be seen in 1985 aerial photographs. Portsmouth Port Industrial Commission (PPIC), property owners, stated that unauthorized dumping activities became problematic in the late 1980s, thus PPIC fenced and gated the property. Currently the site is not in use. Field observations indicate a broad range of fill material. Filled material includes, but may not be limited to, tires, shingles, smelting byproduct debris, and household trash. Adjacent land use is residential and commercial port facilities. Potential contaminant sources: miscellaneous fill material.

1.2. Objectives.

The primary objective of the Elizabeth River Wetlands Subsurface Investigation is to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Physical and chemical characterization was accomplished through the use of test pits and/or soil borings. The sampling strategy for locating the test pits and/or soil borings consisted of a combination of systematic and hot spot sampling strategies. For each site, a recommended number of test pits and/or soil borings were located to provide for adequate site coverage, and additional test pits and/or soil borings were installed to better define potential hot spots encountered during the investigation. Physical characterization included visual identification of distinct subsurface strata, visual classification of the soil types within each distinct subsurface strata, and approximating the vertical extent of each distinct subsurface strata. Chemical characterization consisted of laboratory analyses of samples representative of the distinct subsurface strata. The samples were analyzed for site-specific constituents based on available historical information. The analytical methods served to identify the presence or absence and to accurately quantify each constituent. The data collected from the Elizabeth River Wetlands Subsurface Investigation also serve to satisfy the following secondary objectives to better assess the feasibility of wetlands restoration at each site: identify potential risks to human health and the environment associated with the fill and/or in-situ materials; estimate the approximate volume of fill material; identify potential disposal and handling requirements, and estimate approximate costs to excavate and/or dispose or grade fill material.

2. FIELD ACTIVITIES.

Field activities commenced on 9 November 1999 and extended through 18 November 1999. The sampling team consisted of personnel from the Norfolk District USACE. Test pit excavation services were provided by Allard Environmental through Schnabel Engineering. Drilling services were provided by Fishburne Drilling through Schnabel Engineering. Primary laboratory analytical services were provided by Severn Tent Laboratories (STL) Baltimore. Quality Assurance (QA) laboratory analytical services were provided by DataChem Laboratories. All field activities were conducted in accordance with the 29 September 1999 *Sampling and Analysis Plan (SAP), Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia*, unless otherwise specified in this report. All site safety concerns were managed in accordance with the 22 October 1999 *Site Safety and Health Plan (SSHP), Elizabeth River Wetlands Subsurface Investigation, Elizabeth River, Virginia*, unless otherwise specified in this report. A brief summary of relevant field activities for each of the six (6) candidate sites is presented in the following paragraphs.

2.1. Site 4, Grandy Village, Norfolk, Virginia.

Field activities at this candidate site commenced on 9 November 1999 and extended through 10 November 1999. Sampling personnel consisted of Mr. Marc D. Gutterman and Mr. David Byeong W. Kang, both of the GeoE Section. Test pit excavation services were provided by Allard Environmental. Drilling services were provided by Fishburne Drilling.

On 9 November 1999, the sampling team mobilized to the site at approximately 830 hours. Weather conditions were sunny and the temperature was approximately 70° Fahrenheit. The sampling team excavated five (5) test pits, identified as 00-GV-TP-1 through 00-GV-TP-5, in the western and southern portions of the site. On 10 November 1999, the sampling team mobilized to the site at approximately 800 hours. Weather conditions were sunny and the temperature was approximately 80° Fahrenheit The sampling team excavated two (2) test pits, identified as 00-GV-TP-6 and 00-GV-TP-7, and four (4) soil borings, identified as 00-GV-SB-1 through 00-GV-SB-4. A total of seven (7) test pits and four (4) soil borings were excavated and advanced during the subsurface investigation of this candidate site. A site plan depicting the locations of the seven (7) test pits and the four (4) soil borings is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

Primary, Quality Control (QC) field samples, and QA field samples were collected by sampling personnel in accordance with the 29 September 1999 *SAP*. Primary and QC field samples were shipped via Federal Express to STL Baltimore in Sparks, Maryland. QA field samples were shipped via Federal Express to DataChem Laboratories in Salt Lake City, Utah. A Sample Summary Sheet summarizing the sample IDs, dates and times of collection, and the analyses performed is shown in Attachment E. Sampling personnel completed the appropriate Chain-of-Custody documentation, which accompanies the samples to the respective laboratories. Attachment F contains completed Chain-of-Custody documentation.

2.1.1. Primary Samples.

Sampling personnel submitted six (6) primary soil samples to the primary laboratory for the following analyses: Target Compound List (TCL) polycyclic aromatic hydrocarbons (PAHs) by EPA SW-846 Method 8270 Single Ion Monitoring (SIM), Target Analyte List (TAL) metals by EPA SW-846 Method 6010/7000 series, cyanide by EPA SW-846 Method 9012, Total Petroleum Hydrocarbons (TPH) Gasoline Range Organics (GRO) by EPA SW-846 Method 5035/8015, and TPH Diesel Range Organics (DRO) by EPA SW-846 Method 3550/8015.

2.1.1.1. 00-GV-TP-1.

Test pit 00-GV-TP-1 was located in the southwestern part of the site. Excavation commenced on 9 November 1999 at 900 hours and continued down to a maximum depth of 9 feet below ground surface (bgs). The material representative of 0 to 6.5 feet bgs is suspected to be fill material that may have been either physically deposited or naturally collected over time. At approximately 6 5 feet bgs, the field team encountered a very stiff dark clay intermixed with roots and vegetation. Based on the presence of roots and vegetation at this depth, it is the professional opinion of the GeoE Section that the material encountered at 6.5 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 9 November 1999 at 955 hours, sampling personnel collected primary soil sample, 00-GV-TP-1-7.5, representative of suspect in-situ material at 7.5 feet bgs.

2.1.1.2. 00-GV-TP-6.

Test pit 00-GV-TP-6 was located in the southeastern part of the site, in one of the localized areas having sparse to no vegetation. Excavation commenced on 10 November 1999 at 800 hours and continued down to a maximum depth of 11 feet bgs. The material representative of 0 to 5 feet bgs is suspected to be fill material. On 10 November 1999 at 900 hours, sampling personnel collected primary soil sample, 00-GV-TP-6-1, representative of suspect fill material at 1 foot bgs. At approximately 5 feet bgs, the field team encountered a gray sandy clay w/decaying organic material. Based on the presence of organic material at this depth, it is the professional opinion of the GeoE Section that the material encountered at 5 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ

material. On 10 November 1999 at 920 hours, sampling personnel collected primary soil sample, 00-GV-TP-6-5, representative of suspect in-situ material at 5 feet bgs

2.1.1.3. 00-GV-SB-1.

Soil boring 00-GV-SB-1 was located in the northeastern part of the site, along the drainage area behind the housing community. Drilling commenced on 10 November 1999 at 1000 hours and continued down to 6 feet bgs. The material representative of 0 to 0.5 feet bgs is suspected to be fill material. At approximately 0.5 feet bgs, sampling personnel encountered a saturated gray clay intermixed with organic matter. It is the professional opinion of the GeoE Section that the material encountered at 0.5 feet bgs represents the interface between the fill and in-situ material. On 10 November 1999 at 1015 hours, sampling personnel collected primary soil sample, 00-GV-SB-1-3, representative of suspect in-situ material at 3 feet bgs.

2.1.1.4. 00-GV-SB-2.

Soil boring 00-GV-SB-2 was located in the northeast part of the site, along the drainage area behind the housing community. Drilling commenced on 10 November 1999 at 1100 hours and continued down to 10 5 feet bgs. The material representative of 0 to 0.5 feet bgs is suspected to be fill material. On 10 November 1999 at 1130 hours, sampling personnel collected primary soil sample, 00-GV-SB-2-0.5, representative of suspect fill material at 0.5 feet bgs. At approximately 0.5 feet bgs, sampling personnel encountered a fine gray sand with vegetation. It is the professional opinion of the GeoE Section that the material encountered at 0.5 feet bgs represents the interface between the fill and in-situ material.

2.1.1.5. 00-GV-SB-3.

Soil boring 00-GV-SB-3 was located in the northeast part of the site, along the drainage area behind the housing community. Drilling commenced on 10 November 1999 at 1300 hours and continued down to 9 feet bgs. The material representative of 0 to 3 feet bgs is suspected to be fill material. At approximately 3 feet bgs, sampling personnel encountered a saturated fine gray sand consistent with what was encountered in 00-GV-SB-2 at 0.5 feet bgs. It is the professional opinion of the GeoE Section that the material encountered at 3 feet bgs represents the interface between the fill and in-situ material. On 10 November 1999 at 1325 hours, sampling personnel collected primary soil sample, 00-GV-SB-3-3, representative of suspect in-situ material.

2.1.2. QC Field Samples.

Sampling personnel submitted one (1) QC trip blank sample to the primary laboratory for TPH GRO analysis. The QC trip blank sample, identified as 00-GV-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the primary laboratory unopened. The QC trip blank sample was submitted to the primary laboratory for TPH GRO analysis.

2.1.3. QA Field Samples.

No QA field samples were collected at this candidate site during the field investigations.

2.1.4. Investigation Derived Wastes.

The sampling team performed drilling and sampling activities in a manner to minimize the generation of Investigation Derived Wastes (IDW). Upon completion of sample collection activities, the sampling team disposed of soil generated from the sample collection process by placing the material back into the test pit or bore hole. Upon completion of sample collection activities, the sampling team disposed of the decontamination water on-site by allowing it to infiltrate the ground. Upon completion of sample collection activities, the sampling team disposed of disposable personal protective equipment as solid waste

2.2. Site 6, Portsmouth City Park, Portsmouth, Virginia.

Field activities at this candidate site commenced on 11 November 1999 and extended through 12 November 1999. Sampling personnel consisted of Mr. Marc D Gutterman and Mr. David Byeong W.

Kang, both of the GeoE Section. Test pit excavation services were provided by Allard Environmental Drilling services were provided by Fishburne Drilling.

On 11 November 1999, the sampling team mobilized to the site at approximately 800 hours. Weather conditions were sunny and the temperature was approximately 70° Fahrenheit. The sampling team excavated four (4) test pits, identified as 00-PC-TP-1 through 00-PC-TP-4. On 12 November 1999, the sampling team mobilized to the site at approximately 830 hours. The sampling team advanced four (4) soil borings, identified as 00-PC-SB-1 through 00-PC-SB-4. A total of four (4) test pits and four (4) soil borings were excavated and advanced during the subsurface investigation of this candidate site. A site plan depicting the locations of the four (4) test pits and the four (4) soil borings is shown in Attachment C Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

Primary, QC field samples, and QA field samples were collected by sampling personnel in accordance with the 29 September 1999 *SAP*. Primary and QC field samples were shipped via Federal Express to STL Baltimore in Sparks, Maryland. QA field samples were shipped via Federal Express to DataChem Laboratories in Salt Lake City, Utah. A Sample Summary Sheet summarizing the sample IDs, dates and times of collection, and the analyses performed is shown in Attachment E. Sampling personnel completed the appropriate Chain-of-Custody documentation, which accompanies the samples to the respective laboratories. Attachment F contains completed Chain-of-Custody documentation.

2.2.1. Primary Samples.

Sampling personnel submitted six (6) primary soil samples to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.2.1.1. 00-PC-TP-2.

Test pit 00-PC-TP-2 was located in the southern part of the site within the swale area proposed for restoration. Excavation commenced on 11 November 1999 at 1015 hours and continued down to a maximum depth of 6.5 feet bgs The material representative of 0 to 3 feet bgs is suspected to be fill material On 11 November 1999 at 1025 hours, sampling personnel collected primary soil sample, 00-PC-TP-2-1.5, representative of suspect fill material at 1.5 feet bgs. At approximately 3 feet bgs, the field team encountered a layer of black organic matter with roots and vegetation. Based on the presence of organic material at this depth, it is the professional opinion of the GeoE Section that the material encountered at 3 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material On 11 November 1999 at 1050 hours, sampling personnel collected primary soil sample, 00-PC-TP-2-3, representative of suspect in-situ material at 3 feet bgs.

2.2.1.2. 00-PC-SB-2.

Soil boring 00-PC-SB-2 was located in the southern part of the site within the swale area proposed for restoration. Drilling commenced on 12 November 1999 at 925 hours and continued down to a maximum depth of 9 feet bgs The material representative of 0 to 3.6 feet bgs is suspected to be fill material. On 12 November 1999 at 925 hours, sampling personnel collected primary soil sample, 00-PC-SB-2-0.8, representative of suspect fill material at 0.8 feet bgs. At approximately 3.6 feet bgs, the field team encountered a tan clayey sand with traces of orange oxide deposits that was free of brick debris that was present in the suspect fill material. Based on the absence of brick debris at this depth, it is the professional opinion of the GeoE Section that the material encountered at 3.6 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 12 November 1999 at 1050 hours, sampling personnel collected primary soil sample, 00-PC-SB-2-3, representative of suspect in-situ material at 3.6 feet bgs.

2.2.1.3. 00-PC-SB-4.

Soil boring 00-PC-SB-4 was located in the northern part of the site adjacent to the eroded fringe along the shoreline of Bailey's Creek.. Drilling commenced on 12 November 1999 at 1040 hours and continued down to a maximum depth of 7 feet bgs. The material

representative of 0 to 3 feet bgs is suspected to be fill material. On 12 November 1999 at 1040 hours, sampling personnel collected primary soil sample, 00-PC-SB-4-2, representative of suspect fill material at 2 feet bgs. At approximately 3.5 feet bgs, the field team encountered a dark gray sand with high organic content and fresh roots. Based on the presence of fresh roots and vegetation at this depth, it is the professional opinion of the GeoE Section that the material encountered at 3.5 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 12 November 1999 at 1045 hours, sampling personnel collected primary soil sample, 00-PC-SB-4-3.5, representative of suspect in-situ material at 3.5 feet bgs.

2.2.2. QC Field Samples.

Sampling personnel submitted one (1) QC field duplicate sample to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO. Sampling personnel submitted one (1) QC field blank sample to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO. Sampling personnel submitted one (1) QC equipment rinse blank sample to the primary laboratory for the following analyses. TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO Sampling personnel submitted one (1) QC trip blank sample to the primary laboratory for TPH GRO analysis.

2.2.2.1. 00-PC-TP-2-2.

On 11 November 1999 at 1025 hours, sampling personnel collected a QC field duplicate sample of primary soil sample 00-PC-TP-2-1.5. Sampling personnel identified the QC field duplicate sample as 00-PC-TP-2-2 and submitted it to the primary laboratory for the following analyses· TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.2.2.2. 00-PC-FB.

On 12 November 1999 at 845 hours, sampling personnel collected one (1) QC field blank sample. Sampling personnel collected the QC field blank sample by transferring deionized water into the appropriate sample containers and identified the sample as 00-PC-FB. Sampling personnel submitted QC field blank sample, 00-PC-FB, to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.2.2.3. 00-PC-EB.

On 12 November 1999 at 1025 hours, sampling personnel collected one (1) QC equipment rinse blank sample Sampling personnel collected the QC equipment rinse blank sample by rinsing decontaminated sampling utensils with deionized water and collecting the rinse water in the appropriate sample containers. Sampling personnel identified the QC equipment rinse blank sample as 00-PC-EB. Sampling personnel submitted QC equipment rinse blank sample. 00-PC-EB, to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.2.2.4. 00-PC-TB (TRIP BLANK).

The QC trip blank sample, identified as 00-PC-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the laboratory unopened. The QC trip blank sample was submitted to the primary laboratory for TPH GRO analysis.

2.2.3. QA Field Samples.

Sampling personnel submitted one (1) QA field duplicate sample to the QA laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO. Sampling personnel submitted one (1) QA trip blank sample to the QA laboratory for TPH GRO analysis.

2.2.3.1. 00-PC-TP-2-3.

On 11 November 1999 at 1050 hours, sampling personnel collected a QA field duplicate sample of primary soil sample 00-PC-TP-2-3 and submitted it to the QA laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.2.3.2. 00-PC-TB (TRIP BLANK).

The QA trip blank sample, identified as 00-PC-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the QA laboratory unopened. The QA trip blank sample was submitted to the QA laboratory for TPH GRO analysis.

2.2.4. Investigation Derived Wastes.

The sampling team performed drilling and sampling activities in a manner to minimize the generation of IDW. Upon completion of sample collection activities, the sampling team disposed of soil generated from the sample collection process by placing the material back into the test pit or bore hole. Upon completion of sample collection activities, the sampling team disposed of the decontamination water on-site by allowing it to infiltrate the ground. Upon completion of sample collection activities, the sampling team disposed of disposable personal protective equipment as solid waste.

2.3. Site 11, Carolanne Farms, Virginia Beach, Virginia.

Field activities at this candidate site were conducted on 15 November 1999 Sampling personnel consisted of Mr. G. Kent Balden and Mr. David Byeong W. Kang, both of the Norfolk District USACE. Drilling services were provided by Fishburne Drilling.

On 15 November 1999, the sampling team mobilized to the site at approximately 900 hours. Weather conditions were sunny and the temperature was approximately 50° Fahrenheit. The sampling team advanced five (5) soil borings, identified as 00-CF-SB-1 through 00-CF-SB-5. A total of five (5) soil borings were advanced during the subsurface investigation of this candidate site A site plan depicting the locations of the five (4) soil borings is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

Primary, QC field samples, and QA field samples were collected by sampling personnel in accordance with the 29 September 1999 *SAP*. Primary and QC field samples were shipped via Federal Express to STL Baltimore in Sparks, Maryland. QA field samples were shipped via Federal Express to DataChem Laboratories in Salt Lake City, Utah. A Sample Summary Sheet summarizing the sample IDs, dates and times of collection, and the analyses performed is shown in Attachment E. Sampling personnel completed the appropriate Chain-of-Custody documentation, which accompanies the samples to the respective laboratories. Attachment F contains completed Chain-of-Custody documentation.

2.3.1. Primary Samples.

Sampling personnel submitted two (2) primary soil samples to the primary laboratory for the following analyses: TCL volatile organic compounds (VOCs) by EPA SW-846 Method 8260B, TCL semivolatile organic compounds (SVOCs) by EPA SW-846 Method 8270C, TCL pesticides by EPA SW-846 Method 8081, TCL polychlorinated biphenyls (PCBs) by EPA SW-846 Method 8082, TAL metals, and cyanide.

2.3.1.1. 00-CF-SB-3.

Soil boring 00-CF-SB-3 was located in the middle of the site Drilling commenced on 15 November 1999 at 1040 hours and continued down to a maximum depth of 7.5 feet bgs. The material representative of 0 to 2 feet bgs is suspected to be fill material. On 15 November 1999 at 1040 hours, sampling personnel collected primary soil sample, 00-CF-SB-3-1, representative of suspect fill material at 1 feet bgs At approximately 2 feet bgs, the field team encountered a gray stiff clay with traces of orange iron oxide deposits. Based on the presence of orange iron oxide deposits at this depth, it is the professional opinion of the GeoE Section that the material encountered at 2 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material.

2.3.1.2. 00-CF-SB-5.

Soil boring 00-CF-SB-5 was located in the northwest part of the site. Drilling commenced on 15 November 1999 at 1235 hours and continued down to a maximum depth of 9 feet bgs. The material representative of 0 to 3.2 feet bgs is suspected to be fill material. At approximately 3.2 feet bgs, the field team encountered a moist gray clay with some organic content and traces of orange iron oxide deposits. Based on the presence of organic material at this depth, it is the professional opinion of the GeoE Section that the material encountered at 3.2 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 15 November 1999 at 1245 hours, sampling personnel collected primary soil sample, 00-CF-SB-5-4, representative of suspect in-situ material at 4 feet bgs.

2.3.2. QC Field Samples.

Sampling personnel submitted one (1) QC field duplicate sample to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide. Sampling personnel submitted one (1) QC field blank sample to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide. Sampling personnel submitted one (1) QC equipment rinse blank sample to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide. Sampling personnel submitted one (1) QC trip blank sample to the primary laboratory for TCL VOCs analysis.

2.3.2.1. 00-CF-SB-3-2.

On 15 November 1999 at 1040 hours, sampling personnel collected a QC field duplicate sample of primary soil sample 00-CF-SB-3-1 Sampling personnel identified the QC field duplicate sample as 00-CF-SB-3-2 and submitted it to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.3.2.2. 00-CF-FB.

On 15 November 1999 at 1125 hours, sampling personnel collected one (1) QC field blank sample. Sampling personnel collected the QC field blank sample by transferring deionized water into the appropriate sample containers and identified the sample as 00-CF-FB. Sampling personnel submitted QC field blank sample, 00-CF-FB, to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.3.2.3. 00-PC-EB.

On 15 November 1999 at 1115 hours, sampling personnel collected one (1) QC equipment rinse blank sample. Sampling personnel collected the QC equipment rinse blank sample by rinsing decontaminated sampling utensils with deionized water and collecting the rinse water in the appropriate sample containers. Sampling personnel identified the QC equipment rinse blank sample as 00-CF-EB. Sampling personnel submitted QC equipment rinse blank sample 00-CF-EB, to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.3.2.4. 00-CF-TB (TRIP BLANK).

The QC trip blank sample, identified as 00-CF-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the laboratory unopened. The QC trip blank sample was submitted to the primary laboratory for TCL VOCs analysis.

2.3.3. QA Field Samples.

Sampling personnel submitted one (1) QA field duplicate sample to the QA laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide. Sampling personnel submitted one (1) QA trip blank sample to the QA laboratory for TCL VOCs analyses.

2.3.3.1. 00-CF-SB-5-4.

On 15 November 1999 at 1245 hours, sampling personnel collected a QA field duplicate sample of primary soil sample 00-CF-SB-5-4 and submitted it to the QA laboratory for the following analyses: TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.3.3.2. 00-CF-TB (TRIP BLANK).

The QA trip blank sample, identified as 00-PC-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the QA laboratory unopened. The QA trip blank sample was submitted to the QA laboratory for TCL VOCs analysis.

2.3.4. Investigation Derived Wastes.

The sampling team performed drilling and sampling activities in a manner to minimize the generation of IDW. Upon completion of sample collection activities, the sampling team disposed of soil generated from the sample collection process by placing the material back into the test pit or bore hole. Upon completion of sample collection activities, the sampling team disposed of the decontamination water on-site by allowing it to infiltrate the ground. Upon completion of sample collection activities, the sampling team disposed of disposable personal protective equipment as solid waste.

2.4. Site 3, Somme Avenue, Norfolk, Virginia.

Field activities at this candidate site were conducted on 16 November 1999. Sampling personnel consisted of Mr. James E. Demby and Mr. David Byeong W. Kang, both of the GeoE Section. Test pit excavation services were provided by Allard Environmental.

On 16 November 1999, the sampling team mobilized to the site at approximately 930 hours Weather conditions were sunny and the temperature was approximately 70° Fahrenheit. The sampling team excavated four (4) test pits, identified as 00-SA-TP-1 through 00-SA-TP-4. A total of four (4) test pits were excavated during the subsurface investigation of this candidate site. A site plan depicting the locations of the four (4) test pits is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

Primary, QC field samples, and QA field samples were collected by sampling personnel in accordance with the 29 September 1999 *SAP*. Primary and QC field samples were shipped via Federal Express to STL Baltimore in Sparks, Maryland. QA field samples were shipped via Federal Express to DataChem Laboratories in Salt Lake City, Utah. A Sample Summary Sheet summarizing the sample IDs, dates and times of collection, and the analyses performed is shown in Attachment E. Sampling personnel completed the appropriate Chain-of-Custody documentation, which accompanies the samples to the respective laboratories. Attachment F contains completed Chain-of-Custody documentation.

2.4.1. Primary Samples.

Sampling personnel submitted two (2) primary soil samples to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.4.1.1. 00-SA-TP-2.

Test pit 00-SA-TP-2 was located in the western part of the site. Excavation commenced on 16 November 1999 at 1015 hours and continued down to a maximum depth of 7 feet bgs. The material representative of 0 to 6.5 feet bgs is suspected to be fill material. On 16 November 1999 at 1035 hours, sampling personnel collected primary soil sample, 00-SA-TP-2-1, representative of suspect fill material at 1 foot bgs. At approximately 6.5 feet bgs, the field team encountered a gray clay intermixed with vegetation and roots. Based on the presence of roots and vegetation at this depth, it is the professional opinion of the GeoE Section that the material encountered at 6.5 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 16 November 1999 at 1055 hours,

sampling personnel collected primary soil sample, 00-SA-TP-2-6.5, representative of suspect in-situ material at 6.5 feet bgs.

2.4.2. QC Field Samples.

Sampling personnel submitted one (1) QC field blank sample to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO. Sampling personnel submitted one (1) QC equipment rinse blank sample to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO. Sampling personnel submitted one (1) QC trip blank sample to the primary laboratory for TPH GRO analysis.

2.4.2.1. 00-SA-FB.

On 16 November 1999 at 1240 hours, sampling personnel collected one (1) QC field blank sample. Sampling personnel collected the QC field blank sample by transferring deionized water into the appropriate sample containers and identified the sample as 00-SA-FB. Sampling personnel submitted QC field blank sample, 00-SA-FB, to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.4.2.2. 00-SA-EB.

On 16 November 1999 at 1230 hours, sampling personnel collected one (1) QC equipment rinse blank sample. Sampling personnel collected the QC equipment rinse blank sample by rinsing decontaminated sampling utensils with deionized water and collecting the rinse water in the appropriate sample containers. Sampling personnel identified the QC equipment rinse blank sample as 00-SA-EB Sampling personnel submitted QC equipment rinse blank sample. 00-SA-EB, to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO, and TPH DRO.

2.4.2.3. 00-SA-TB (TRIP BLANK).

The QC trip blank sample, identified as 00-SA-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the laboratory unopened The QC trip blank sample was submitted to the primary laboratory for TPH GRO analysis.

2.4.3. QA Field Samples.

No QA field samples were collected at this candidate site during the field investigations.

2.4.4. Investigation Derived Wastes.

The sampling team performed drilling and sampling activities in a manner to minimize the generation of IDW. Upon completion of sample collection activities, the sampling team disposed of soil generated from the sample collection process by placing the material back into the test pit or bore hole. Upon completion of sample collection activities, the sampling team disposed of the decontamination water on-site by allowing it to infiltrate the ground Upon completion of sample collection activities, the sampling team disposed of disposable personal protective equipment as solid waste.

2.5. Site 10a, Swimming Point (Crawford Bay), Portsmouth, Virginia.

Field activities at this candidate site were conducted on 17 November 1999. Sampling personnel consisted of Mr. Marc D. Gutterman and Mr. David Byeong W. Kang, both of the GeoE Section of the Norfolk District USACE. Test pit excavation services were provided by Allard Environmental.

On 17 November 1999, the sampling team mobilized to the site at approximately 900 hours. Weather conditions were sunny and the temperature was approximately 40° Fahrenheit. The sampling team excavated two (2) test pits, identified as 00-SP-TP-1 and 00-SP-TP-2. A total of two (2) test pits were excavated during the subsurface investigation of this candidate site. A site plan depicting the locations of the two (2) test pits is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

Primary, QC field samples, and QA field samples were collected by sampling personnel in accordance with the 29 September 1999 *SAP*. Primary and QC field samples were shipped via Federal Express to STL Baltimore in Sparks, Maryland. QA field samples were shipped via Federal Express to DataChem Laboratories in Salt Lake City, Utah. A Sample Summary Sheet summarizing the sample IDs, dates and times of collection, and the analyses performed is shown in Attachment E. Sampling personnel completed the appropriate Chain-of-Custody documentation, which accompanies the samples to the respective laboratories Attachment F contains completed Chain-of-Custody documentation.

2.5.1. Primary Samples.

Sampling personnel submitted two (2) primary soil samples to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TAL metals, and cyanide.

2.5.1.1. 00-SP-TP-2.

Test pit 00-SP-TP-2 was located in the southeast corner of the site. Excavation commenced on 17 November 1999 at 955 hours and continued down to a maximum depth of 6 feet bgs. Because a slight sheen was encountered in the previous test pit, 00-SP-TP-1, plastic sheeting was used to stage the material excavated from 00-SP-TP-2. The material representative of 0 to 3 is suspected to be fill material. On 17 November 1999 at 1000 hours, sampling personnel collected primary soil sample, 00-SP-TP-2-2.6, representative of suspect fill material. Water appeared to be seeping in at 3 feet bgs. The water level in the excavation stabilized at approximately 3 feet bgs, and an organic sheen was visible on the water surface. The excavation continued down to a depth of 6 feet bgs A sheen was visible on the excavated material representative of 3 to 5 feet bgs. A soil sample was collected for headspace screening; however, the headspace did not register above background. The material exhibited a chemical odor. As the soil from this strata appeared to be saturated with free product, no sample was collected for chemical analyses, as the sensitive methods would only serve to confirm the obvious presence of free phase hydrocarbons. At approximately 5 feet bgs, the field team encountered a gray fine to medium sand with some silt. On 17 November 1999 at 1040 hours, sampling personnel collected primary soil sample, 00-SP-TP-2-5, representative of suspect in-situ material beneath the free product sheen. The two primary soil samples were collected from what appeared to be above and below the area of saturated hydrocarbon The excavation continued down to a depth of 6 feet bgs and ceased at 1100 hours. The test pit was backfilled with clean #2 sand obtained from Tarmac in Portsmouth, Virginia.

2.5.2. QC Field Samples.

Sampling personnel submitted one (1) QC trip blank sample to the primary laboratory for TCL VOCs analysis. The QC trip blank sample, identified as 00-SP-TB (TRIP BLANK), is a sample of deionized water that accompanied the sample shipment cooler to the sampling site and returned to the primary laboratory unopened.

2.5.3. QA Field Samples.

No QA field samples were collected at this candidate site during the field investigations.

2.5.4. Investigation Derived Wastes.

The sampling team performed drilling and sampling activities in a manner to minimize the generation of IDW. Upon completion of sample collection activities, the sampling team containerized the soil excavated from 00-SP-TP-2 in four 55-gallon drums. The plastic sheeting used to stage the excavated material and disposable personal protective equipment were containerized in one 55-gallon drum. The five drums were labeled and staged in the northeast corner of the lot. Omega Environmental Services, currently under contract with the Norfolk District, disposed of the IDW in accordance with all local, state, and federal regulations.

2.6. Site 9a, Sugar Hill (Scotts Creek), Portsmouth, Virginia.

Field activities at this candidate site were conducted on 18 November 1999. Sampling personnel consisted of Mr. Thomas McCarthy and Mr. David Byeong W Kang, both of the Norfolk District USACE. Test pit excavation services were provided by Allard Environmental

On 18 November 1999, the sampling team mobilized to the site at approximately 900 hours. Weather conditions were sunny and the temperature was approximately 70° Fahrenheit. The sampling team excavated four (4) soil borings, identified as 00-SH-TP-1 through 00-SH-TP-4. A total of four (4) test pits were excavated during the subsurface investigation of this candidate site. A site plan depicting the locations of the four (4) test pits is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

Primary, QC field samples, and QA field samples were collected by sampling personnel in accordance with the 29 September 1999 *SAP*. Primary and QC field samples were shipped via Federal Express to STL Baltimore in Sparks, Maryland. QA field samples were shipped via Federal Express to DataChem Laboratories in Salt Lake City, Utah. A Sample Summary Sheet summarizing the sample IDs, dates and times of collection, and the analyses performed is shown in Attachment E Sampling personnel completed the appropriate Chain-of-Custody documentation, which accompanies the samples to the respective laboratories. Attachment F contains completed Chain-of-Custody documentation.

2.6.1. Primary Samples.

Sampling personnel submitted four (4) primary soil samples to the primary laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.6.1.1. 00-SH-TP-2.

Test pit 00-SH-TP-2 was located in the southeastern part of the site. Excavation commenced on 18 November 1999 at 1025 hours and continued down to a maximum depth of 12 feet bgs. The material representative of 0 to 9.0 feet bgs is suspected to be fill material On 18 November 1999 at 1055 hours, sampling personnel collected primary soil sample, 00-SH-TP-2-0.5, representative of suspect fill material at 0.5 foot bgs. At approximately 9.0 feet bgs, the field team encountered a gray clay intermixed with vegetation and roots. Based on the presence of roots and vegetation at this depth, it is the professional opinion of the GeoE Section that the material encountered at 9.0 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 18 November 1999 at 1050 hours, sampling personnel collected primary soil sample, 00-SH-TP-2-9, representative of suspect in-situ material at 9.0 feet bgs.

2.6.1.2. 00-SH-TP-4.

Test pit 00-SH-TP-4 was located in the southeastern part of the site. Excavation commenced on 18 November 1999 at 1230 hours and continued down to a maximum depth of 8 feet bgs. The material representative of 0 to 7.0 feet bgs is suspected to be fill material. On 18 November 1999 at 1240 hours, sampling personnel collected primary soil sample, 00-SH-TP-4-0.5, representative of suspect fill material at 0.5 foot bgs. At approximately 7 0 feet bgs, the field team encountered a gray clay intermixed with vegetation and roots. Based on the presence of roots and vegetation at this depth, it is the professional opinion of the GeoE Section that the material encountered at 7.0 feet bgs represents the former surface of the historical wetland and the interface between the fill and in-situ material. On 18 November 1999 at 1255 hours, sampling personnel collected primary soil sample, 00-SH-TP-4-7, representative of suspect in-situ material at 7.0 feet bgs.

2.6.2. QC Field Samples.

Sampling personnel submitted one (1) QC field duplicate sample to the primary laboratory for the following analyses: TCL pesticides and TCL PCBs. Sampling personnel submitted one (1) QC field blank sample to the primary laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide. Sampling personnel submitted one (1) QC equipment rinse blank sample to the primary laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.6.2.1. 00-SH-TP-2-1.5.

On 18 November 1999 at 1055 hours, sampling personnel collected a QC field duplicate sample of primary soil sample 00-SH-TP-2-0.5. Sampling personnel identified the QC field duplicate sample as 00-SH-TP-2-1.5 and submitted it to the primary laboratory for the following analyses: TCL pesticides and TCL PCBs.

2.6.2.2. 00-SH-FB.

On 18 November 1999 at 1115 hours, sampling personnel collected one (1) QC field blank sample. Sampling personnel collected the QC field blank sample by transferring deionized water into the appropriate sample containers and identified the sample as 00-SH-FB. Sampling personnel submitted QC field blank sample, 00-SH-FB, to the primary laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.6.2.3. 00-SH-EB.

On 18 November 1999 at 1135 hours, sampling personnel collected one (1) QC equipment rinse blank sample. Sampling personnel collected the QC equipment rinse blank sample by rinsing decontaminated sampling utensils with deionized water and collecting the rinse water in the appropriate sample containers. Sampling personnel identified the QC equipment rinse blank sample as 00-SH-EB. Sampling personnel submitted QC equipment rinse blank sample. 00-SH-EB, to the primary laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.6.3. QA Field Samples.

Sampling personnel submitted one (1) QA field duplicate sample to the QA laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.6.3.1. 00-SH-TP-2-9.

On 18 November 1999 at 1050 hours, sampling personnel collected a QA field duplicate sample of primary soil sample 00-SH-TP-2-9 and submitted it to the QA laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

2.6.4. Investigation Derived Wastes.

The sampling team performed drilling and sampling activities in a manner to minimize the generation of IDW. Upon completion of sample collection activities, the sampling team disposed of soil generated from the sample collection process by placing the material back into the test pit or bore hole. Upon completion of sample collection activities, the sampling team disposed of the decontamination water on-site by allowing it to infiltrate the ground. Upon completion of sample collection activities, the sampling team disposed of disposable personal protective equipment as solid waste.

3. ANALYTICAL RESULTS.

The complete set of analytical results for the primary and QC field samples was received from STL Baltimore on 31 January 2000. The complete set of raw analytical data is currently on file in the GeoE Section of the Norfolk District USACE and is available upon request.

The complete set of analytical results for the QA field samples was received from DataChem Laboratories on 31 January 2000. The complete set of raw analytical data is currently on file in the GeoE Section of the Norfolk District USACE and is available upon request.

Both data sets were submitted to Meridian Science and Technology, Inc. (MSTI), under contract with the Norfolk District USACE, on 31 January 2000 for 100% Data Validation Services.

4. DATA VALIDATION.

The Data Validation Reports for the complete set of analytical results for the primary, QC field, and QA field samples were received from MSTI on 17 March 2000. All organic data was reviewed at a level equivalent to the M-3 level of validation, in accordance with *EPA Region III Modifications to the National Functional*

Guidelines for Organic Data Review (September 1994). All inorganic data was reviewed at a level equivalent to the IM-2 level of validation, in accordance with *EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (April 1993). A copy of the Data Validation Report Narratives is shown in Attachment G. The Data Validation Reports in their entirety are currently on file in the GeoE Section of the Norfolk District USACE and is available upon request The following sections summarize the results of the data validation and contain excerpts from the Data Validation Reports concerning data usability.

Tables of the validated analytical results are shown in Attachment H.

4.1. Analytical Results of TCL VOCs Analysis.

According to the Data Validation Report for the TCL VOCs analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994). No major problems were identified during data validation of the results of the TCL VOCs analyses. The following minor problems were identified·

- Acetone, bromodichloromethane, chloroform, and methylene chloride were detected in field or laboratory method blanks in the primary laboratory. Associated primary and QC field samples with concentrations of common laboratory contaminants less than ten times the blank concentration or with concentrations less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Acetone, bromodichloromethane, chloroform, 1,2-dichloropropane, methylene chloride, toluene, and total xylenes were detected in field or laboratory blanks in the QA laboratory. Associated QA field samples with concentrations of common laboratory contaminants less than ten times the blank concentration or with concentrations less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- All positive results that are reported below the quantitation limit have been qualified with "J" flags, indicating that the reported value is an estimated value.

All of the results of the TCL VOCs analyses are considered valid and usable as reported with qualified data being considered conditionally usable.

4.2. Analytical Results of TCL SVOCs Analysis.

According to the Data Validation Report for the TCL SVOCs analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994). No major problems were identified during data validation of the results of the TCL SVOCs analyses. The following minor problems were identified:

- Bis(2-ethylhexyl)phthalate was detected in field or laboratory method blanks in the primary laboratory. Associated primary and QC field samples with concentrations of common laboratory contaminants less than ten times the blank concentration or with concentrations less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Di-n-butylphthalate was detected in field or laboratory blanks in the QA laboratory. Associated QA field samples with concentrations of common laboratory contaminants less than ten times the blank concentration or with concentrations less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks
- All positive results that are reported below the quantitation limit have been qualified with "J" flags indicating that the reported value is an estimated value

All of the results of the TCL SVOCs analyses are considered valid and usable as reported with qualified data being considered conditionally usable.

4.3. Analytical Results of TCL PAHs Analysis.

According to the Data Validation Report for the TCL PAHs analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994). No major problems were identified during data validation of the results of the TCL PAHs analyses. The following minor problems were identified:

- Naphthalene and acenaphthylene were detected in field or laboratory blanks in the primary laboratory Associated primary and QC field samples with concentrations of common laboratory contaminants less than ten times the blank concentration or with concentrations less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- All of the PAH analyses associated with primary samples 00-SH-TP-4-0.5 and 00-SH-TP-4-7 displayed low Internal Standard (IS) area counts for the following IS compounds: chrysene and perylene. All positive results and quantitation limits for the compounds associated with these IS compounds in 00-SH-TP-4-0.5 and 00-SH-TP-4-7 were qualified with "J" and "UJ" flags indicating that the reported values are estimated.
- The analysis of sample 00-SA-TP-2-1 displayed a high surrogate recovery for the compound terphenyl. Positive results were detected for all of the target compounds. All of these positive results were qualified with a "J" flag indicating that the reported values are estimated.
- All positive results that are reported below the quantitation limit have been qualified with "J" flags, indicating that the reported value is an estimated value

All of the results of the TCL PAHs analyses are considered valid and usable as reported with qualified data being considered conditionally usable.

4.4. Analytical Results of TCL Pesticides Analysis.

According to the Data Validation Report for the TCL Pesticides analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994). No major problems were identified during data validation of the results of the TCL Pesticides analyses. The following minor problems were identified.

- The reported results for several compounds were greater than twenty-five percent between the two columns for primary sample 00-CF-SB-3-1. The positive results for these compounds were qualified with "J" flags indicating that the reported values are estimated.
- The reported results for several compounds were greater than twenty-five percent between the two columns for primary samples 00-SH-TP-4-0.5 and 00-SH-TP-4-7 The positive results for these compounds were qualified with "J" flags indicating that the reported values are estimated.
- The reported results for gamma-BHC were greater than twenty-five percent between the two columns for QA field sample 00-SH-TP-2-9. The positive result for this compound was qualified with a "J" flag indicating that the reported value is estimated.

All of the results of the TCL Pesticides analyses are considered valid and usable as reported with qualified data being considered conditionally usable.

4.5. Analytical Results of TCL PCBs Analysis.

According to the Data Validation Report for the TCL PCBs analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994). No major problems were identified during data validation of the results of the TCL PCBs analyses. The following minor problems were identified:

- The reported results for aroclor 1260 were greater than twenty-five percent between the two columns for primary samples 00-CF-SB-3-1 and 00-SH-TP-4-0.5. The positive results for this compound were qualified with "J" flags indicating that the reported values are estimated.

All of the results of the TCL PCBs analyses are considered valid and usable as reported with qualified data being considered conditionally usable.

4.6. Analytical Results of TAL Inorganics Analyses.

According to the Data Validation Report for the TAL Inorganics analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (April 1993). The following problems were identified:

- The Matrix Spike (MS) associated with primary samples collected from Grandy Village displayed very low recovery for cyanide. Cyanide was not detected in any of the primary samples collected from Grandy Village. The quantitation limits were qualified with "R" flags indicating that these results are unusable
- Beryllium, cobalt, mercury, selenium, potassium, and sodium were detected in field or laboratory blanks associated with primary samples collected from Grandy Village. Associated samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- The serial dilution results for aluminum, barium, calcium, copper, magnesium, and manganese exhibited a greater than 10% difference from the undiluted analyses in the primary samples collected from Grandy Village. The positive results for these compounds in the primary samples collected from Grandy Village have been qualified with "J" flags indicating that the results are estimated.
- Antimony and sodium were detected in field or laboratory blanks associated with primary samples collected from Portsmouth City Park. Associated samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Beryllium, cobalt, nickel, selenium, silver, and thallium had negative values in laboratory blanks associated with primary samples collected from Portsmouth City Park. The quantitation limits for these analytes may be biased low and have been qualified with "UL" flags. All positive results less than two times the value of the blank have been qualified with "L" flags indicating that the result may be biased low.
- The serial dilution results for aluminum, calcium, magnesium, sodium and zinc exhibited a greater than 10% difference from the undiluted analyses in the primary samples collected from Portsmouth City Park. The positive results for these compounds in the primary samples collected from Portsmouth City Park have been qualified with "J" flags indicating that the results are estimated.
- The MS associated with primary samples collected from Portsmouth City Park displayed very low recovery for antimony. Positive results of antimony in the primary samples collected from Portsmouth City Park have been qualified with "L" flags indicating that the results may be biased low.
- Beryllium, cobalt, mercury, selenium, potassium, sodium, and vanadium were detected in field or laboratory blanks associated with primary samples collected from Carolanne Farms. Associated samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Silver and thallium had negative values in laboratory blanks associated with primary samples collected from Carolanne Farms. The quantitation limits for these analytes may be biased low and have been qualified with "UL" flags All positive results less than two times the value of the blank have been qualified with "L" flags indicating that the result may be biased low.
- The serial dilution results for aluminum, barium, calcium, copper, magnesium, and manganese exhibited a greater than 10% difference from the undiluted analyses in the primary samples collected

from Carolanne Farms. The positive results for these compounds in the primary samples collected from Carolanne Farms have been qualified with "J" flags indicating that the results are estimated.

- The MS associated with primary samples collected from Carolanne Farms displayed very low recovery for antimony and selenium. Positive results of these compounds in the primary samples collected from Carolanne Farms have been qualified with "L" flags indicating that the results may be biased low. Quantitation limits for these compounds in the primary samples collected from Carolanne Farms have been qualified with "UL" flags indicating that they are potentially biased low.
- Antimony and sodium were detected in field or laboratory blanks associated with primary samples collected from Somme Avenue. Associated samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Beryllium, cobalt, selenium, and silver had negative values in laboratory blanks associated with primary samples collected from Somme Avenue. The quantitation limits for these analytes may be biased low and have been qualified with "UL" flags. All positive results less than two times the value of the blank have been qualified with "L" flags indicating that the result may be biased low.
- The serial dilution results for aluminum, calcium, magnesium, sodium, and zinc exhibited a greater than 10% difference from the undiluted analyses in the primary samples collected from Somme Avenue. The positive results for these compounds in the primary samples collected from Somme Avenue have been qualified with "J" flags indicating that the results are estimated
- The MS associated with primary samples collected from Somme Avenue displayed very low recovery for antimony. Positive results of antimony in the primary samples collected from Somme Avenue have been qualified with "L" flags indicating that the results may be biased low. Quantitation limits for these compounds in the primary samples collected from Somme Avenue have been qualified with "UL" flags indicating that they are potentially biased low.
- Antimony and selenium were detected in field or laboratory blanks associated with primary samples collected from Swimming Point. Associated samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Beryllium, cobalt, nickel, selenium, and silver had negative values in laboratory blanks associated with primary samples collected from Swimming Point. The quantitation limits for these analytes may be biased low and have been qualified with "UL" flags. All positive results less than two times the value of the blank have been qualified with "L" flags indicating that the result may be biased low.
- The serial dilution results for aluminum, calcium, magnesium, sodium, and zinc exhibited a greater than 10% difference from the undiluted analyses in the primary samples collected from Swimming Point. The positive results for these compounds in the primary samples collected from Swimming Point have been qualified with "J" flags indicating that the results are estimated.
- The MS associated with primary samples collected from Swimming Point displayed very low recovery for antimony. Positive results of antimony in the primary samples collected from Swimming Point have been qualified with "L" flags indicating that the results may be biased low. Quantitation limits for these compounds in the primary samples collected from Swimming Point have been qualified with "UL" flags indicating that they are potentially biased low.
- Antimony, beryllium, selenium, silver, and sodium were detected in field or laboratory blanks associated with primary samples collected from Sugar Hill. Associated samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- Arsenic, beryllium, cobalt, nickel, selenium, and silver had negative values in laboratory blanks associated with primary samples collected from Sugar Hill. The quantitation limits for these analytes may be biased low and have been qualified with "UL" flags. All positive results less than two times the value of the blank have been qualified with "L" flags indicating that the result may be biased low.
- The serial dilution results for aluminum, calcium, magnesium, sodium, and zinc exhibited a greater than 10% difference from the undiluted analyses in the primary samples collected from Sugar Hill. The positive results for these compounds in the primary samples collected from Sugar Hill have been qualified with "J" flags indicating that the results are estimated.

- The MS associated with primary samples collected from Somme Avenue displayed very low recovery for antimony. Positive results of antimony in the primary samples collected from Sugar Hill have been qualified with "L" flags indicating that the results may be biased low. Quantitation limits for these compounds in the primary samples collected from Sugar Hill have been qualified with "UL" flags indicating that they are potentially biased low.
- Cadmium and cobalt were detected in field or laboratory blanks associated with the QA field samples. Associated QA field samples with concentrations of these compounds less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field or laboratory blanks.
- The MS and MS duplicate (MSD) associated with the QA field samples displayed very low recovery for antimony. Quantitation limits for antimony in the QA field samples have been qualified with "UL" flags indicating that they are potentially biased low.
- The laboratory duplicate for QA field sample 00-PC-TP-2-3 displayed % relative percent differences (RPDs) outside QC limits for barium, lead, and thallium. Positive results of these compounds have been qualified with "J" flags indicating that the results are estimated.
- The laboratory duplicate for QA field sample 00-CF-SB-5-4 displayed % RPDs outside QC limits for arsenic, barium, cobalt, lead, and thallium Positive results of these compounds have been qualified with "J" flags.
- The serial dilution results for aluminum, calcium, and iron exhibited a greater than 10% difference from the undiluted analyses in QA field sample 00-PC-TP-2-3. The positive results for these compounds have been qualified with "J" flags indicating that the results are estimated.
- The serial dilution results for aluminum, calcium, iron, magnesium, manganese, and sodium exhibited a greater than 10% difference from the undiluted analyses in QA field sample 00-CF-SB-5-4. The positive results for these compounds have been qualified with "J" flags indicating that the results are estimated.

4.7. Analytical Results of TPH Analyses.

According to the Data Validation Report for the TPH analyses, all samples were successfully analyzed for all target compounds in accordance with *EPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994) The following problems were identified:

- The analysis of sample 00-GV-SB-3-3 displayed a low surrogate recovery. The quantitation limit for the TPH-GRO in this sample was qualified with a "UL" flag indicating that the result may be biased low.
- The analysis of sample 00-PC-TP-2-2 displayed a low surrogate recovery. The sample was reanalyzed with the same results, indicating possible matrix effects. The quantitation limit for TPH-GRO in this sample was qualified with a "R" flag indicating that the result is unusable.
- The non detected results for TPH GRO of samples 00-PC-TB and 00-SA-TB were rejected due to exceedance of holding times. However, the trip blank samples were maintained under controlled conditions by the GeoE Branch of the Norfolk District USACE It is the professional opinion of the GeoE Branch that the results are valid and usable despite being rejected by the validator.
- The TPH DRO analysis of sample 00-SA-TP-2-1 displayed positive results; however, comparing the sample chromatograms to the chromatograms shows that the late eluting hydrocarbon pattern from the sample is not consistent with the standard pattern for diesel fuel. The positive result was reported and qualified with a "NJ" flag indicating that the compound was tentatively identified and estimated.
- The analysis of samples 00-SA-TP-2-1 and 00-SA-TP-2-6.5 displayed low surrogate recoveries. The quantitation limits for TPH-GRO in these samples were qualified with "R" flags indicating that the results are unusable.

5. DATA QUALITY OBJECTIVES.

The primary objective of the Elizabeth River Wetlands Subsurface Investigation is to characterize the physical and chemical nature and extent of the fill material and the in-situ material beneath the fill at each of the six (6) candidate sites. Chemical characterization consisted of laboratory analyses of samples representative of distinct subsurface strata. The samples were analyzed for site-specific constituents based on available historical

information. The analytical methods served to identify the presence or absence and to accurately quantify each constituent.

5.1. Sensitivity.

No formal standards, criteria, or benchmarks for chemical concentrations in soil were provided to the GeoE Section for this investigation. The GeoE Section identified in the 29 September 1999 *SAP* the following quantitative data quality objectives for the investigation. EPA Region III risk based concentrations (RBCs) for soil ingestion in residential and industrial scenarios (October 1999) and the release reporting requirements established by VaDEQ under the *Storage Tank Program Technical Manual.* The sensitivity of the selected analytical methods was sufficient to meet the data quality objectives.

5.2. Precision.

Precision is the mutual agreement among individual measurements of the same property and is a measure of the random error component of the data collection process The overall precision of the data is the sum of that due to sampling and analyses. Analytical precision was assessed through the use of internal QC duplicate samples. Sampling precision was assessed by evaluating the results of field duplicate samples.

Internal QC checks were performed by the primary laboratory in accordance with *SW-846 Test Methods for Evaluating Sold Waste Physical/Chemical Methods, Final Update III* and Section 8 Analytical Quality Control as stated in STL's *Quality Assurance Management Plan* Internal QC checks were performed by the QA laboratory in accordance with *SW-846 Test Methods for Evaluating Solid Waste. Physical/Chemical Methods, Final Update III* and Section 10 Internal Quality Control Checks as stated in DataChem's *Quality Assurance Program Plan.* All of the analyses showed compliance with established internal control limits, except as noted above in Section 4.0.

The sampling precision, measured as intralaboratory and interlaboratory precision, was assessed by analyzing QC and QA field duplicate samples, respectively. QC field duplicate samples of primary samples were submitted blindly to the primary laboratory to assess the intralaboratory precision of each analytical method. QA field duplicate samples of primary samples were submitted to the QA laboratory to assess the interlaboratory precision of each analytical method. The RPDs between the results obtained from primary and QC/QA field duplicate samples were calculated from the following equation:

$$RPD = \frac{|X_1 - X_2|}{((X_1 + X_2)/2)} \times 100\%$$

Where: RPD = Relative Percent Difference
X_1 = larger of two observed values
X_2 = smaller of two observed values

The RPDs calculated between the results from primary and QC/QA field duplicate samples are shown in Attachment I.

QC field duplicate sample, 00-CF-SB-3-2, of primary sample, 00-CF-SB-3-1, was submitted blindly to the primary laboratory for TCL VOCs analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision. RPDs were calculated for acetone and methylene chloride at 4.35% and 0.00%, respectively. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the low RPDs and the agreement of non-detected results, the intralaboratory precision of the TCL VOCs analyses is of acceptable quality. A QA field duplicate sample of primary sample, 00-CF-SB-5-4 was submitted to the QA laboratory for TCL VOCs analyses to assess the interlaboratory precision. RPDs were calculated for acetone and methylene chloride at 48.76% and 45.83%, respectively. No calculations for RPDs could be made for non-detected ("U" flagged) results. The interlaboratory precision of the TCL VOCs analyses is of acceptable quality. The overall precision of the results of the TCL VOCs analyses is of acceptable quality.

QC field duplicate sample, 00-CF-SB-3-2, of primary sample, 00-CF-SB-3-1, was submitted blindly to the primary laboratory for TCL SVOCs analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision. An RPD was calculated for bis(2-ethylhexyl)phthalate at 4.96%. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the low RPDs and the agreement of non-detected results, the intralaboratory precision of the TCL SVOCs analyses is of acceptable quality. A QA field duplicate sample of primary sample, 00-CF-SB-5-4 was submitted to the QA laboratory for TCL SVOCs analyses to assess the interlaboratory precision. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the agreement of non-detected results, the interlaboratory precision of the TCL SVOCs analyses is of acceptable quality The overall precision of the results of the TCL SVOCs analyses is of acceptable quality.

QC field duplicate sample, 00-PC-TP-2-2, of primary sample, 00-PC-TP-2-1.5, was submitted blindly to the primary laboratory for TCL PAHs analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision All RPDs were less than the specified objective of 50%. The intralaboratory precision of the TCL PAHs analyses is of acceptable quality. A QA field duplicate sample of primary sample, 00-PC-TP-2-3 was submitted to the QA laboratory for TCL PAHs analyses to assess the interlaboratory precision. Most of the RPDs were above the specified objective of 50%. Although the specified objective for precision was exceeded, independent validation of the results revealed no major problems just minor problems resulting in qualified data. The observed differences are most likely attributable to the inhomogeneity of the sampled soils and some of the values being estimated ("J" flagged). The interlaboratory precision of the TCL PAHs analyses is of questionable quality. As a corrective measure for the results of sample 00-PC-TP-2-3, the GeoE Section will use the higher reported value for each compound in the risk screening as a conservative means of assessing site risks.

QC field duplicate sample, 00-CF-SB-3-2, of primary sample, 00-CF-SB-3-1, and QC field duplicate sample, 00-SH-TP-2-1.5, of primary sample, 00-SH-TP-2-0.5, were submitted blindly to the primary laboratory for TCL pesticides analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the agreement of non-detected results, the intralaboratory precision of the TCL pesticides analyses is of acceptable quality. QA field duplicate samples of primary samples, 00-CF-SB-5-4 and 00-SH-TP-2-9, were submitted to the QA laboratory for TCL pesticides analyses to assess the interlaboratory precision. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the agreement of non-detected results, the interlaboratory precision of the TCL pesticides analyses is of acceptable quality. The overall precision of the results of the TCL pesticides analyses is of acceptable quality.

QC field duplicate sample, 00-CF-SB-3-2, of primary sample, 00-CF-SB-3-1, and QC field duplicate sample, 00-SH-TP-2-1.5, of primary sample, 00-SH-TP-2-0.5, were submitted blindly to the primary laboratory for TCL pesticides analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the agreement of non-detected results, the intralaboratory precision of the TCL pesticides analyses is of acceptable quality. QA field duplicate samples of primary samples, 00-CF-SB-5-4 and 00-SH-TP-2-9, were submitted to the QA laboratory for TCL pesticides analyses to assess the interlaboratory precision. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the agreement of non-detected results, the interlaboratory precision of the TCL pesticides analyses is of acceptable quality. The overall precision of the results of the TCL pesticides analyses is of acceptable quality.

QC field duplicate sample, 00-CF-SB-3-2, of primary sample, 00-CF-SB-3-1, was submitted blindly to the primary laboratory for TCL PCBs analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the agreement of non-detected results, the intralaboratory precision of the TCL pesticides analyses is of acceptable quality. A QA field duplicate sample was submitted to the QA laboratory for TCL PCBs

analyses to assess the interlaboratory precision; however, the QA laboratory did not run the sample. As a result no determination could be made regarding the interlaboratory precision of the TCL PCBs analyses.

QC field duplicate sample, 00-PC-TP-2-2, of primary sample, 00-PC-TP-2-1.5, and QC field duplicate sample, 00-CF-SB-3-2, of primary sample, 00-CF-SB-3-1, were submitted blindly to the primary laboratory for TAL Inorganics analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision. All RPDs were less than the specified objective of 50%. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the low RPDs and agreement of non-detected results, the intralaboratory precision of the TCL pesticides analyses is of acceptable quality. QA field duplicate samples of primary samples, 00-PC-TP-2-3 and 00-CF-SB-5-4, were submitted to the QA laboratory for TAL Inorganics analyses to assess the interlaboratory precision. All RPDs were less than the specified objective of 50%, except for lead in sample 00-PC-TP-2-3 and thallium in sample 00-CF-SB-5-4. The RPD of 54.8% for lead in sample 00-PC-TP-2-3 is most likely attributable to the QA laboratory's result being estimated ("J" flagged). The RPD of 98.54% for thallium in sample 00-CF-SB-5-4 is most likely attributable to the QA laboratory's result being estimated ("J" flagged) and the primary laboratory's results being biased low ("L" flagged) As a corrective measure for these results, the GeoE Section will use the higher reported value for these compounds in the risk screening as a conservative means of assessing site risks. No calculations for RPDs could be made for non-detected ("U" flagged) results. Based on the low RPDs and agreement of non-detected results, the interlaboratory precision of the TAL Inorganics analyses is of acceptable quality. The overall precision of the results of the TCL Inorganics analyses is of acceptable quality.

QC field duplicate sample, 00-PC-TP-2-2, of primary sample, 00-PC-TP-2-1.5, was submitted blindly to the primary laboratory for TPH analyses to assess the intralaboratory precision. According to the 29 September 1999 *SAP*, an RPD of less than 50% for each compound is considered to be an acceptable level of precision. The sample result for TPH-GRO in the QC field sample was rejected ("R" flagged) by the independent validator; therefore no determination could be made regarding the intralaboratory precision of the TPH-GRO analysis. The RPD for TPH-DRO was less than the specified objective of 50%. The intralaboratory precision of the TPH-DRO analysis is of acceptable quality. A QA field duplicate sample of primary sample, 00-PC-TP-2-3 was submitted to the QA laboratory for TPH analyses to assess the interlaboratory precision. TPH-GRO was not detected in either sample. Based on the agreement of non-detects, the interlaboratory precision of the TPH-GRO analysis is of acceptable quality. TPH-DRO was detected in the primary sample but not detected in the QA field duplicate sample. The interlaboratory precision of the TPH-DRO analysis is of questionable quality; however, the high reported value for this sample shall be used in the risk screening as a conservative means of assessing potential site risks.

5.3. Accuracy.

Accuracy is the degree of agreement of a measured value with the true or expected value of the measured quantity. It is a measure of the bias or systematic error of the entire data collection process. Analytical accuracy was measured through the use of internal calibration and method blanks, calibration verification samples, laboratory control samples, and matrix spikes. Sampling accuracy was assessed by evaluating the results of QC field blank samples, QC equipment blank samples, and QC trip blank samples.

Internal QC checks were performed by the primary laboratory in accordance with *SW-846 Test Methods for Evaluating Sold Waste Physical/Chemical Methods, Final Update III* and Section 8 Analytical Quality Control as stated in STL's *Quality Assurance Management Plan* Internal QC checks were performed by the QA laboratory in accordance with *SW-846 Test Methods for Evaluating Solid Waste. Physical/Chemical Methods, Final Update III* and Section 10 Internal Quality Control Checks as stated in DataChem's *Quality Assurance Program Plan* All of the analyses showed compliance with established internal control limits, except as noted above in Section 4.0.

The sampling accuracy was assessed by analyzing QC field blank samples, QC equipment rinse blank samples, and QC trip blank samples. All of these samples were derived from analyte-free media (deionized water) and therefore expected not to contain contaminants Several compounds were detected at low levels in the QC blank samples. The presence of these compounds in the QC blank samples

suggests that the results for these compounds in the associated primary samples may be biased high or may not be attributable completely to the site. As noted above in Section 4.0, associated primary samples with concentrations of common laboratory contaminants less than ten times the blank concentration or with concentrations less than five times the blank concentration have been qualified with "B" flags indicating that the compound was not detected substantially above the level reported in field blanks. Although some blank contamination was encountered, the potential impacts to the data consist of false positives and a high bias for those compounds. Considering the screening nature of this investigation and the conservative approach in evaluating the data, the impacts to data usability are minimal. The overall accuracy of the results is of acceptable quality.

5.4. Representativeness.

Data representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. This sampling program was designed so that the samples collected were as representative as possible of the media being sampled.

Although sampling precision for some compounds based on field duplicate analyses were outside of the criteria established in the *25 January 1999 SAP*, the differences appear to be primarily attributable to low level of detection resulting in estimated values ("J" flagged). When evaluating data for samples with results from duplicate samples, the conservative approach of using the higher reported value is recommended. Although some blank contamination was encountered, the potential impacts to the data consist of false positives and a high bias for those compounds. Considering the screening nature of this investigation and the conservative approach in evaluating the data, the impacts to data usability are minimal. The data is considered usable and representative of the sampled media

5.5. Completeness.

Completeness is defined as the percentage of measurements made that are judged to be valid data. A total of 180 samples were collected for laboratory analyses during this investigation. A total of 2,371 measurements were made during this investigation. Of the 2,371 measurements made, 11 measurements were rejected ("R" flagged) by the independent validator resulting in a total of 2,360 measurements deemed valid and usable. This corresponds to percent completeness of 99.54% completeness, based on the following formula:

$$\%C = (V/T) \times 100\%$$

Where: %C = Percent Completeness
V = total number of measurements judged valid
T = total number of measurements

A data quality objective of 90% was specified for completeness in the *25 January 1999 SAP* The data quality objective for completeness has been satisfied.

5.6. Comparability.

Data comparability is a measure of the confidence with which one data set can be compared to another. It can not be described in quantitative terms, but must be considered in designing the sampling plans, analytical methodology, quality control, and data reporting. The sum of standard sample techniques and EPA approved methods assures that the parameters being measured are comparable with data generated from other sources. Reporting of data in units consistent with other organizations also assures comparability.

All of the data deemed valid and usable is considered comparable. Internal QC checks were performed by the primary laboratory in accordance with *SW-846 Test Methods for Evaluating Sold Waste Physical/Chemical Methods, Final Update III* and Section 8 Analytical Quality Control as stated in STL's *Quality Assurance Management Plan.* Internal QC checks were performed by the QA laboratory in accordance with *SW-846 Test Methods for Evaluating Solid Waste· Physical/Chemical Methods, Final*

Update III and Section 10 Internal Quality Control Checks as stated in DataChem's *Quality Assurance Program Plan* All of the analyses showed compliance with established internal control limits, except as noted above in Section 4.0. Analytical results outside of established internal control limits have been flagged by the respective laboratories with the appropriate qualifiers.

6. DISCUSSION.

The purpose of this discussion is to evaluate the results of the Elizabeth River Wetlands Subsurface Investigation for each of the six (6) candidate sites. This evaluation includes both physical and chemical characterization.

Physical characterization includes identification and classification of distinct subsurface strata and approximating the vertical extent of the strata based on soil boring and test pit logs. Materials were classified based on field observation of physical properties and recorded in the soil boring and test pit logs. The GeoE Section further categorized the materials into the following broader categories. suspected fill material and suspected in-situ material. The GeoE Section used the presence of miscellaneous debris and abrupt contrasts in stratigraphy as indicators for categorizing material as suspected fill The GeoE Section used the presence of vegetation and organic matter and abrupt contrasts in stratigraphy as indicators for categorizing material as suspected in-situ material representative of the historic wetland

Chemical characterization includes identification of potential contaminants of concern (COCs) within the distinct subsurface strata, based on the chemical analyses of samples representative of the distinct subsurface strata The objective of selecting potential COCs is to identify a subset of detected compounds/analytes that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors.

6.1. Site 4, Grandy Village, Norfolk, Virginia.

A total of seven (7) test pits and four (4) soil borings were excavated and advanced during the subsurface investigation of this candidate site. A site plan depicting the locations of the seven (7) test pits and the four (4) soil borings is shown in Attachment C. The seven (7) test pits were located along the shoreline of the site and the four (4) soil borings were located along the drainage ditch behind the Grandy Village housing complex. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs, and photographs.

6.1.1. Physical Characterization.

The stratigraphy appeared to be fairly consistent between the seven (7) test pits located along the shoreline of the site. Suspected fill material primarily consisted of tan sand intermixed with gray sandy clay and miscellaneous debris consisting of asphalt, concrete, red bricks, cobblestones, terra cotta piping, and gravel. Suspected fill material was encountered either at the surface or beneath a thin layer of topsoil and extended down to an average depth of 5.5 feet bgs. Suspected in-situ material primarily consisted of gray clay with orange mottling and organic matter.

The stratigraphy appeared to be fairly consistent between the four (4) soil borings located along the drainage ditch behind the Grandy Village housing complex. Suspected fill material primarily consisted of grassy ground cover and topsoil that extended down to an average depth of 1.125 feet bgs. Suspected in-situ material primarily consisted of gray fine sand with vegetation and gray clay with orange mottling.

The following table includes a brief description of the suspected fill and in-situ material and the approximate depth of the interface between the suspected fill and in-situ material for each soil boring and test pit·

Soil Boring / Test Pit No.	Description of Suspected Fill Material	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Description of Suspected In-situ Material
00-GV-TP-1	Tan sand and gray clay w/asphalt.	6.5 feet bgs	Gray clay w/decayed vegetation.
00-GV-TP-2	Tan sand and gray clay w/asphalt, bricks, cobblestones, and clay pipe.	5 0 feet bgs	Gray sandy clay w/organic matter
00-GV-TP-3	Brown sand and gray sandy clay w/bricks, concrete, and gravel.	3.5 feet bgs	Gray clay w/organic matter.
00-GV-TP-4	Tan sand and gray sandy clay w/bricks, concrete, and gravel.	6.0 feet bgs	Bluish gray clay w/decayed vegetation.
00-GV-TP-5	Tan sand w/bricks, cobblestones, and concrete.	9.0 feet bgs	Bluish gray clay w/decayed vegetation.
00-GV-TP-6	Tan sand w/bricks and gravel.	5.0 feet bgs	Gray clay w/organic matter.
00-GV-TP-7	Tan sand and gray sandy clay w/bricks.	3.3 feet bgs	Gray clay
00-GV-SB-1	Topsoil	0.5 feet bgs	Gray clay w/organic matter
00-GV-SB-2	Topsoil	0.5 feet bgs	Gray sand w/decayed vegetation; gray clay w/orange mottling.
00-GV-SB-3	Topsoil	3.0 feet bgs	Gray sand w/decayed vegetation; gray clay w/orange mottling.
00-GV-SB-4	Topsoil	0.5 feet bgs	Gray clay w/orange mottling

The following table lists the soil borings and test pits from which the primary soil samples were collected:

Soil Boring / Test Pit No.	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Primary Soil Sample Representative of Suspected Fill Material	Primary Soil Sample Representative of Suspected In-situ Material
00-GV-TP-1	6.5 feet bgs		00-GV-TP-1-7.5
00-GV-TP-6	5.0 feet bgs	00-GV-TP-6-1	00-GV-TP-6-5
00-GV-SB-1	0.5 feet bgs		00-GV-SB-1-3
00-GV-SB-2	0.5 feet bgs	00-GV-SB-2-0.5	
00-GV-SB-3	3.0 feet bgs		00-GV-SB-3-3

6.1.2. Chemical Characterization.

A total of six (6) primary soil samples collected from this site were submitted to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO and TPH DRO.

6.1.2.1. Non-Detected Compounds/Analytes.

Compounds and analytes that were not detected at concentrations exceeding the method detection limits have been excluded from consideration as potential COCs. None of the

sixteen (16) PAHs were excluded from consideration as potential COCs. Of the twenty-four (24) TAL Inorganics, the following four (4) were excluded from consideration as potential COCs: antimony, cadmium, silver, and thallium. TPH-GRO was excluded from consideration as a potential COC

6.1.2.2. Detected Compounds/Analytes.

A table of validated analytical results of detected compounds/analytes for Grandy Village is shown in Attachment J.

The following sixteen (16) PAHs were detected at concentrations exceeding their method detection limits: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The following twenty (20) TAL Inorganics were detected at concentrations exceeding their detection limits: aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, vanadium, zinc, and cyanide. TPH-DRO was detected at concentrations exceeding the method detection limit.

The detected compounds and analytes were screened, using an exclusion process, to eliminate those compounds and analytes that were not appropriate to retain as potential COCs The exclusion process consisted of comparisons between maximum detected concentrations vs. the quantitative data quality objectives (i.e. EPA Region III RBCs for soil ingestion in residential and industrial scenarios and the release reporting requirements established by the VaDEQ under the *Storage Tank Program Technical Manual*).

6.1.2.2.1. EPA Region III RBCs.

The maximum concentrations of detected compounds and analytes were compared to the available EPA Region III RBCs. The RBCs do not constitute regulation or guidance, and are not viewed as a substitute for a site-specific risk assessment; however, the RBCs do serve as an effective means for screening chemicals based on standard default exposure assumptions. The RBCs correspond to a predetermined level of risk, a hazard quotient of 1 or a lifetime cancer risk of 10^{-6}, for various chemicals in water, air, fish tissue, and soil. The RBCs are essentially generic risk assessments run in reverse.

The table in Attachment J shows the maximum detected concentrations and RBCs for the detected compounds and analytes.

RBCs were available for thirteen (13) of the sixteen (16) detected PAHs. None of the maximum detected concentrations exceeded the available RBCs. All thirteen (13) detected PAHs, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

RBCs were available for fourteen (14) of the twenty (20) detected TAL Inorganics. None of the maximum detected concentrations exceeded the available RBCs, except for arsenic. Arsenic was retained as a potential COC for this site. The other thirteen (13) TAL Inorganics, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following six (6) detected TAL Inorganics. calcium, lead, magnesium, mercury, potassium, and sodium.

6.1.2.2.2. VaDEQ Release Reporting Requirements.

The maximum concentration of detected TPH was compared to the VaDEQ release reporting requirement under the *Storage Tank Program Technical Manual*. TPH-DRO was detected in sample 00-GV-SB-01-03 at 490,000 micrograms/kilogram (ug/kg),

which exceeded the release reporting requirement of 100,000 ug/kg TPH-DRO was retained as a potential COC for this site.

6.1.2.2.3. Compounds/Analytes without Criteria.

RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. Assuming that the most conservative PAH RBC of 87 ug/kg could be used as a surrogate criterion for these compounds, the maximum detected concentrations of these three (3) detected PAHs did not exceed the surrogate RBC. Therefore, these three (3) detected PAHs were excluded from consideration as potential COCs

RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

Some chemicals are essential trace elements or nutrients in the human diet, and may be present in site media at concentrations at health-protective levels. The following four (4) detected TAL Inorganics were evaluated with regard to essential trace element or nutrient status: calcium, magnesium, potassium, and sodium. A chemical may be excluded from consideration as a potential COC if it is an essential trace element or nutrient, and conservative exposure to the element in site media would result in intakes at or below health protective levels. The ingestion rates for these analytes were calculated by multiplying maximum detected concentrations by an intake rate of 200 milligrams of soil per day (mg/day) The ingestion rates were compared to standard recommended daily allowances (RDAs) for these analytes. The following ingestion rates were calculated for calcium, magnesium, potassium, and sodium: 16.88 mg/day, 0.268 mg/day, 0.1536 mg/day, and 0.1864 mg/day, respectively. The RDAs for calcium, magnesium, potassium, and sodium are 800 mg/day, 270 mg/kg, 1,950 mg/day, and 10,000 mg/day, respectively. None of the ingestion rates exceeded the RDAs. These four (4) detected TAL Inorganics were excluded from consideration as potential COCs.

The maximum concentration of lead was detected in sample 00-GV-TP-1-7.5 at 20,900 ug/kg. The EPA Region III recommends soil abatement activities when lead levels are found at 5,000,000 ug/kg or more in bare residential soil. Soil abatement activities include removal and replacement of contaminated soil and use of permanent barriers. The maximum detected concentration of lead did not exceed this criterion. Based on this screening criterion, no abatement activities are required to address lead in the soils 400,000 ug/kg is used as a residential bare soil lead screening level for corrective actions under the Resource Conservation and Recovery Act (RCRA), cleanups under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Office of Solid Waste and Emergency Response (OSWER) Interim Soil Directive This screening level is not a cleanup standard or a cleanup goal, but rather a level of contamination above which there is enough concern to warrant site-specific study of risks. When bare soil lead levels exceed 400,000 ug/kg and children are likely to be present, exposure-reduction responses focusing on interim controls designed to change use patterns and create barriers between children and contaminated soil are recommended. The maximum detected concentration of lead did not exceed the residential soil lead screening level of 400,000 ug/kg. Based on these screening criteria, the lead in the soils does not pose a significant threat to human health nor does it warrant any interim exposure-reduction measures or soil abatement activities. Lead was excluded from consideration as a potential COC.

The maximum concentration of mercury was detected in sample 00-GV-SB-2-0.5 at 160 ug/kg. Mercury was detected in all six (6) of the primary samples at comparable levels; however, all of the results were "B" flagged indicating that the results were not detected significantly above laboratory or field blanks. This suggests that the presence of

mercury in these samples may not be entirely attributable to the site, but rather the result of possible laboratory contamination. Recognizing that the objective of selecting potential COCs is to identify a subset of detected chemicals that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors, mercury was excluded from consideration as a potential COC, since the "B" flags suggest that the presence of mercury may not be a result of site sources.

6.1.2.3. Potential Contaminants of Concern.

Based on the results of the risk screening of the detected compounds and analytes, the following analyte and compound were retained as potential COCs for the Grandy Village site. arsenic and TPH-DRO.

6.2. Site 6, Portsmouth City Park, Portsmouth, Virginia.

A total of four (4) test pits and four (4) soil borings were excavated and advanced during the subsurface investigation of this candidate site. A site plan depicting the locations of the four (4) test pits and the four (4) soil borings is shown in Attachment C. Test pits, 00-PC-TP-1 and 00-PC-TP-2, and soil borings, 00-PC-SB-1, 00-PC-SB-2, and 00-PC-SB-3, were located in the southern part of the site within the larger swale area proposed for restoration. Test pits, 00-PC-TP-3 and 00-PC-TP-4, and soil boring, 00-PC-SB-4, were located in the northern part of the site within the smaller swale area proposed for restoration. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

6.2.1. Physical Characterization.

The stratigraphy appeared to be fairly consistent between the two (2) test pits and three (3) soil borings located in the southern swale. Suspected fill material primarily consisted of grassy ground cover, topsoil, and gray clayey sand intermixed with debris consisting of asphalt, bricks, concrete, terra cotta piping, plastic sheeting, and gravel Suspected fill material was encountered at the surface and extended down to an average depth of 3.68 feet bgs. Suspected in-situ material primarily consisted of gray fine sand with clay with orange mottling and organic matter.

The stratigraphy appeared to be fairly consistent between the two (2) test pits and soil boring located in the northern swale. Suspected fill material primarily consisted of grassy ground cover, topsoil, and brown medium sand intermixed with asphalt and gravel. Suspected fill material was encountered at the surface and extended down to an average depth of 4 25 feet bgs. Suspected in-situ material primarily consisted of gray to dark brown sand with orange mottling and organic matter.

The following table includes a brief description of the suspected fill and in-situ material and the approximate depth of the interface between the suspected fill and in-situ material for each soil boring and test pit·

Soil Boring / Test Pit No.	Description of Suspected Fill Material	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Description of Suspected In-situ Material
00-PC-TP-1	Topsoil w/asphalt, brick, concrete, plastic sheeting, and terra cotta piping, gray clayey sand w/brick.	3.0 feet bgs	Gray fine sand w/clay.
00-PC-TP-2	Topsoil w/asphalt, brick, concrete; gray clayey sand.	3.0 feet bgs	Gray fine sand w/clay and organic matter.
00-PC-TP-3	Topsoil w/asphalt; brown medium sand w/asphalt debris and gravel.	5.0 feet bgs	Dark brown sand w/orange mottling and organic matter.
00-PC-TP-4	Topsoil w/asphalt, brown medium sand w/asphalt debris and gravel.	Bottom of Hole (BOH) 6.0 feet bgs	Sidewalls kept caving in at 3.0 feet bgs; difficult to ascertain stratigraphy.
00-PC-SB-1	Topsoil; tan sand w/gravel.	5.0 feet bgs	Gray sandy clay w/orange mottling
00-PC-SB-2	Topsoil; brown sand w/bricks.	3.6 Feet bgs	Tan clayey sand w/orange mottling.
00-PC-SB-3	Topsoil; brown sand w/asphalt and gravel.	3.5 feet bgs	Gray sandy clay w/orange mottling.
00-PC-SB-4	Topsoil, brown medium sand w/asphalt debris and gravel.	3 5 feet bgs	Gray sand w/organic matter

The following table lists the soil borings and test pits from which the primary soil samples were collected.

Soil Boring / Test Pit No	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Primary Soil Sample Representative of Suspected Fill Material	Primary Soil Sample Representative of Suspected In-situ Material
00-PC-TP-2	3.0 feet bgs	00-PC-TP-2-1.5	00-PC-TP-2-3
00-PC-SB-2	3.6 feet bgs	00-PC-SB-2-0.8	00-PC-SB-2-3
00-PC-SB-4	3.5 feet bgs	00-PC-SB-4-2	00-PC-SB-4-3.5

6.2.2. Chemical Characterization.

A total of six (6) primary soil samples collected from this site were submitted to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO and TPH DRO.

6.2.2.1. Non-Detected Compounds/Analytes.

Compounds and analytes that were not detected at concentrations exceeding the method detection limits were excluded from consideration as potential COCs. None of the sixteen (16) PAHs were excluded from consideration as potential COCs. Of the twenty-four (24) TAL Inorganics, the following four (4) were excluded from consideration as potential COCs: selenium, silver, thallium, and cyanide. TPH-GRO was excluded from consideration as a potential COC.

6.2.2.2. Detected Compounds/Analytes.

A table of validated analytical results of detected compounds/analytes for Portsmouth City Park is shown in Attachment J.

The following sixteen (16) PAHs were detected at concentrations exceeding their method detection limits: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The following twenty (20) TAL Inorganics were detected at concentrations exceeding their detection limits. aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium, and zinc. TPH-DRO was detected at concentrations exceeding the method detection limit.

These detected compounds and analytes were screened, using an exclusion process, to eliminate those compounds and analytes that were not appropriate to retain as potential COCs. The exclusion process consisted of comparisons between maximum detected concentrations vs. the quantitative data quality objectives (i.e. EPA Region III RBCs for soil ingestion in residential and industrial scenarios and the release reporting requirements established by the VaDEQ under the *Storage Tank Program Technical Manual*).

6.2.2.2.1. EPA Region III RBCs.

The maximum concentrations of detected compounds and analytes were compared to the available EPA Region III RBCs.

The table in Attachment J shows the maximum detected concentration and RBC for the detected compounds and analytes.

RBCs were available for thirteen (13) of the sixteen (16) detected PAHs. The maximum detected concentrations of benzo(a)pyrene and dibenz(a,h)anthracene exceeded their respective RBCs. Benzo(a)pyrene and dibenz(a,h) anthracene were retained as potential COCs for this site. The other eleven (11) PAHs, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

RBCs were available for fourteen (14) of the twenty (20) detected TAL Inorganics. None of the maximum detected concentrations exceeded the available RBCs, except for arsenic. Arsenic was retained as a potential COC for this site. The other thirteen (13) TAL Inorganics, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

6.2.2.2.2. VaDEQ Release Reporting Requirements.

The maximum concentration of detected TPH was compared to the VaDEQ release reporting requirement under the *Storage Tank Program Technical Manual* TPH-DRO was detected in sample 00-PC-SB-4-3 5 at 65,000 ug/kg, which did not exceed the release reporting requirement of 100,000 ug/kg. TPH-DRO was excluded from consideration as a potential COC for this site.

6.2.2.2.3. Compounds/Analytes without Criteria.

RBCs were not available for the following three (3) detected PAHs· acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. Assuming that the most conservative PAH RBC of 87 ug/kg could be used as a surrogate criterion for these compounds, the maximum detected concentrations of these three (3) detected PAHs exceeded the surrogate RBC. Therefore, these three (3) detected PAHs were retained as potential COCs.

RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium

The following four (4) detected TAL Inorganics were evaluated with regard to essential trace element or nutrient status: calcium, magnesium, potassium, and sodium The ingestion rates for these analytes were calculated by multiplying maximum detected concentrations by an intake rate of 200 mg/day. The ingestion rates were compared to standard RDAs for these analytes. The following ingestion rates were calculated for calcium, magnesium, potassium, and sodium: 0.195 mg/day, 0 1314 mg/day, 0.1244 mg/day, and 0.0924 mg/day, respectively. The RDAs for calcium, magnesium, potassium, and sodium are 800 mg/day, 270 mg/kg, 1,950 mg/day, and 10,000 mg/day, respectively. None of the ingestion rates exceeded the RDAs These four (4) detected TAL Inorganics were excluded from consideration as potential COCs.

The maximum concentration of lead was detected in sample 00-PC-SB-4-2 at 43,400 ug/kg. The EPA Region III recommends soil abatement activities when lead levels are found at 5,000,000 ug/kg or more in bare residential soil. The maximum detected concentration of lead did not exceed this criterion. Based on this screening criterion, no abatement activities are required to address lead in the soils. The maximum detected concentration of lead did not exceed the residential soil lead screening level of 400,000 ug/kg. Based on these screening criteria, the lead in the soils does not pose a significant threat to human health nor does it warrant any interim exposure-reduction measures or soil abatement activities. Lead was excluded from consideration as a potential COC.

The maximum concentration of mercury was detected in sample 00-PC-SB-4-2 at 150 ug/kg. No screening criteria were available for mercury in soils. The objective of selecting potential COCs is to identify a subset of detected chemicals that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors. Mercury was detected in four (4) of the six (6) primary soil samples. It is the professional opinion of the GeoE Section that the mercury data have good quality and are present at sufficient frequency to warrant site-specific study of risk associated with mercury. Mercury was retained as a potential COC.

6.2.2.3. Potential Contaminants of Concern.

Based on the results of the risk screening of the detected compounds and analytes, the following seven (7) compounds and analytes were retained as potential COCs for the Portsmouth City Park site: acenaphthylene, benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, and mercury.

6.3. Site 11, Carolanne Farms, Virginia Beach, Virginia.

A total of five (5) soil borings were advanced during the subsurface investigation of this candidate site. A site plan depicting the locations of the five (5) soil borings is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

6.3.1. Physical Characterization.

The stratigraphy appeared to be fairly consistent between the five (5) soil borings Suspected fill material primarily consisted of grassy ground cover, topsoil, and tan and gray medium sand with gravel, although gray silty clay was encountered in one boring, 00-CF-SB-5. Suspected fill material was encountered at the surface and extended down to an average depth of 2.24 feet bgs. Suspected in-situ material primarily consisted primarily of gray clay with orange mottling and organic matter.

The following table includes a brief description of the suspected fill and in-situ material and the approximate depth of the interface between the suspected fill and in-situ material for each soil boring and test pit.

Soil Boring / Test Pit No.	Description of Suspected Fill Material	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Description of Suspected In-situ Material
00-CF-SB-1	Topsoil; tan sand w/gravel.	1.5 feet bgs	Gray clay w/orange mottling.
00-CF-SB-2	Topsoil; tan sand w/gravel.	2.0 feet bgs	Gray clay w/decayed organic matter.
00-CF-SB-3	Topsoil; gray medium sand w/gravel	2.0 feet bgs	Gray clay w/orange mottling
00-CF-SB-4	Topsoil; gray-brown medium sand w/gravel	2.5 feet bgs	Gray clay w/orange mottling.
00-CF-SB-5	Topsoil; gray silty clay	3.2 feet bgs	Gray clay w/organic matter.

The following table lists the soil borings and test pits from which the primary soil samples were collected:

Soil Boring / Test Pit No	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Primary Soil Sample Representative of Suspected Fill Material	Primary Soil Sample Representative of Suspected In-situ Material
00-CF-SB-3	2.0 feet bgs	00-CF-SB-3-1	
00-CF-SB-5	3.2 feet bgs		00-CF-SB-5-4

6.3.2. Chemical Characterization.

A total of two (2) primary soil samples collected from this site were submitted to the primary laboratory for the following analyses. TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

6.3.2.1. Non-Detected Compounds/Analytes.

Compounds and analytes that were not detected at concentrations exceeding the method detection limits were excluded from consideration as potential COCs. Of the thirty-three (33) VOCs, acetone and methylene chloride were the only compounds detected in the primary soil samples. All of the VOCs, except for acetone and methylene chloride, were excluded from consideration as potential COCs. Of the sixty-four (64) SVOCs, bis(2-ethylhexyl)phthalate was the only compound detected in the primary soil samples All of the SVOCs, except for bis(2-ethylhexyl)phthalate, were excluded from consideration as potential COCs. Of the twenty-one (21) pesticides, the following six (6) were the only compounds detected in the primary soil samples: 4,4'-DDE, alpha-chlordane, dieldrin, endrin aldehyde, gamma-chlordane, and heptachlor epoxide. All of the pesticides, except for 4,4'-DDE, alpha-chlordane, dieldrin, endrin aldehyde, gamma-chlordane, and heptachlor epoxide, were excluded from consideration as potential COCs. Of the seven (7) PCBs, aroclor 1254 and aroclor 1260 were the only compounds detected in the primary soil samples. All of the PCBs, except for aroclor 1254 and aroclor 1260, were excluded from consideration as potential COCs. Of the twenty-four (24) TAL Inorganics, the following two (2) were not detected in the primary soil samples: cadmium and cyanide. Cadmium and cyanide were excluded from consideration as potential COCs.

6.3.2.2. Detected Compounds/Analytes.

A table of validated analytical results of detected compounds/analytes for Carolanne Farms is shown in Attachment J.

The following two (2) VOCs were detected at concentrations exceeding their method detection limits: acetone and methylene chloride. The following SVOC was detected at a concentration

exceeding the method detection limit: bis(2-ethylhexyl)phthalate. The following six (6) pesticides were detected at concentrations exceeding their method detection limits: 4,4'-DDE, alpha-chlordane, dieldrin, endrin aldehyde, gamma-chlordane, and heptachlor epoxide. The following two (2) PCBs were detected at concentrations exceeding their method detection limits: aroclor 1254 and aroclor 1260. The following twenty-two (22) TAL Inorganics were detected at concentrations exceeding their method detection limits: aluminum, antimony, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

These detected compounds and analytes were screened, using an exclusion process, to eliminate those compounds and analytes that were not appropriate to retain as potential COCs. The exclusion process consisted of comparisons between maximum detected concentrations vs. the quantitative data quality objectives (i e. EPA Region III RBCs for soil ingestion in residential and industrial scenarios and the release reporting requirements established by the VaDEQ under the *Storage Tank Program Technical Manual*).

6.3.2.2.1. EPA Region III RBCs.

The maximum concentrations of detected compounds and analytes were compared to the available EPA Region III RBCs.

The table in Attachment J shows the maximum detected concentration and RBC for the detected compounds and analytes.

RBCs were available for the two (2) detected VOCs. The maximum detected concentrations of acetone and methylene chloride did not exceed their respective RBCs. Acetone and methylene chloride were excluded from consideration as potential COCs for this site.

An RBC was available for the detected SVOC. The maximum detected concentration of bis(2-ethylhexyl)phthalate did not exceed the RBC. Bis(2-ethylhexyl)phthalate was excluded from consideration as a potential COC for this site.

RBCs were available for three (3) of the six (6) detected pesticides. None of the maximum detected concentrations exceeded the available RBCs. The three (3) pesticides, for which RBCs were available, were excluded from consideration as potential COCs for this site. RBCs were not available for the following three (3) pesticides: alpha-chlordane, endrin aldehyde, and gamma-chlordane.

RBCs were available for the two (2) detected PCBs. None of the maximum detected concentrations exceeded the available RBCs. Aroclor 1254 and aroclor 1260 were excluded from consideration as potential COCs for this site.

RBCs were available for sixteen (16) of the twenty-two (22) detected TAL Inorganics. None of the maximum detected concentrations exceeded the available RBCs, except for arsenic. Arsenic was retained as a potential COC for this site. The other fifteen (15) TAL Inorganics, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

6.3.2.2.2. Compounds/Analytes without Criteria.

RBCs were not available for the following three (3) pesticides: alpha-chlordane, endrin aldehyde, and gamma-chlordane. Assuming that the most conservative pesticide RBC of 40 ug/kg could be used as a surrogate criterion for these compounds, the maximum detected concentrations of these three (3) pesticides did not exceed the surrogate RBC.

Therefore, these three (3) detected pesticides were excluded from consideration as potential COCs

RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

The following four (4) detected TAL Inorganics were evaluated with regard to essential trace element or nutrient status· calcium, magnesium, potassium, and sodium. The ingestion rates for these analytes were calculated by multiplying maximum detected concentrations by an intake rate of 200 mg/day. The ingestion rates were compared to standard RDAs for these analytes. The following ingestion rates were calculated for calcium, magnesium, potassium, and sodium: 0.35 mg/day, 1.026 mg/day, 0.28 mg/day, and 0.1308 mg/day, respectively. The RDAs for calcium, magnesium, potassium, and sodium are 800 mg/day, 270 mg/kg, 1,950 mg/day, and 10,000 mg/day, respectively. None of the ingestion rates exceeded the RDAs. These four (4) detected TAL Inorganics were excluded from consideration as potential COCs.

The maximum concentration of lead was detected in sample 00-CF-SB-5-4 at 6,200 ug/kg. The EPA Region III recommends soil abatement activities when lead levels are found at 5,000,000 ug/kg or more in bare residential soil. The maximum detected concentration of lead did not exceed this criterion. Based on this screening criterion, no abatement activities are required to address lead in the soils. The maximum detected concentration of lead did not exceed the residential soil lead screening level of 400,000 ug/kg Based on these screening criteria, the lead in the soils does not pose a significant threat to human health nor does it warrant any interim exposure-reduction measures or soil abatement activities. Lead was excluded from consideration as a potential COC.

The maximum concentration of mercury was detected in sample 00-CF-SB-3-1 at 520 ug/kg. No screening criteria were available for mercury in soils. The objective of selecting potential COCs is to identify a subset of detected chemicals that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors. It is the professional opinion of the GeoE Section that the mercury data have good quality and are present at sufficient frequency to warrant site-specific study of risk associated with mercury Mercury was retained as a potential COC.

6.3.2.3. Potential Contaminants of Concern.

Based on the results of the risk screening of the detected compounds and analytes, the following two (2) analytes were retained as potential COCs for the Carolanne Farms site: arsenic, and mercury.

6.4. Site 3, Somme Avenue, Norfolk, Virginia.

A total of three (3) test pits were excavated during the subsurface investigation of this candidate site A site plan depicting the locations of the four (4) test pits is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

6.4.1. Physical Characterization.

The stratigraphy appeared to be fairly consistent between the three (3) test pits. Suspected fill material primarily consisted of silty sand intermixed with debris consisting of bricks, cobblestones, concrete, curbing, gravel, and terra cotta piping. Suspected fill material was encountered at the surface and extended down to an average depth of 7.167 feet bgs. Suspected in-situ material primarily consisted of gray clay with vegetation and roots.

The following table includes a brief description of the suspected fill and in-situ material and the approximate depth of the interface between the suspected fill and in-situ material for each soil boring and test pit:

Soil Boring / Test Pit No.	Description of Suspected Fill Material	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Description of Suspected In-situ Material
00-SA-TP-1	Silty sand w/cobblestones, concrete, curbing and gravel.	5.0 feet bgs	Gray clay w/vegetation.
00-SA-TP-2	Silty sand w/concrete, gravel and terra cotta piping.	6.5 feet bgs	Gray clay w/vegetation and roots.
00-SA-TP-3	Silty sand w/bricks, concrete, gravel and terra cotta piping.	10 feet bgs	Gray clay w/vegetation and roots.

The following table lists the soil borings and test pits from which the primary soil samples were collected:

Soil Boring / Test Pit No.	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Primary Soil Sample Representative of Suspected Fill Material	Primary Soil Sample Representative of Suspected In-situ Material
00-SA-TP-2	6.5 feet bgs	00-SA-TP-2-1	00-SA-TP-2-6.5

6.4.2. Chemical Characterization.

A total of two (2) primary soil samples collected from this site were submitted to the primary laboratory for the following analyses: TCL PAHs, TAL metals, cyanide, TPH GRO and TPH DRO.

6.4.2.1. Non-Detected Compounds/Analytes.

Compounds and analytes that were not detected at concentrations exceeding the method detection limits were excluded from consideration as potential COCs. None of the sixteen (16) PAHs were excluded from consideration as potential COCs. Of the twenty-four (24) TAL Inorganics, the following five (5) were excluded from consideration as potential COCs. cadmium, selenium, silver, thallium, and cyanide. TPH-GRO was excluded from consideration as a potential COC.

6.4.2.2. Detected Compounds/Analytes.

A table of validated analytical results of detected compounds/analytes for Somme Avenue is shown in Attachment J.

The following sixteen (16) PAHs were detected at concentrations exceeding their method detection limits: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The following nineteen (19) TAL Inorganics were detected at concentrations exceeding their detection limits: aluminum, antimony, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium, and zinc. TPH-DRO was detected at concentrations exceeding the method detection limit.

These detected compounds and analytes were screened, using an exclusion process, to eliminate those compounds and analytes that were not appropriate to retain as potential COCs. The exclusion process consisted of comparisons between maximum detected concentrations vs the quantitative data quality objectives (i.e. EPA Region III RBCs for soil ingestion in residential and industrial scenarios and the release reporting requirements established by the VaDEQ under the *Storage Tank Program Technical Manual*).

6.4.2.2.1. EPA Region III RBCs.

The maximum concentrations of detected compounds and analytes were compared to the available EPA Region III RBCs.

The table in Attachment J shows the maximum detected concentration and RBC for the detected compounds and analytes.

RBCs were available for thirteen (13) of the sixteen (16) detected PAHs. The maximum detected concentration of benzo(a)pyrene and dibenz(a,h)anthracene exceeded their respective RBCs. Benzo(a)pyrene and dibenz(a,h) anthracene were retained as potential COCs for this site. The other eleven (11) PAHs, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

RBCs were available for thirteen (13) of the nineteen (19) detected TAL Inorganics. None of the maximum detected concentrations exceeded the available RBCs, except for arsenic. Arsenic was retained as a potential COC for this site. The other thirteen (13) TAL Inorganics, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following six (6) detected TAL Inorganics. calcium, lead, magnesium, mercury, potassium, and sodium.

6.4.2.2.2. VaDEQ Release Reporting Requirements.

The maximum concentration of detected TPH was compared to the VaDEQ release reporting requirement under the *Storage Tank Program Technical Manual.* TPH-DRO was detected in sample 00-SA-TP-2-1 at 110,000 ug/kg, which exceeded the release reporting requirement of 100,000 ug/kg. TPH-DRO was retained as a potential COC for this site.

6.4.2.2.3. Compounds/Analytes without Criteria.

RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. Assuming that the most conservative PAH RBC of 87 ug/kg could be used as a surrogate criterion for these compounds, the maximum detected concentrations of benzo(g,h,i)perylene and phenanthrene exceeded the surrogate RBC; therefore, these two (2) detected PAHs were retained as potential COCs. The maximum detected concentration of acenaphthylene did not exceed the surrogate RBC; therefore, acenaphthylene was excluded from consideration as a potential COC.

RBCs were not available for the following six (6) detected TAL Inorganics. calcium, lead, magnesium, mercury, potassium, and sodium.

The following four (4) detected TAL Inorganics were evaluated with regard to essential trace element or nutrient status· calcium, magnesium, potassium, and sodium. The ingestion rates for these analytes were calculated by multiplying maximum detected concentrations by an intake rate of 200 mg/day. The ingestion rates were compared to standard RDAs for these analytes. The following ingestion rates were calculated for calcium, magnesium, potassium, and sodium: 2.04 mg/day, 0.876 mg/day, 0.544 mg/day, and 1.302 mg/day, respectively. The RDAs for calcium, magnesium,

potassium, and sodium are 800 mg/day, 270 mg/kg, 1,950 mg/day, and 10,000 mg/day, respectively. None of the ingestion rates exceeded the RDAs These four (4) detected TAL Inorganics were excluded from consideration as potential COCs.

The maximum concentration of lead was detected in sample 00-SA-TP-2-1 at 149,000 ug/kg. The EPA Region III recommends soil abatement activities when lead levels are found at 5,000,000 ug/kg or more in bare residential soil. The maximum detected concentration of lead did not exceed this criterion. Based on this screening criterion, no abatement activities are required to address lead in the soils. The maximum detected concentration of lead did not exceed the residential soil lead screening level of 400,000 ug/kg. Based on these screening criteria, the lead in the soils does not pose a significant threat to human health nor does it warrant any interim exposure-reduction measures or soil abatement activities. Lead was excluded from consideration as a potential COC.

The maximum concentration of mercury was detected in sample 00-SA-TP-2-6 5 at 300 ug/kg. No screening criteria were available for mercury in soils. The objective of selecting potential COCs is to identify a subset of detected chemicals that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors. It is the professional opinion of the GeoE Section that the mercury data have good quality and are present at sufficient frequency to warrant site-specific study of risk associated with mercury. Mercury was retained as a potential COC

6.4.2.3. Potential Contaminants of Concern.

Based on the results of the risk screening of the detected compounds and analytes, the following seven (7) compounds and analytes were retained as potential COCs for the Somme Avenue site: benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, mercury, and TPH-DRO.

6.5. Site 10a, Swimming Point (Crawford Bay), Portsmouth, Virginia.

A total of two (2) test pits were excavated during the subsurface investigation of this candidate site. A site plan depicting the locations of the two (2) test pits is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

6.5.1. Physical Characterization.

The stratigraphy appeared to be fairly consistent between the two (2) test pits. Suspected fill material primarily consisted of grassy ground cover, topsoil, and silty sand intermixed with bricks, glass, and wood debris. Suspected fill material was encountered at the surface and extended down to an average depth of 3.25 feet bgs. Suspected in-situ material primarily consisted primarily of gray sand with decayed organic matter.

The following table includes a brief description of the suspected fill and in-situ material and the approximate depth of the interface between the suspected fill and in-situ material for each soil boring and test pit:

Soil Boring / Test Pit No.	Description of Suspected Fill Material	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Description of Suspected In-situ Material
00-SP-TP-1	Silty sand w/bricks, glass, and wood	3 5 feet bgs	Gray sand w/decayed organic matter.
00-SP-TP-2	Silty sand w/bricks, glass, and wood.	3 0 feet bgs	Gray sand.

The following table lists the soil borings and test pits from which the primary soil samples were collected:

Soil Boring / Test Pit No.	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Primary Soil Sample Representative of Suspected Fill Material	Primary Soil Sample Representative of Suspected In-situ Material
00-SP-TP-2	3.0 feet bgs	00-SP-TP-2-2.6	00-SP-TP-2-5

6.5.2. Chemical Characterization.

A total of two (2) primary soil samples collected from this site were submitted to the primary laboratory for the following analyses: TCL VOCs, TCL SVOCs, TAL metals, and cyanide.

6.5.2.1. Non-Detected Compounds/Analytes.

Compounds and analytes that were not detected at concentrations exceeding the method detection limits were excluded from consideration as potential COCs. Of the thirty-three (33) VOCs, the following five (5) VOCs were detected in the primary soil samples. All of the VOCs, except for acetone, benzene, ethylbenzene, toluene, and xylenes, were excluded from consideration as potential COCs. Of the sixty-four (64) SVOCs, the following twenty-two (22) SVOCs were detected in the primary soil samples: 2-methylnaphthalene, 2-methylphenol, 4-methylphenol, acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, phenol, and pyrene. All of the SVOCs, except for the twenty-two (22) detected SVOCs, were excluded from consideration as potential COCs. Of the twenty-four (24) TAL Inorganics, the following two (2) were not detected in the primary soil samples: cadmium and silver. Cadmium and silver were excluded from consideration as potential COCs.

6.5.2.2. Detected Compounds/Analytes.

A table of validated analytical results of detected compounds/analytes for Swimming Point is shown in Attachment J.

The following five (5) VOCs were detected at concentrations exceeding their method detection limits: acetone, benzene, ethylbenzene, toluene, and xylenes. The following twenty-two (22) SVOCs were detected at a concentration exceeding their method detection limits. 2-methylnaphthalene, 2-methylphenol, 4-methylphenol, acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, phenol, and pyrene. The following twenty-two (22) TAL Inorganics were detected at concentrations exceeding their method detection limits: aluminum, antimony, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, thallium, vanadium, zinc, and cyanide.

These detected compounds and analytes were screened, using an exclusion process, to eliminate those compounds and analytes that were not appropriate to retain as potential COCs. The exclusion process consisted of comparisons between maximum detected concentrations vs. the quantitative data quality objectives (i.e. EPA Region III RBCs for soil ingestion in residential and industrial scenarios and the release reporting requirements established by the VaDEQ under the *Storage Tank Program Technical Manual*)

6.5.2.2.1. EPA Region III RBCs.

The maximum concentrations of detected compounds and analytes were compared to the available EPA Region III RBCs.

The table in Attachment J shows the maximum detected concentration and RBC for the detected compounds and analytes.

RBCs were available for all five (5) detected VOCs. The maximum detected concentrations did not exceed their respective RBCs. Acetone, benzene, ethylbenzene, toluene, and xylenes were excluded from consideration as potential COCs for this site.

RBCs were available for nineteen (19) of the twenty-two (22) detected SVOCs. The maximum detected concentrations of the following five (5) SVOCs exceeded their respective RBCs: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were retained as potential COCs for this site. The other fourteen (14) SVOCs, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

RBCs were available for sixteen (16) of the twenty-two (22) detected TAL Inorganics. None of the maximum detected concentrations exceeded the available RBCs, except for arsenic. Arsenic was retained as a potential COC for this site. The other fifteen (15) TAL Inorganics, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium

6.5.2.2.2. Compounds/Analytes without Criteria.

RBCs were not available for the following three (3) detected PAHs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. Assuming that the most conservative SVOC RBC of 87 ug/kg could be used as a surrogate criterion for these compounds, the maximum detected concentrations of these three (3) SVOCs exceeded the surrogate RBC. Therefore, the following three (3) detected SVOCs were retained as potential COCs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

The following four (4) detected TAL Inorganics were evaluated with regard to essential trace element or nutrient status: calcium, magnesium, potassium, and sodium. The ingestion rates for these analytes were calculated by multiplying maximum detected concentrations by an intake rate of 200 mg/day. The ingestion rates were compared to standard RDAs for these analytes. The following ingestion rates were calculated for calcium, magnesium, potassium, and sodium: 2.3 mg/day, 0.446 mg/day, 0.0962 mg/day, and 0.202 mg/day, respectively. The RDAs for calcium, magnesium, potassium, and sodium are 800 mg/day, 270 mg/kg, 1,950 mg/day, and 10,000 mg/day, respectively. None of the ingestion rates exceeded the RDAs. These four (4) detected TAL Inorganics were excluded from consideration as potential COCs.

The maximum concentration of lead was detected in sample 00-SP-TP-2-2.6 at 3,110,000 ug/kg. The EPA Region III recommends soil abatement activities when lead levels are found at 5,000,000 ug/kg or more in bare residential soil. The maximum detected concentration of lead did not exceed this criterion. Based on this screening criterion, no abatement activities are required to address lead in the soils. The maximum detected concentration of lead exceeded the residential soil lead screening level of 400,000 ug/kg. Although, no abatement activities are required, the exceedance of the residential soil lead screening level may warrant site-specific study of risks associated with lead. Lead was retained as a potential COC.

The maximum concentration of mercury was detected in sample 00-SP-TP-2-2.6 at 970 ug/kg. No screening criteria were available for mercury in soils. The objective of selecting potential COCs is to identify a subset of detected chemicals that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors. It is the professional opinion of the GeoE Section that the mercury data have good quality and are present at sufficient frequency to warrant site-specific study of risks associated with mercury. Mercury was retained as a potential COC.

6.5.2.3. Potential Contaminants of Concern.

Based on the results of the risk screening of the detected compounds and analytes, the following eleven (11) compounds and analytes were retained as potential COCs for the Swimming Point site: acenaphthylene, benz(a)anthracene, benzo(a,)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, phenanthrene, arsenic, lead, and mercury.

6.6. Site 9a, Sugar Hill (Scotts Creek), Portsmouth, Virginia.

A total of four (4) test pits were excavated during the subsurface investigation of this candidate site. A site plan depicting the locations of the four (4) test pits is shown in Attachment C. Attachment D contains field documentation, which includes logbook entries, site diagrams, test pit/soil boring logs and photographs.

6.6.1. Physical Characterization.

The stratigraphy appeared to be fairly consistent between the four (4) soil borings Suspected fill material primarily consisted of silty sand and gray clay intermixed with asphalt, bricks, glass, and metal debris. Suspected fill material was encountered at the surface and extended down to an average depth of 7.5 feet bgs. Suspected in-situ material primarily consisted primarily of gray clay with organic matter and roots.

The following table includes a brief description of the suspected fill and in-situ material and the approximate depth of the interface between the suspected fill and in-situ material for each soil boring and test pit:

Soil Boring / Test Pit No.	Description of Suspected Fill Material	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Description of Suspected In-situ Material
00-SH-TP-1	Silty sand w/asphalt, bricks, glass, and metal; gray clay and gravel w/debris.	BOH 7.0 feet bgs	Refusal at 7.0 feet. Still appeared to be suspect fill material at BOH.
00-SH-TP-2	Silty sand w/asphalt, bricks, glass, and metal; gray clay and gravel w/debris	9.0 feet bgs	Gray clay w/organic matter, roots, and vegetation.
00-SH-TP-3	Silty sand w/asphalt, bricks, glass, and metal; gray clay and gravel w/debris.	6.5 feet bgs	Gray clay w/organic matter and roots.
00-SH-TP-4	Silty sand w/asphalt, bricks, glass, and metal; gray clay and gravel w/debris.	7.0 feet bgs	Gray clay w/organic matter and roots.

The following table lists the soil borings and test pits from which the primary soil samples were collected:

Soil Boring / Test Pit No.	Approximate Depth of Interface between Suspected Fill and In-situ Materials	Primary Soil Sample Representative of Suspected Fill Material	Primary Soil Sample Representative of Suspected In-situ Material
00-SH-TP-2	2.0 feet bgs	00-SH-TP-2-0.5	00-SH-TP-2-9
00-SH-TP-4	3.2 feet bgs	00-SH-TP-4-0.5	00-SH-TP-4-7

6.6.2. Chemical Characterization.

A total of four (4) primary soil samples collected from this site were submitted to the primary laboratory for the following analyses: TCL PAHs, TCL pesticides, TCL PCBs, TAL metals, and cyanide.

6.6.2.1. Non-Detected Compounds/Analytes.

Compounds and analytes that were not detected at concentrations exceeding the method detection limits were excluded from consideration as potential COCs. Of the sixteen (16) PAH, the following two (2) PAHs were not detected in the primary soil samples: acenaphthene and acenaphthylene. Acenaphthene and acenaphthylene were excluded from consideration as potential COCs. Of the twenty-one (21) pesticides, the following three (3) were the only compounds detected in the primary soil samples: 4,4'-DDD, 4,4'-DDE, and heptachlor epoxide. All of the pesticides, except for 4,4'-DDD, 4,4'-DDE, and heptachlor epoxide, were excluded from consideration as potential COCs. Of the seven (7) PCBs, aroclor 1260 was the only compound detected in the primary soil samples. All of the PCBs, except for aroclor 1260, were excluded from consideration as potential COCs. Of the twenty-four (24) TAL Inorganics, the following two (2) were not detected in the primary soil samples: cadmium and cyanide. Cadmium and cyanide were excluded from consideration as potential COCs.

6.6.2.2. Detected Compounds/Analytes.

A table of validated analytical results of detected compounds/analytes for Sugar Hill is shown in Attachment J.

The following fourteen (14) PAHs were detected at concentrations exceeding their method detection limits anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The following three (3) pesticides were detected at concentrations exceeding their method detection limits: 4,4'-DDD, 4,4'-DDE, and heptachlor epoxide The following PCB was detected at a concentration exceeding the method detection limit. aroclor 1260. The following twenty-two (22) TAL Inorganics were detected at concentrations exceeding their method detection limits: aluminum, antimony, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

These detected compounds and analytes were screened, using an exclusion process, to eliminate those compounds and analytes that were not appropriate to retain as potential COCs. The exclusion process consisted of comparisons between maximum detected concentrations vs. the quantitative data quality objectives (i.e EPA Region III RBCs for soil ingestion in residential and industrial scenarios and the release reporting requirements established by the VaDEQ under the *Storage Tank Program Technical Manual*).

6.6.2.2.1. EPA Region III RBCs.

The maximum concentrations of detected compounds and analytes were compared to the available EPA Region III RBCs

The table in Attachment J shows the maximum detected concentration and RBC for the detected compounds and analytes.

RBCs were available for twelve (12) of the fourteen (14) detected PAHs The maximum detected concentration of benzo(a)pyrene and dibenz(a,h)anthracene exceeded their respective RBCs. Benzo(a)pyrene and dibenz(a,h) anthracene were retained as potential COCs for this site. The other ten (10) PAHs, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following two (2) detected PAHs: benzo(g,h,i)perylene, and phenanthrene.

RBCs were available for all three (3) of the detected pesticides. None of the maximum detected concentrations exceeded the available RBCs. The three (3) detected pesticides were excluded from consideration as potential COCs for this site.

An RBC was available for the detected PCB. The maximum detected concentration of aroclor 1260 did not exceed the RBC Aroclor 1260 was excluded from consideration as a potential COC for this site

RBCs were available for sixteen (16) of the twenty-two (22) detected TAL Inorganics. None of the maximum detected concentrations exceeded the available RBCs, except for arsenic and iron. Arsenic and iron were retained as potential COCs for this site. The other fourteen (14) TAL Inorganics, for which RBCs were available, were excluded from consideration as potential COCs. RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

6.6.2.2.2. Compounds/Analytes without Criteria.

RBCs were not available for the following two (2) PAHs: benzo(g,h,i)perylene and phenanthrene. Assuming that the most conservative PAH RBC of 87 ug/kg could be used as a surrogate criterion for these compounds, the maximum detected concentrations of these two (2) PAHs exceeded the surrogate RBC. Therefore, the two (2) detected PAHs were retained as potential COCs.

RBCs were not available for the following six (6) detected TAL Inorganics: calcium, lead, magnesium, mercury, potassium, and sodium.

The following four (4) detected TAL Inorganics were evaluated with regard to essential trace element or nutrient status: calcium, magnesium, potassium, and sodium. The ingestion rates for these analytes were calculated by multiplying maximum detected concentrations by an intake rate of 200 mg/day. The ingestion rates were compared to standard RDAs for these analytes The following ingestion rates were calculated for calcium, magnesium, potassium, and sodium: 2.26 mg/day, 0.832 mg/day, 0.502 mg/day, and 1.162 mg/day, respectively. The RDAs for calcium, magnesium, potassium, and sodium are 800 mg/day, 270 mg/kg, 1,950 mg/day, and 10,000 mg/day, respectively. None of the ingestion rates exceeded the RDAs. These four (4) detected TAL Inorganics were excluded from consideration as potential COCs.

The maximum concentration of lead was detected in sample 00-SH-TP-4-7 at 380,000 ug/kg. The EPA Region III recommends soil abatement activities when lead levels are found at 5,000,000 ug/kg or more in bare residential soil. The maximum detected concentration of lead did not exceed this criterion. Based on this screening criterion, no abatement activities are required to address lead in the soils. The maximum detected concentration of lead did not exceed the residential soil lead screening level of 400,000 ug/kg. Based on these screening criteria, the lead in the soils does not pose a significant threat to human health nor does it warrant any interim exposure-reduction measures or soil abatement activities. Lead was excluded from consideration as a potential COC.

The maximum concentration of mercury was detected in sample 00-SH-TP-4-7 at 1,600 ug/kg. No screening criteria were available for mercury in soils The objective of selecting potential COCs is to identify a subset of detected chemicals that have good quality, are not naturally occurring, or a result of non-site sources, and are present at sufficient frequency, concentration, and location to pose a potential health risk to exposed receptors. It is the professional opinion of the GeoE Section that the mercury data have good quality and are present at sufficient frequency to warrant site-specific study of risk associated with mercury. Mercury was retained as a potential COC.

6.6.2.3. Potential Contaminants of Concern.

Based on the results of the risk screening of the detected compounds and analytes, the following seven (7) compounds and analytes were retained as potential COCs for the Sugar Hill site: benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, iron, and mercury.

7. CONCLUSIONS AND RECOMMENDATIONS.

7.1. Potential Contaminants of Concern.

A summary of the potential COCs in soil identified for each of the six (6) candidate sites, based on the risk screening of detected compounds and analytes, is shown in the following table.

Candidate Site	Potential COCs in Soil
Grandy Village, Norfolk, Virginia	Arsenic, TPH-DRO.
Portsmouth City Park, Portsmouth, Virginia	Acenaphthylene, Benzo(a,)pyrene, Benzo(g,h,i)perylene, Dibenz(a,h)anthracene, Phenanthrene, Arsenic, Mercury.
Carolanne Farms, Virginia Beach, Virginia	Arsenic, Mercury.
Somme Avenue, Norfolk, Virginia.	Benzo(a,)pyrene, Benzo(g,h,i)perylene, Dibenz(a,h)anthracene, Phenanthrene, Arsenic, Mercury, TPH-DRO
Swimming Point, Portsmouth, Virginia	Acenaphthylene, Benz(a)anthracene, Benzo(a,)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Phenanthrene, Arsenic, Lead, Mercury
Sugar Hill, Portsmouth, Virginia	Benzo(a,)pyrene, Benzo(g,h,i)perylene, Dibenz(a,h)anthracene, Phenanthrene, Arsenic, Iron, Mercury.

7.2. RCRA Hazardous Waste Assessment.

One of the secondary objectives of the Elizabeth River Wetlands Subsurface Investigation was to identify potential disposal and handling requirements of the materials encountered. An important factor that can substantially impact handling and disposal requirements is a material's classification as a RCRA hazardous waste Under RCRA, there are two (2) primary classifications of RCRA hazardous wastes: listed and characteristic A solid waste which is identified on any of the hazardous waste lists in 40 Code of Federal Regulations (CFR) 261 Subpart D is classified as a listed hazardous waste. Knowledge of the contaminant source is required to make a listed RCRA hazardous waste determination. A solid waste which exhibits any of the four (4) hazardous waste characteristics in 40 CFR 261 Subpart C is classified as a characteristic hazardous waste.

Assuming that any detected contamination in the sampled materials can not be traced to a contaminant source or release event, the potential for the material to be classified as a listed RCRA hazardous waste is minimal. However, the sampled materials can still be classified as a characteristic hazardous waste if it exhibits any of the following four (4) hazardous waste characteristics: ignitability, reactivity, corrosivity, and toxicity.

A solid waste exhibits the characteristic of toxicity if the extract obtained from the toxicity characteristic leaching procedure (TCLP) contains any of the forty (40) TCLP contaminants at concentrations exceeding the TCLP maximum concentrations. The TCLP is defined in the EPA SW-846 Manual as Method 1311. The TCLP was designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. The TCLP involves the extraction of a sample with a buffered acetic acid solution equal to 20 times the weight of the solid sample. Following the extraction, the liquid extract is separated from the solid phase through a filter. The TCLP was not performed on any of the samples collected during this investigation; however, the results obtained from the chemical analyses may be used to make a conservative assessment of whether or not the sampled material exhibits the characteristic of toxicity. The results obtained from the chemical analyses of the sampled materials represent total concentrations of chemicals in the solid sample. The mass of a TCLP extract is 20 times the mass of the solid sample according to the method procedure. By dividing the total concentration of a chemical in the solid sample by 20, one may calculate the maximum potential concentration of that chemical in the TCLP extract. By comparing the maximum potential TCLP concentrations of potential COCs, that are also TCLP contaminants, to the TCLP maximum concentrations, one may determine whether or not the sampled material could potentially exhibit the characteristic of toxicity.

The GeoE Section performed these calculations with the maximum total concentration of potential COCs, that were also TCLP contaminants, for each site. The site-specific results are included in the site summaries presented in the following sections

For a given TCLP contaminant, if the maximum potential TCLP concentration did not exceed the TCLP maximum concentration, then the sample can not exhibit the characteristic of toxicity, as actual TCLP concentrations can not exceed the maximum potential TCLP concentration. Furthermore, by assuming that the samples are representative of the sampled material, then one may conclude that the sampled material does not exhibit the characteristic of toxicity.

Tests for ignitability, reactivity, or corrosivity were not performed on any of the samples collected during this investigation. No quantitative evaluation could be made with respect to ignitability, reactivity, or corrosivity; however, it is the professional opinion of the GeoE Section that the characteristic of toxicity is the most stringent of the four (4) hazardous waste characteristics. As such, if a material did not exhibit the characteristic of toxicity, then the GeoE Section expects the material would not exhibit any of the other three (3) characteristics, and we would not expect the material to be classified as a RCRA hazardous waste.

7.3. Site-specific Conclusions and Recommendations.

Site-specific conclusions and recommendations are presented in the following sections.

7.3.1. Site 4, Grandy Village, Norfolk, Virginia.

Based on the results of the risk screening of the detected compounds and analytes, the following analyte and compound were retained as potential COCs for the Grandy Village site: arsenic and TPH-DRO.

The maximum detected concentration of arsenic in soil exceeded the residential RBC for soil ingestion and was retained as a potential COC. The RBCs serve as an effective means of identifying potential COCs that may warrant site-specific study of risk; however, the residential RBCs are based on conservative exposure assumptions that assume an exposure frequency of 350 days per year and an exposure duration of 30 years. Based on the current and anticipated future land use of the site, it is the professional opinion of the GeoE Section that site-specific exposures would not be as frequent or as prolonged as those of the residential RBCs, and that the arsenic would not pose a significant threat to human health at this site.

Of the two (2) potential COCs, arsenic is the only TCLP contaminant. The maximum detected concentration of arsenic was 2,800 ug/kg. The maximum potential TCLP concentration was 140 micrograms/liter (ug/L), which is below the maximum TCLP concentration of 5,000 ug/L for arsenic.

Based on this assessment, the GeoE Section does not expect the material to be classified as a RCRA hazardous waste.

The maximum detected concentration of TPH-DRO in soils exceeded the VaDEQ release reporting requirement of 100,000 ug/kg. The presence of petroleum hydrocarbons in the site soils has been confirmed; however, TPH-DRO was only detected in one (1) of the six (6) primary soil samples, 00-GV-SB-1-3. The GeoE Section recommends the owner/operator report to the Tidewater Regional Office of the VaDEQ the presence of TPH-DRO in excess of 100,000 ug/kg in the drainage area behind the Grandy Village housing complex. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VaDEQ *Storage Tank Program Technical Manual.*

Potential risks to human health associated with the detected compounds and analytes are not anticipated at this site. RCRA hazardous wastes are not anticipated at this site. Petroleum contaminated wastes are anticipated for the material in the drainage area behind the Grandy Village housing complex.

7.3.2. Site 6, Portsmouth City Park, Portsmouth, Virginia.

Based on the results of the risk screening of the detected compounds and analytes, the following seven (7) compounds and analytes were retained as potential COCs for the Portsmouth City Park site: acenaphthylene, benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, and mercury.

The maximum detected concentrations of acenaphthylene, benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, and arsenic in soil exceeded the residential RBCs and surrogate RBC for soil ingestion and were retained as potential COCs. The RBCs serve as an effective means of identifying potential COCs that may warrant site-specific study of risk; however, the residential RBCs are based on conservative exposure assumptions that assume an exposure frequency of 350 days per year and an exposure duration of 30 years. Based on the current and anticipated future land use of the site, it is the professional opinion of the GeoE Section that site-specific exposures would not be as frequent or as prolonged as those of the residential RBCs, and that these compounds and analyte would not pose a significant threat to human health at this site.

No screening criterion was available for mercury. A site-specific study of risks associated with mercury may be warranted.

Of the seven (7) potential COCs, arsenic and mercury are the only TCLP contaminants. The maximum detected concentration of arsenic was 6,900 ug/kg. The maximum potential TCLP concentration was 345 ug/L, which is below the maximum TCLP concentration of 5,000 ug/L for arsenic. The maximum detected concentration of mercury was 150 ug/kg. The maximum potential TCLP concentration was 7.5 ug/L, which is below the maximum TCLP concentration of 200 ug/L for mercury. Based on this assessment, the GeoE Section does not expect the material would be classified as a RCRA hazardous waste.

Potential risks to human health associated with mercury may warrant a site-specific study of risks. RCRA hazardous wastes are not anticipated at this site. Petroleum contaminated wastes are not anticipated at this site.

7.3.3. Site 11, Carolanne Farms, Virginia Beach, Virginia.

Based on the results of the risk screening of the detected compounds and analytes, the following two (2) analytes were retained as potential COCs for the Carolanne Farms site: arsenic and mercury.

The maximum detected concentration of arsenic in soil exceeded the residential RBC for soil ingestion and was retained as a potential COC. The RBCs serve as an effective means of identifying potential COCs that may warrant site-specific study of risk; however, the residential RBCs are based on conservative exposure assumptions that assume an exposure frequency of 350 days per year and

an exposure duration of 30 years. Based on the current and anticipated future land use of the site, it is the professional opinion of the GeoE Section that site-specific exposures would not be as frequent or as prolonged as those of the residential RBC, and that the arsenic would not pose a significant threat to human health at this site.

No screening criterion was available for mercury. A site-specific study of risks associated with mercury may be warranted.

Of the two (2) potential COCs, arsenic and mercury are both TCLP contaminants. The maximum detected concentration of arsenic was 5,100 ug/kg. The maximum potential TCLP concentration was 255 ug/L, which is below the maximum TCLP concentration of 5,000 ug/L for arsenic. The maximum detected concentration of mercury was 520 ug/kg. The maximum potential TCLP concentration was 26 ug/L, which is below the maximum TCLP concentration of 200 ug/L for mercury. Based on this assessment, the GeoE Section does not expect the material would be classified as a RCRA hazardous waste.

Potential risks to human health associated with mercury may warrant a site-specific study of risks. RCRA hazardous wastes are not anticipated at this site. Petroleum contaminated wastes are not anticipated at this site.

7.3.4. Site 3, Somme Avenue, Norfolk, Virginia.

Based on the results of the risk screening of the detected compounds and analytes, the following seven (7) compounds and analytes were retained as potential COCs for the Somme Avenue site: benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, mercury, and TPH-DRO.

The maximum detected concentrations of benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, and arsenic in soil exceeded the residential RBCs and surrogate RBC for soil ingestion and were retained as potential COCs. The RBCs serve as an effective means of identifying potential COCs that may warrant site-specific study of risk; however, the residential RBCs are based on conservative exposure assumptions that assume an exposure frequency of 350 days per year and an exposure duration of 30 years. Based on the current and anticipated future land use of the site, it is the professional opinion of the GeoE Section that site-specific exposures would not be as frequent or as prolonged as those of the residential RBCs, and that these compounds and analyte would not pose a significant threat to human health at this site.

No screening criterion was available for mercury. A site-specific study of risks associated with mercury may be warranted.

Of the seven (7) potential COCs, arsenic and mercury are the only TCLP contaminants. The maximum detected concentration of arsenic was 3,500 ug/kg. The maximum potential TCLP concentration was 175 ug/L, which is below the maximum TCLP concentration of 5,000 ug/L for arsenic. The maximum detected concentration of mercury was 300 ug/kg. The maximum potential TCLP concentration was 15 ug/L, which is below the maximum TCLP concentration of 200 ug/L for mercury. Based on this assessment, the GeoE Section does not expect the material would be classified as a RCRA hazardous waste.

The maximum detected concentration of TPH-DRO in soils exceeded the VaDEQ release reporting requirement of 100,000 ug/kg. The GeoE Section recommends the owner/operator report to the Tidewater Regional Office of the VaDEQ the presence of TPH-DRO in excess of 100,000 ug/kg. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2.7 of the VaDEQ *Storage Tank Program Technical Manual.*

Potential risks to human health associated with mercury may warrant a site-specific study of risks. RCRA hazardous wastes are not anticipated at this site. Petroleum contaminated wastes are anticipated at this site.

7.3.5. Site 10a, Swimming Point (Crawford Bay), Portsmouth, Virginia.

Based on the results of the risk screening of the detected compounds and analytes, the following eleven (11) compounds and analytes were retained as potential COCs for the Swimming Point site. acenaphthylene, benz(a)anthracene, benzo(a,)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, phenanthrene, arsenic, lead, and mercury.

The maximum detected concentrations of acenaphthylene, benz(a)anthracene, benzo(a,)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, phenanthrene, and arsenic in soil exceeded the residential RBCs and surrogate RBC for soil ingestion and were retained as potential COCs. The RBCs serve as an effective means of identifying potential COCs that may warrant site-specific study of risk, however, the residential RBCs are based on conservative exposure assumptions that assume an exposure frequency of 350 days per year and an exposure duration of 30 years. Based on the current and anticipated future land use of the site, it is the professional opinion of the GeoE Section that site-specific exposures would not be as frequent or as prolonged as those of the residential RBCs, and that these compounds and analyte would not pose a significant threat to human health at this site.

No screening criterion was available for mercury. A site-specific study of risks associated with mercury may be warranted.

Of the eleven (11) potential COCs, arsenic, lead, and mercury are the only TCLP contaminants The maximum detected concentration of arsenic was 29,200 ug/kg. The maximum potential TCLP concentration was 1,460 ug/L, which is below the maximum TCLP concentration of 5,000 ug/L for arsenic. The maximum detected concentration of lead was 3,110,000 ug/kg. The maximum potential TCLP concentration was 155,500 ug/L, which exceeded the maximum TCLP concentration of 5,000 ug/L for lead. The maximum detected concentration of mercury was 970 ug/kg. The maximum potential TCLP concentration was 48.5 ug/L, which is below the maximum TCLP concentration of 200 ug/L for mercury. Based on this assessment, the GeoE Section does not expect the material would exhibit arsenic or mercury toxicity. Although the potential maximum TCLP concentration of lead exceeded the maximum TCLP concentration, Omega Environmental Services conducted sampling and analyses of the IDW for disposal purposes, which included TCLP analysis for lead. The concentration of lead in the TCLP extract was 3,160 ug/L, which is below the maximum TCLP concentration of 5,000 ug/L for lead. The analytical results indicated that the soils excavated from the test pits were non-hazardous, but contaminated with petroleum. A copy of the analytical results, non-hazardous manifest, and certificate of treatment are shown in Attachment K.

The maximum detected concentration of TPH-DRO in soils exceeded the VaDEQ release reporting requirement of 100,000 ug/kg. The GeoE Section recommends the owner/operator report to the Tidewater Regional Office of the VaDEQ the presence of TPH-DRO in excess of 100,000 ug/kg. Given the limited information available on this site, the analytical results should be reported as "Petroleum Contamination from Unknown Sources," per Section 2 7 of the VaDEQ *Storage Tank Program Technical Manual.*

Potential risks to human health associated with mercury may warrant a site-specific study of risks RCRA hazardous wastes are not anticipated at this site. Petroleum contaminated wastes are anticipated at this site.

7.3.6. Site 9a, Sugar Hill (Scotts Creek), Portsmouth, Virginia.

Based on the results of the risk screening of the detected compounds and analytes, the following seven (7) compounds and analytes were retained as potential COCs for the Sugar Hill site: benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, iron, and mercury.

The maximum detected concentrations of benzo(a,)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, phenanthrene, arsenic, and iron in soil exceeded the residential RBCs and surrogate RBC for soil ingestion and were retained as potential COCs. The RBCs serve as an effective means of identifying potential COCs that may warrant site-specific study of risk; however, the residential RBCs are based on conservative exposure assumptions that assume an exposure frequency of 350 days per year and an exposure duration of 30 years. Based on the current and anticipated future land use of the site, it is the professional opinion of the GeoE Section that site-specific exposures would not be as frequent or as prolonged as those of the residential RBCs, and that these compounds and analytes would not pose a significant threat to human health at this site.

No screening criterion was available for mercury. A site-specific study of risks associated with mercury may be warranted.

Of the seven (7) potential COCs, arsenic and mercury are the only TCLP contaminants. The maximum detected concentration of arsenic was 17,200 ug/kg. The maximum potential TCLP concentration was 860 ug/L, which is below the maximum TCLP concentration of 5,000 ug/L for arsenic. The maximum detected concentration of mercury was 1,600 ug/kg. The maximum potential TCLP concentration was 80 ug/L, which is below the maximum TCLP concentration of 200 ug/L for mercury. Based on this assessment, the GeoE Section does not expect the material would be classified as a RCRA hazardous waste.

Potential risks to human health associated with mercury may warrant a site-specific study of risks RCRA hazardous wastes are not anticipated at this site. Petroleum contaminated wastes are not anticipated at this site

7.4. Relative Site Rankings.

The following table summarizes the primary HTRW concerns associated with each of the six (6) candidate sites and ranks the sites' relative HTRW potential as low, medium, or high, with respect to each other.

Candidate Site	Potential Risk Concerns	RCRA Hazardous Waste Concerns	Other Waste Concerns	HTRW Potential
Grandy Village, Norfolk, Virginia	None Anticipated	None Anticipated.	Petroleum.	LOW
Portsmouth City Park, Portsmouth, Virginia	Mercury.	None Anticipated.	None Anticipated	LOW
Carolanne Farms, Virginia Beach, Virginia	Mercury	None Anticipated.	None Anticipated.	LOW
Somme Avenue, Norfolk, Virginia.	Mercury.	None Anticipated.	Petroleum.	MEDIUM
Swimming Point, Portsmouth, Virginia	Mercury.	None Anticipated.	Petroleum.	MEDIUM
Sugar Hill, Portsmouth, Virginia	Mercury.	None Anticipated.	None Anticipated.	LOW

The designations of low, medium, and high are relative designations with respect to these six (6) candidate sites. The low designation corresponds to only one (1) primary HTRW concern regarding risk, hazardous waste, or other waste. The medium designation corresponds to two (2) primary HTRW concerns regarding risk, hazardous waste, or other waste. The high designation corresponds to three (3) primary HTRW concerns regarding risk, hazardous waste, or other waste

00-CF-SB-5
00-CF-SB-4
00-CF-SB-3
00-CF-SB-1
00-CF-SB-2
Carolanne Farms
Elizabeth River Environmental Restoration Feasibility Study
Soil Boring
75 0 75 150
Scale in feet 1:3,000
N
W
E
S

00-GV-SB-4
00-GV-SB-3
00-GV-TP-1
00-GV-SB-2
00-GV-SB-1
00-GV-TP-2
00-GV-TP-7
00-GV-TP-3
00-GV-TP-4
00-GV-TP-5
00-GV-TP-6
Grandy Village
Elizabeth River Environmental Restoration Feasibility Study
Test Pit
Soil Boring
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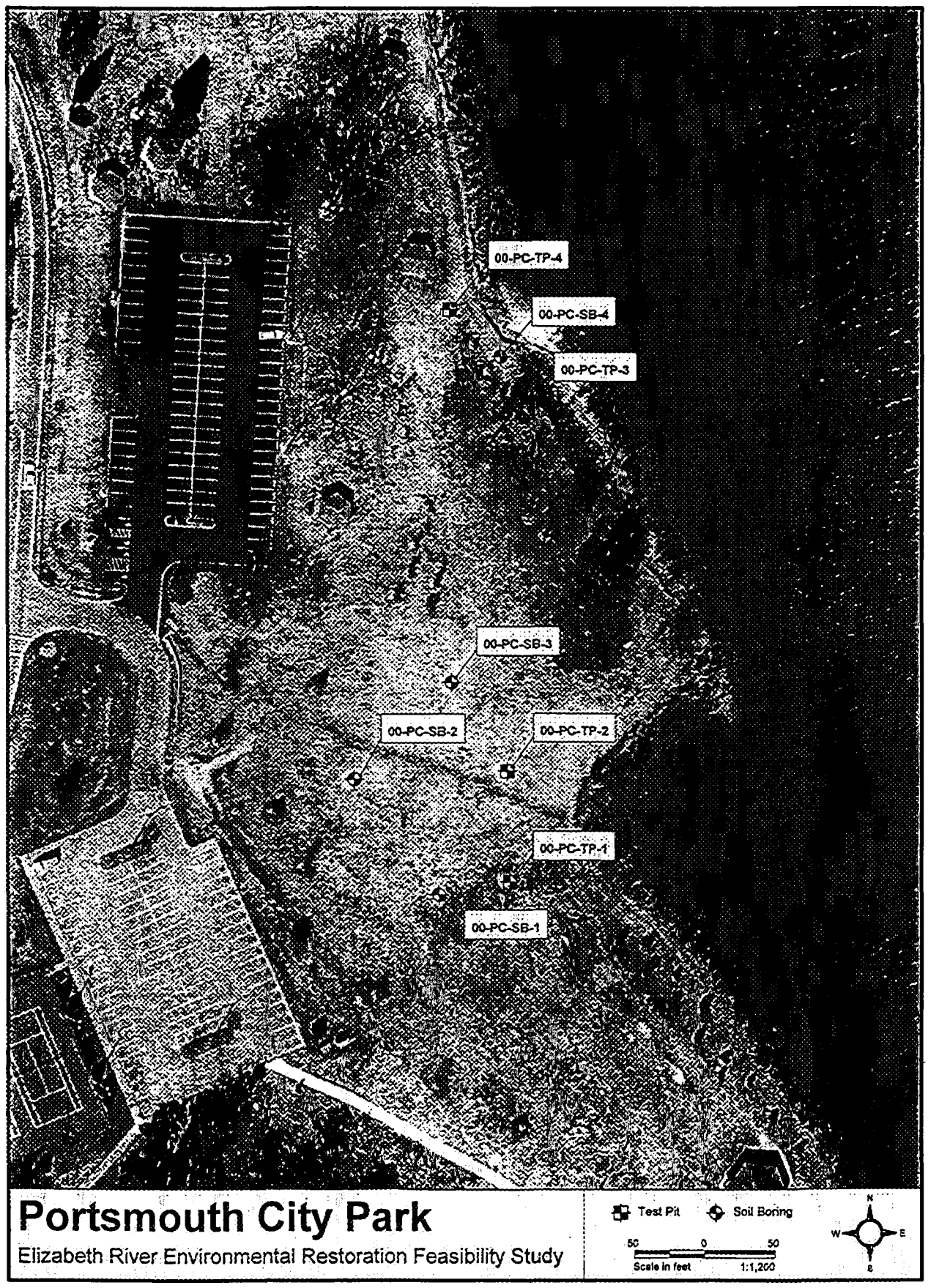
Scale in feet
1:3,000
N
W
E
S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00-PC-SB-2
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00-PC-TP-1
00-PC-SB-1
Portsmouth City Park
Elizabeth River Environmental Restoration Feasibility Study
Test Pit
Soil Boring
50 0 50
Scale in feet
1:1,200
N
W
E
S

00-SA-TP-1
00-SA-TP-2
00-SA-TP-3
Somme Avenue
Elizabeth River Environmental Restoration Feasibility Study
Test Pit
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W
E
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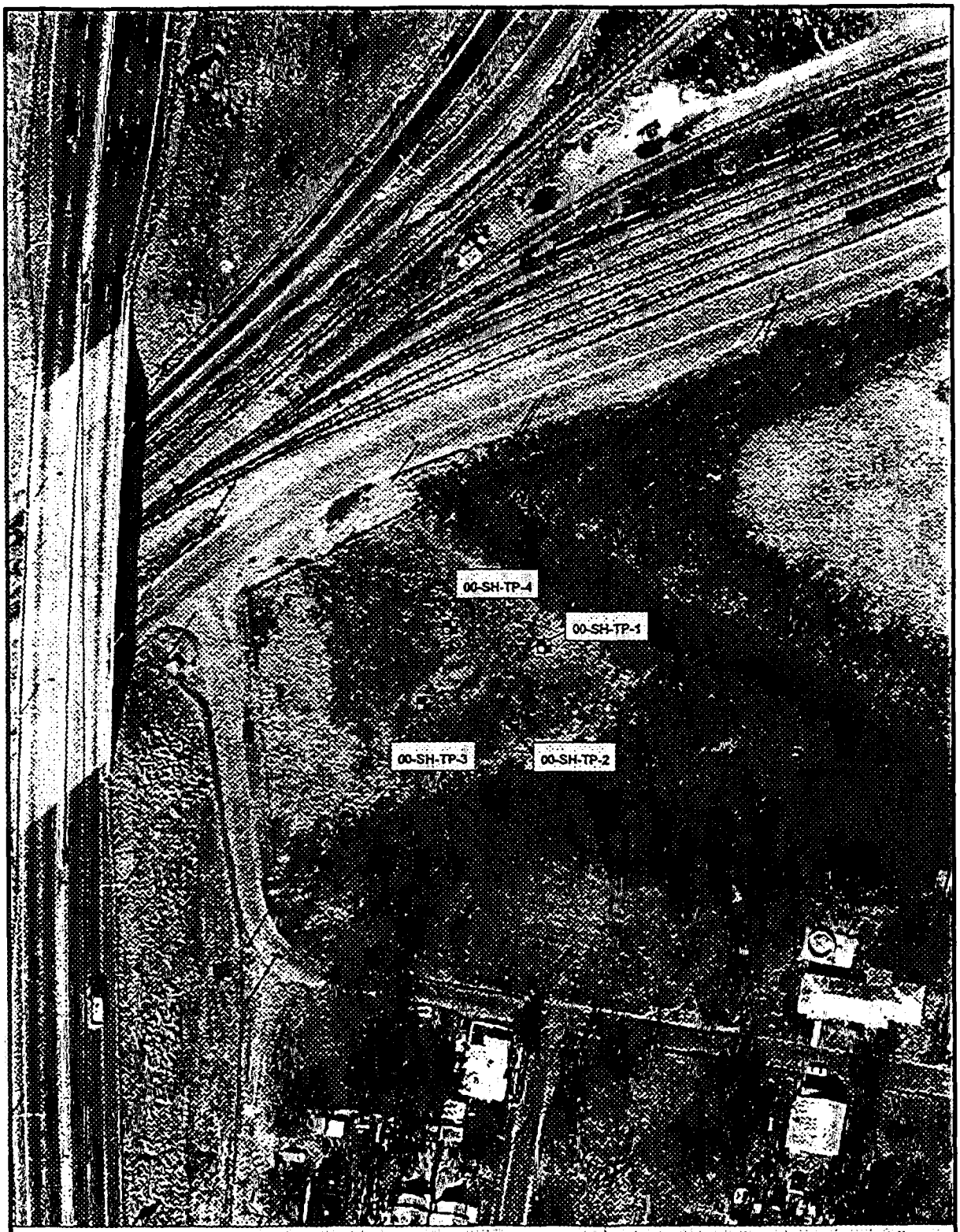
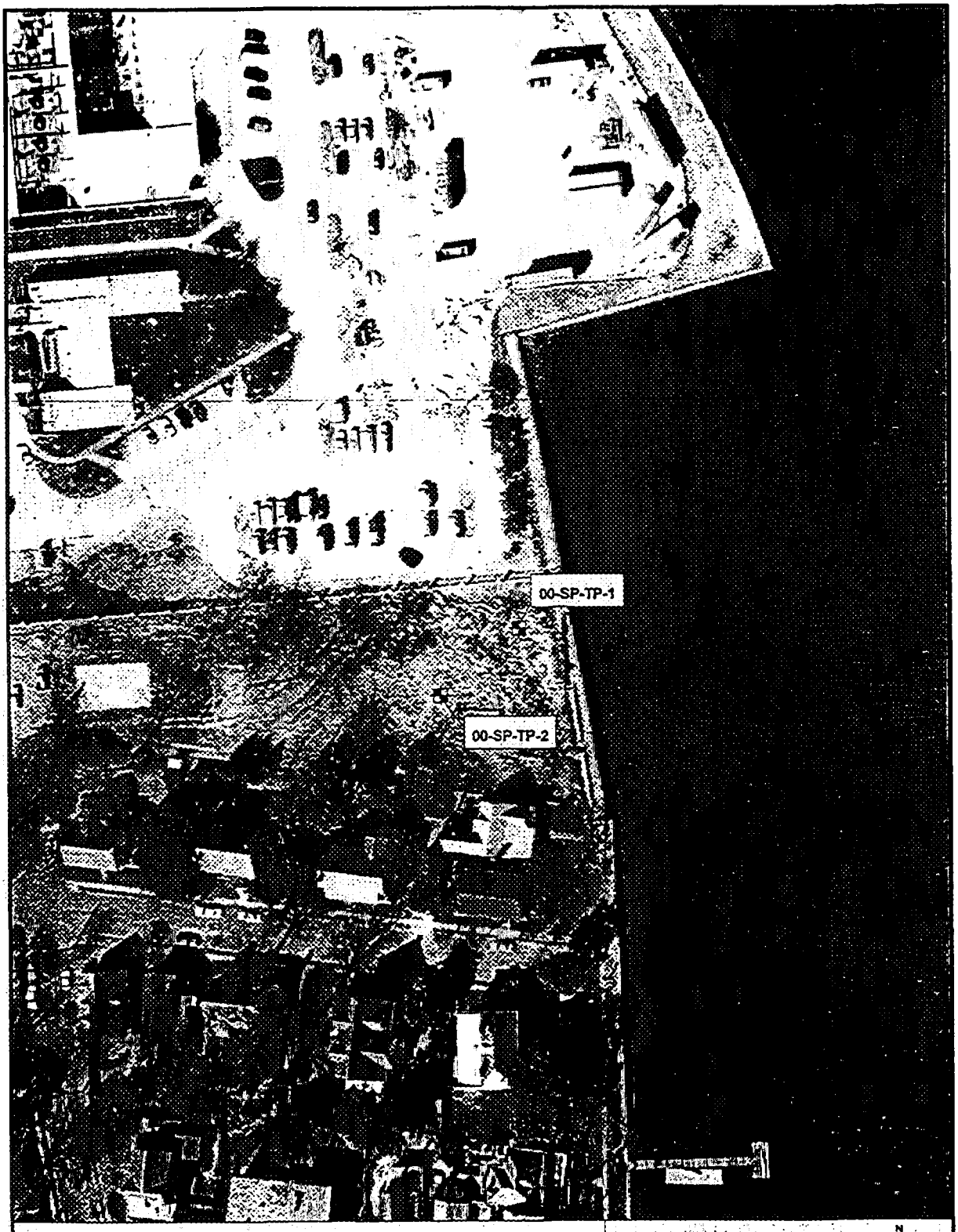


Sugar Hill

Elizabeth River Environmental Restoration Feasibility Study

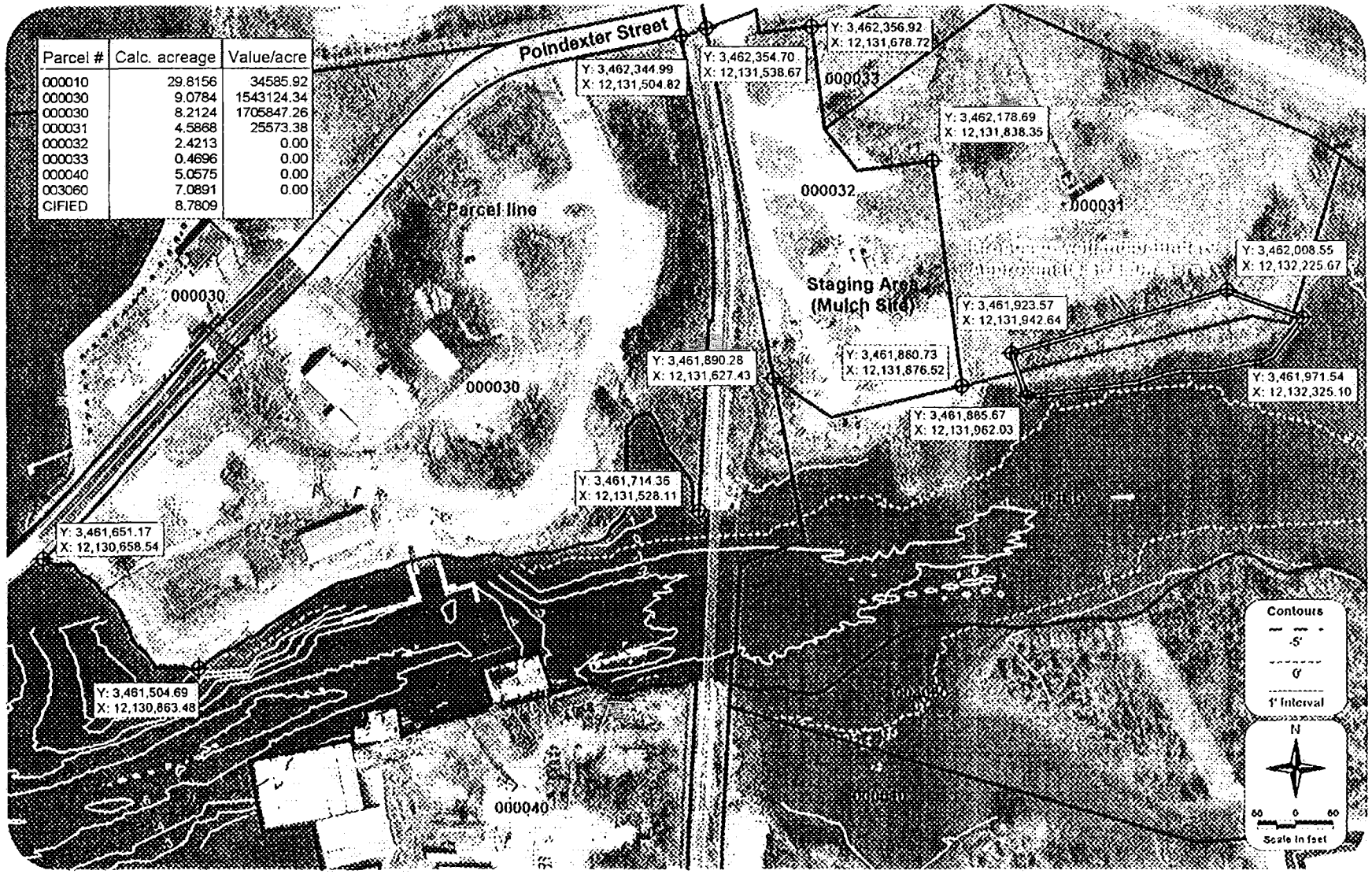


Swimming Point

Elizabeth River Environmental Restoration Feasibility Study

ATTACHMENT D

SCUFFLETOWN CREEK HYDROGRAPHIC SURVEY



Scuffletown Creek

Hydrographic Survey

Elizabeth River Environmental Restoration Feasibility Study

PLATE D-1 - SCUFFLETOWN CREEK HYDROGRAPHIC SURVEY

APPENDIX B

Real Estate Plan

REAL ESTATE PLAN

ELIZABETH RIVER ENVIRONMENTAL RESTORATION

FEASIBILITY INVESTIGATION

Norfolk District Corps of Engineers
Real Estate Branch
December 2000

REAL ESTATE PLAN

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ESTATES	V	7-9
PROPERTY VALUES	VI	10
RECOMMENDATION	VII	11

ATTACHMENTS

Wetland Restoration Sites	Elizabeth River	PLATE 1
Sediment Mediation Site	Chesapeake	PLATE 2
Carolanne Farms	Virginia Beach	EXHIBIT 1
Lancelot Drive	Virginia Beach	EXHIBIT 2
Woodstock Park	Virginia Beach	EXHIBIT 3
Scuffletown Creek	Chesapeake	EXHIBIT 4
Grandy Village	Norfolk	EXHIBIT 5
ODU Drainage Canal	Norfolk	EXHIBIT 6
NW Jordan Bridge	Portsmouth	EXHIBIT 7
Portsmouth City Park	Portsmouth	EXHIBIT 8
Scuffletown Creek(Sediment)	Chesapeake	EXHIBIT 9
Higgerson-Buchanan (Sediment Disposal)	Chesapeake	EXHIBIT 10

REAL ESTATE PLAN

STATEMENT OF PURPOSE

I. This Real Estate appendix is tentative in nature and it is for planning purposes only. The figures in this report are subject to changes once: (a.) The project scope is defined, (b.) Concrete parameters are set, (c.) Maps are drawn showing the exact locations, (d.) Exact number of acres needed for mitigation, environmental restoration and utility relocation are identified, (e.) Realistic values are established as to the cost of the property to be acquired, and (f.) A determination is made as to the exact number of rights of entry needed.

PROJECT DESIGNATION

II. This study was authorized by a resolution dated 14 September 1995 of the House Committee on Transportation and Infrastructure. In that authorization, the Chief of Engineers was requested to review studies conducted under Norfolk Harbor and Channels, Virginia, published as House Document 187, 89th Congress, and other pertinent reports with specific emphasis on the Elizabeth River, Virginia watershed. This was requested with a view to determining the need for modification associated with environmental and related purposes. An Environmental Restoration Study for the Elizabeth River Basin, Virginia was conducted under the authority of Section 905(b) WRDA '86 Analysis in August 1997. This report was prepared to evaluate the potential for Federal interest in the existing watershed problems associated with ecosystem and environmental restoration in the Elizabeth River Watershed, Hampton Roads, Virginia. A Project Study Plan was also prepared in July 1998. This document supported the Feasibility Cost Sharing Agreement, outlined the feasibility study of sediment and wetland, detailed the scope, schedule and budget of the study, and it served as the basis for negotiations between the District and the Non-Federal Sponsors. A Formulation Analysis Notebook was submitted in October 2000 for approval.

LOCATION/DESCRIPTIONS

III. The study area is located at several locations throughout a section of the Tidewater Region known as Southside Hampton Roads. Hampton Roads is a major seaport on the East Coast. The subject projects are all along the Elizabeth River, which is a major tributary of the Chesapeake Bay watershed. (See Plate 1). The wetland restoration project study areas include properties located within the cities of Norfolk, Portsmouth, Chesapeake and Virginia Beach, Virginia. The sediment remediation site is situated entirely within the boundaries of the City of Chesapeake, Virginia. (See Plates 2). These wetland restoration and sediment remediation projects do not fall under the provisions of navigational servitude, as these projects will not serve as an aide to navigation.

REAL ESTATE PLAN

A. The individual wetlands restoration site locations and descriptions are as follows:

	Site Name	Location	Acreage	Elizabeth River Branch
(1)	Carolanne Farms	Virginia Beach	1.8	Eastern Branch
(2)	Lancelot Drive	Virginia Beach	11.6	Eastern Branch
(3)	Woodstock Park	Virginia Beach	4.2	Eastern Branch
(4)	Scuffletown Creek	Chesapeake	0.7	Southern Branch
(5)	Grandy Village	Norfolk	9.3	Eastern Branch
(6)	ODU Drainage Canal	Norfolk	1.2	Main Stem
(7)	NW Jordan Bridge	Portsmouth	3.4	Southern Branch
(8)	Portsmouth City Park	Portsmouth	1.5	Western Branch

(1) Carolanne Farms

This site is an upland parcel located in and owned by the City of Virginia Beach. This site is on the Eastern Branch of the Elizabeth River and will require excavation, grading and planting. The site was created from the deposit of material. We do not foresee the need to relocate utilities at this site. This site is owned by the City of Virginia. This site is shown on the attached Exhibit 1.

(2) Lancelot Drive

This site is located in the City of Virginia Beach on the Eastern Branch of the Elizabeth River. It was formerly a wetland site that was filled. Excavation, grading and planting wetland grasses will be required to restore it to the condition that once existed. A portion of the site is encumbered with a Hampton Roads Sanitation District sewage force main that is above grade and should not be affected by this project. This site is shown on the attached Exhibit 2.

(3) Woodstock Park

This site is located in the City of Virginia Beach and it is presently a borrow pit adjacent to a city park. Some privately owned parcels may be involved and the city will be required to obtain easement and then assign them to the Government. To recreate the wetlands that previously existed, fill, grading and planting of wetland grasses will be required. No known utilities are present that will require relocation. The site is located on the Eastern Branch of the Elizabeth River. Land ingress/egress is limited to a narrow city right of way. This site is shown on the attached Exhibit 3.

(4) Scuffletown Creek

The wetland restoration project, that is known as Scuffletown Creek, is a stripe of land located adjacent to the Elizabeth River Park. The shoreline has eroded over the years and has been filled with broken concrete and other material. The shoreline of the parcel is located on Scuffletown Creek, a tributary of the Southern Branch of the Elizabeth River in Chesapeake, Virginia. This site is owned by the City of Chesapeake. It is used as a city park/boat launch area and for maintenance and support and for the City owned Jordan Bridge. The proposed solution to mediate the said condition would be to excavate, grade and plant wetland grasses to restore this former wetland site.

There may be utilities on the site that may require relocation. Much of the work will be done from the water, but there is adequate land ingress/egress through city-owned property, if needed. This site is shown on the attached Exhibit 4.

(5) Grandy Village

This site is located behind the Grandy Village Public Housing complex in Norfolk on the Eastern Branch of the Elizabeth River. The site is owned by the Norfolk Redevelopment and Housing Authority and the City of Norfolk and consists of a formerly filled wetland area and the proposed restoration solution would be to excavate, grade and plant. The site is undeveloped vacant land with the only structure on the site being a Federal Aviation Administration directional beacon. There are no known utilities effecting the project. There is electric power that is fed from an upland location, going to the directional beacon. There is also a paper street, known as Chesterfield Boulevard, but no other utilities or structures are in close proximity to the subject that may have an effect on this project. There is adequate ingress/ egress to the site by way of city/housing authority property. The Norfolk Redevelopment and Housing Authority is a public body under the control associated with the City of Norfolk. This site is shown on the attached Exhibit 5.

(6) ODU Drainage Canal

This site is presently a shallow water inter-tidal area also used for storm water drainage and is owned by the City of Norfolk. The site is located at the rear of the Old Dominion University Campus and is located in the City of Norfolk on the Elizabeth River main stem. Most of this site is subaqueous. The actions required will be filling, grading and planting of wetland grasses. The restoration site is undeveloped. The possible relocation of an existing storm drain easement will have to be addressed as construction plans are developed, and no other relocations are anticipated. Most of the work will be done from the water. Although the terrain is steep, the site may be accessed through the university campus. This site is shown on the attached Exhibit 6.

(7) Northwest side of Jordan Bridge

This site is located on the Southern Branch of the Elizabeth River in the City of Portsmouth. It is known as the old Wycoff Pipe site, which may have been a creosote facility. The site is located across the street from the Atlantic Woods plant which is on the Environmental Protection Agencies Super Fund list. The subject site was a previous wetland, but presently most of it is subaqueous and would require fill, grading and planting of wetland grasses to re-establish it. No utilities are known to exist, and the plans are to have the work performed from the waterside of the property.

(8) Portsmouth City Park

This site is on the Western Branch of the Elizabeth River in the City of Portsmouth. It is a part of a public park facility owned by the City of Portsmouth. It is a formerly wetland site that was filled to the point of being high marsh/upland. It will require excavation, grading and plantings of wetland grasses. The site is remote from the actively used portions of the park and does not have any known utilities that would require relocation. There is adequate ingress/egress through the City Park to the site.

B. The sediment remediation site is identified as follows:

REAL ESTATE PLAN

The sediment cleanup project will be performed at Scuffletown Creek a tributary of the Elizabeth River. It is located in the Washington Borough, and the South Norfolk section of the City of Chesapeake, Virginia. On the north it is bound by the city owned Elizabeth River Park, mulch/debris site and the Jordan Bridge's toll/maintenance facilities and two properties owned by Chesapeake Tower, Inc. and used for communication towers. Section of Scuffletown to be dredged is bound by Interstate 464 to the east, private property to the south and the Southern Branch of the Elizabeth River to the west, which will be dredged to remove the sediments and an American Oil Company fuel storage tank farm to the South. Also located within the project area are a 20 foot Colonial Pipeline Easement which crosses Scuffletown Creek and a wooden Beltline Railroad bridge which crosses the creek. Several parcels of land will be involved with this project. The said sites are identified as follows:

(1) Scuffletown Creek Staging and Rehandling Site
The City of Chesapeake, one of the local sponsors, owns two sites that are located adjacent to the area to be dredged. One parcel is currently being used as a bulk storage yard and has stockpiles of materials such as mulch, sand, etc. This site will be used for staging and rehandling of any material that must be decontaminated before being transferred to the dredged material disposal site. No utility relocation is foreseen at this location. The site is located in the City of Chesapeake and is shown in Exhibit 10.

(2) Higgerson and Buchanan Dredge Material Disposal Site
The proposed privately owned primary Dredge Material Placement Site is encumbered by an easement, which the City of Chesapeake acquired for the placement of material from the dredging of the Southern Branch of the Elizabeth River. The site has approximately 54.0 acres and is adjacent to a 79.0 acre former dredge material management site that is currently being used as a construction debris landfill. The easements were transferred, by deed dated March 21, 1979, from the City to the United States of America. The easement rights on the 79-acre tract were released back to the underlying fee owner. These sites are owned by Higgerson and Buchanan and have been used in the past for deposit of dredged material from the Southern Branch of the Elizabeth River. Since the easements acquired from the City of Chesapeake specified that they are to be used for deposit of material from the construction and maintenance of the Southern Branch channel and the subject material will be coming from a sediment mediation site, additional real estate interest will be needed. The parcels are bound by Dominion Boulevard to the southeast, and Bainbridge Boulevard on the Northwest. This site would be used for the permanent placement of the material. This site is shown in Exhibit 9.

(3) Higgerson and Buchanan Barge Landing and Easements to the Disposal Site
It has been determined that the movement of the material from the barge to the disposal site will be made requirements in the proposals for bids. The successful contractor will be responsible for acquiring easements for pumping, staging and any other real estate required to move the material from the barges to the disposal site.

REAL ESTATE PLAN

SUMMARY OF REAL ESTATE REQUIREMENTS

IV. This office has acquired rights of entries for surveys and exploration on most of the sites included in this project. The real estate requirements for the proposed local cooperation project will differ for the wetland restoration portion and the sediment cleanup project. The local sponsor will be required to obtain all LEER, and they will be given a credit for Corps approved expenses associated with such acquisitions. A permit will be acquired from the Commonwealth of Virginia for the dredging of the state owned river bottom for the sediment clean-up portion of the project. A one (1) year Temporary Work Area Easement will be needed adjacent to the dredge site for equipment staging, stock piling of the dredged material and land ingress/egress. The utility companies have been contacted concerning the location of utilities on this site. The project delivery team has determined that the best way to determine the location of any utilities would be to have a utility locator survey and mark the existing utilities on each site. It is believed from site inspections that most of the site will not be encumbered with utilities requiring relocation. Any utility relocation necessary will be covered under the 25% contingency for this project. There are oyster ground releases that will be needed from private owners. In the event it is determined that utilities will have to be relocated, we will work with the local sponsor on the relocation issues. The material dredged from this site will be placed temporally on the temporary construction easement, treated and transferred to a permanent dredge material disposal facility.

Fifty-year Wetlands Restoration Easement will be acquired for the wetlands restoration sites listed in this report. The major activities being performed on these sites are excavating, grading and planting of wetland grasses of upland sites that have been filled with material changing them from wetlands to upland. Filling, grading and planting wetland grasses will be required on sites that have been previously lowered by dredging or other means changing them from wetlands to subaqueous. The material being excavated from the wetland restoration sites will be placed in solid waste landfills that accept inert waste, demolition waste and construction waste materials. Two such sites have been identified and no real estate instrument will be required for such placement. Any utility relocation on these sites will be handled as stated above. A one (1) year Temporary Work Area Easement will be needed for equipment staging, stock piling of the fill or excavated material and for land ingress/egress. Two of these sites will be constructed from barges over state-owned-river bottom and will not require the use of upland facilities. Four of these sites will require access through private properties. State permit will be required for dredging the sediment from Scuffletown Creek. These wetland restoration and sediment remediation projects do not fall under the provisions of navigation servitude, as these projects will not serve as an aide to navigation.

REAL ESTATE PLAN

Site Name	Restoration	Real Estate Needs	Acres restored	Notes
Carolanne Farms	Wetlands	(1) (2) (7)	1.8	
Lancelot Drive	Wetlands	(1) (2) (7)	11.6	
Woodstock Park	Wetlands	(1) (2) (7)	4.2	
Scuffletown Creek	Wetlands	(1) (2) (7)	0.7	
Grandy Village	Wetlands	(1) (2) (5) (7)	9.3	
ODU Drainage Canal	Wetlands	(2) (3) (4) (5)	1.2	(a) (b) (c)
NW of the Jordan Bridge	Wetlands	(2) (3) (4) (5)	3.4	(a) (b) (c)
Portsmouth City Park	Wetlands	(1) (2) (5) (7)	1.5	
Scuffletown Creek	Sediment	(1) (3) (4) (5) (7)		
Material Disposal Site	Sediment	(6)		

Key to real estate needed: (1) Temporary Work Area Easement, (2) Wetlands Restoration Easement, (3) State Permit, (4) Oyster Ground Releases, (5) Possible Utilities Relocation Easement, (6) Dredge Material Disposal Easement, (7) Rights of Entries acquired for surveys and exploration

Key to notes: (a) Filling of State owned bottom, (b) Material moved and work to be performed from barges, (c) Land access across private property, if necessary

ESTATE

V. A site located between the Scuffletown Creek to the south, the Southern Branch of the Elizabeth River to the west, Poindexter Street to the north and Interstate 464 to the east are being considered for staging, and operation and stock piling material. This site has approximately 26 acres and would be needed for approximately 6 months. An adjacent site also owned by the local sponsor may be needed for staging and launching.

There are eight sites under consideration for wetland restoration. Three of the sites are in Virginia Beach, two sites are in Norfolk, one site is in Chesapeake and two sites are in Portsmouth. A wetland restoration easement is needed for each of these sites which will allow us to escalate or fill, grade and plant wetland grasses and maintain the areas. This easement is basically a channel improvement easement modified to allow cutting, filling, grading and planting.

The Standard Oyster Ground Release Agreements will be used for the oyster grounds needed. There are no potential relocations, under Public Law 91-646, and we do not foresee the need to acquire any property for mitigation purposes at this time. Approval is requested for all non-standard estates.

Approximately twenty rights of entries were acquired for survey and exploration work during the feasibility phase.

REAL ESTATE PLAN

A. Channel Improvement Easement. A five year assignable easement to construct, operate and maintain channel improvement works on, over and across (the land described in schedule A) for the purpose as authorized by the Act of Congress approved _____, including the right to clear, cut, fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate, dredge, cut away, and remove any or all of the said land and to place thereon dredge material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owner, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the right and easements for public roads and highways, public utilities, railroads and pipelines. (Non-Standard Estate)

B. Wetlands Restoration Easement. A fifty-year assignable easement to construct, operate and maintain wetlands on, over and across (the land described in schedule A) for the purpose as authorized by the Act of Congress approved _____, including the right to clear, cut, fall, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate, dredge, cut away, and remove any or all of the said land and/or to place thereon fill, grade and plant plants; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owner, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the right and easements for public roads and highways, public utilities, railroads and pipelines. The District Engineer and the Local Sponsor shall jointly monitor and reserve the right to restrict activities which may be determined to be detrimental to the wetland maintenance. (Non-Standard Estate)

C. Temporary Work Area Easement. A temporary easement and right of way in, on, over and across (the land described in Schedule A) (Tract Nos. ___, ___, ___ and ___), for a period not to exceed one year, beginning with the date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area and/or right of way, including the right to deposit fill, dredged material and waste material thereon, move, store and remove equipment and supplies and erect and remove a temporary barge landings. (Modified Standard Estate)

D. Amended Dredge Material Placement Easement. A one-year assignable easement to construct, operate and maintain on, over and across (the land described in schedule A) for the purpose as authorized by the Act of Congress approved _____, including the right to clear, cut, fall, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate, dredge, cut away, and remove any or all of the said land and/or to place thereon fill and dredged material and related structures such as dikes, weirs, sediment fencing, etc. for such other purposes as may be required in connection with said work or improvement; reserving, however, to the owner, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the right and easements for public roads and highways, public utilities, railroads and pipelines. (Standard Estate)

E. Temporary Easement for Exploration (Right of Entry for Survey). An (irrevocable) (revocable) right to enter upon the lands described in schedule A, at any time within a period of six months beginning with the date of possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors, for purposes of conducting surveys, appraisals, test borings and other exploratory work necessary to design a public works project reserving, however, to the owner, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the right and easements for public roads and highways, public utilities, railroads and pipelines. (Standard Estate)

F. Utilities Relocation Easement. A perpetual and assignable easement and right-of-way in, on, over and across the land described in schedule A, for the location, construction, operation, maintenance, alteration, repair and patrol of (overhead) (underground) (Specifically name type of utility or pipeline); together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right of way; reserving, however, to the owner, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the right and easements for public roads and highways, public utilities, railroads and pipelines. (Standard Estate)

G. Oyster Ground Releases. The undersigned Lessee, their heirs and/or assigns grant an irrevocable and perpetual release and discharge of any and all claims for damages or taking of whatever nature, which may result from the sediment mediation and or wetlands restoration projects, on, over and across oyster ground leases as described in schedule A to the (Local Sponsor's name), United States of America, its employees, representatives, agents, and contractors, except for damages which may result due to the fault or negligence of the (Local Sponsor's name), United States of America, its employees representatives, agents, and contractors.

REAL ESTATE PLAN

PROPERTY VALUES

VI. Tracts have been visited and appraised by District Staff Appraisers. They have determined that the Fair Market Value of the real estate interest to be acquired for all of the sites listed is:

FIFTY-SIX THOUSAND FIVE HUNDRED AND NO/100 DOLLARS ($56,000.00)

The break down on these values on the wetland sites are as follows:

Site Name	Location	Acreage	Appraised Value
Carolanne Farms	Virginia Beach	1.8	$14,000.00
Lancelot Drive	Virginia Beach	11.6	$ 6,000.00
Woodstock Park	Virginia Beach	4.2	$ 2,500.00
Scuffletown Creek	Chesapeake	0.7	$ 2,500.00
Grandy Village	Norfolk	9.3	$ 5,000.00
ODU Drainage Canal	Norfolk	1.2	$ 2,500.00
NW Jordan Bridge	Portsmouth	3.4	$ 2,500.00
Portsmouth City Park	Portsmouth	1.5	$11,000.00

The breakdown of the value on the sediment mediation sites are as follows:

Site Name	Location	Acreage	Appraised Value
Scuffletown Rehandling site	Chesapeake	1.9	$9,000.00
Higgerson Buchanan Inc. Barge docking and rehandling site. To be cost shared with the local sponsor thru construction cost and not included as real estate credits.	Chesapeake		$0.00
Higgerson & Buchanan Inc. Disposal Site	Chesapeake	54.0	$1,000.00
Commonwealth of Virginia Dredging of state-owned bottom. Permit to be acquired as a part of the dredging permit process	River Bottom		$0.00

REAL ESTATE PLAN

RECOMMENDATION

VII. This report has been prepared in accordance with Corps of Engineers Regulation ER 405-1-12, Chapter 12 (Draft). It is recommended that this report be approved.

Dated: 12/21/2000

Prepared by: David B. Parson
Realty Specialist

Dated: 12/21/2000

Reviewed by : Dillard H. Horton, Jr.
Chief, Acquisition, Management
& Disposal Section

Date: 12/21/2000

Recommended by: Robert P. Turner
Chief, Real Estate Branch

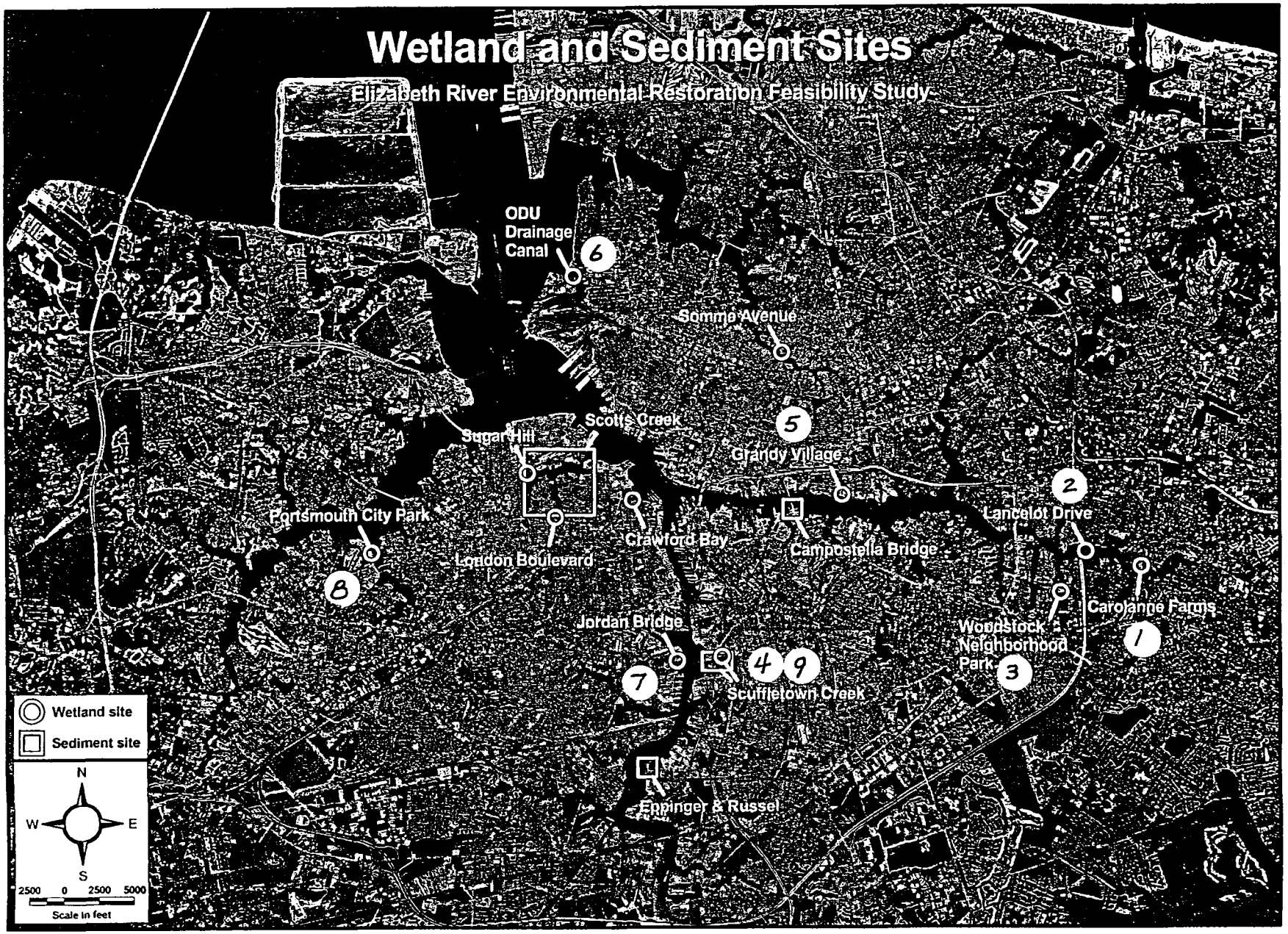


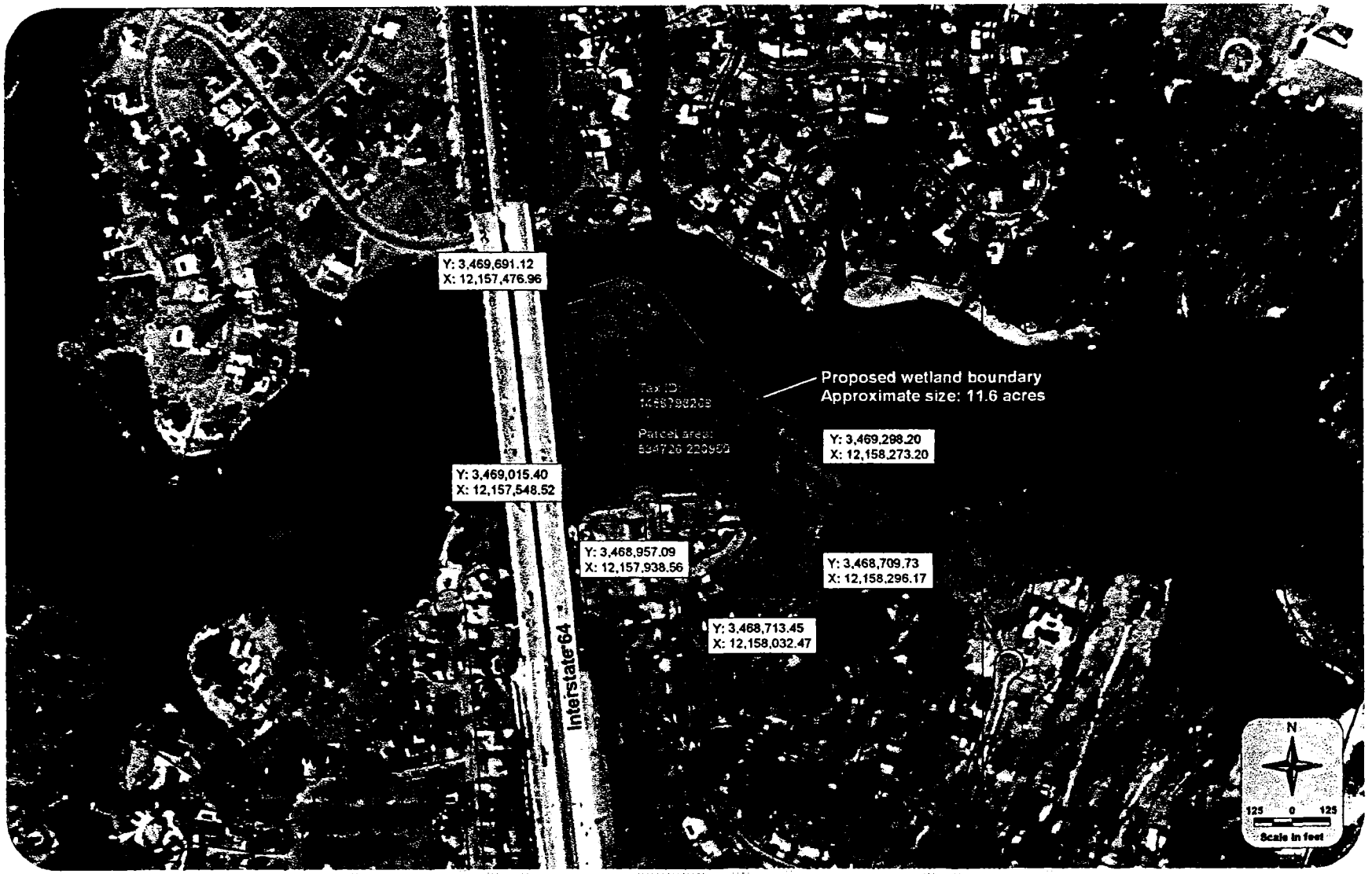
PLATE 1
&
PLATE 2

Carolanne Farms

Candidate Wetland Site, City of Virginia Beach

Elizabeth River Environmental Restoration Feasibility Study

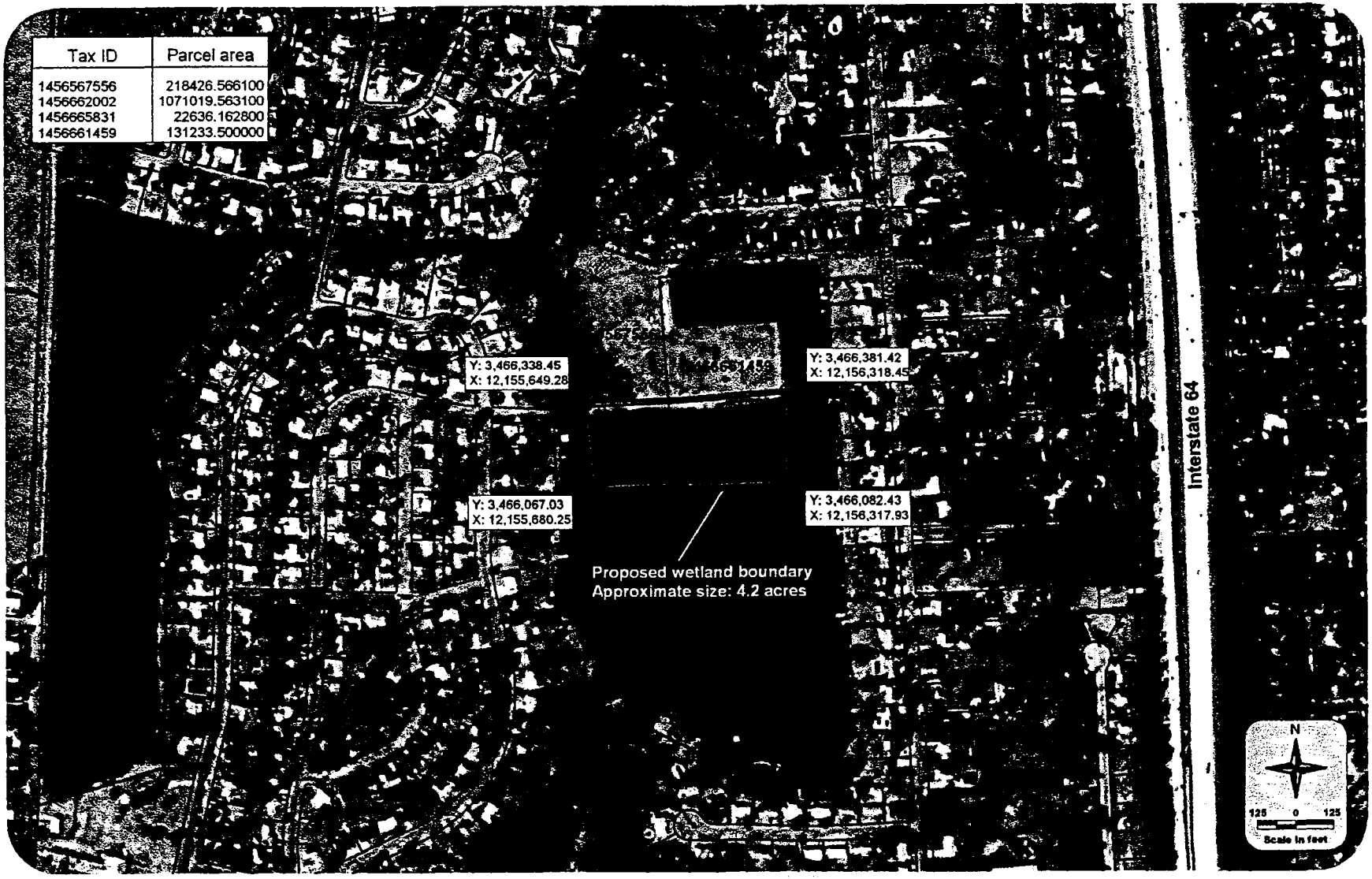
Exhibit 1



Lancelot Drive

Candidate Wetland Site, City of Virginia Beach
Elizabeth River Environmental Restoration Feasibility Study

Exhibit 2

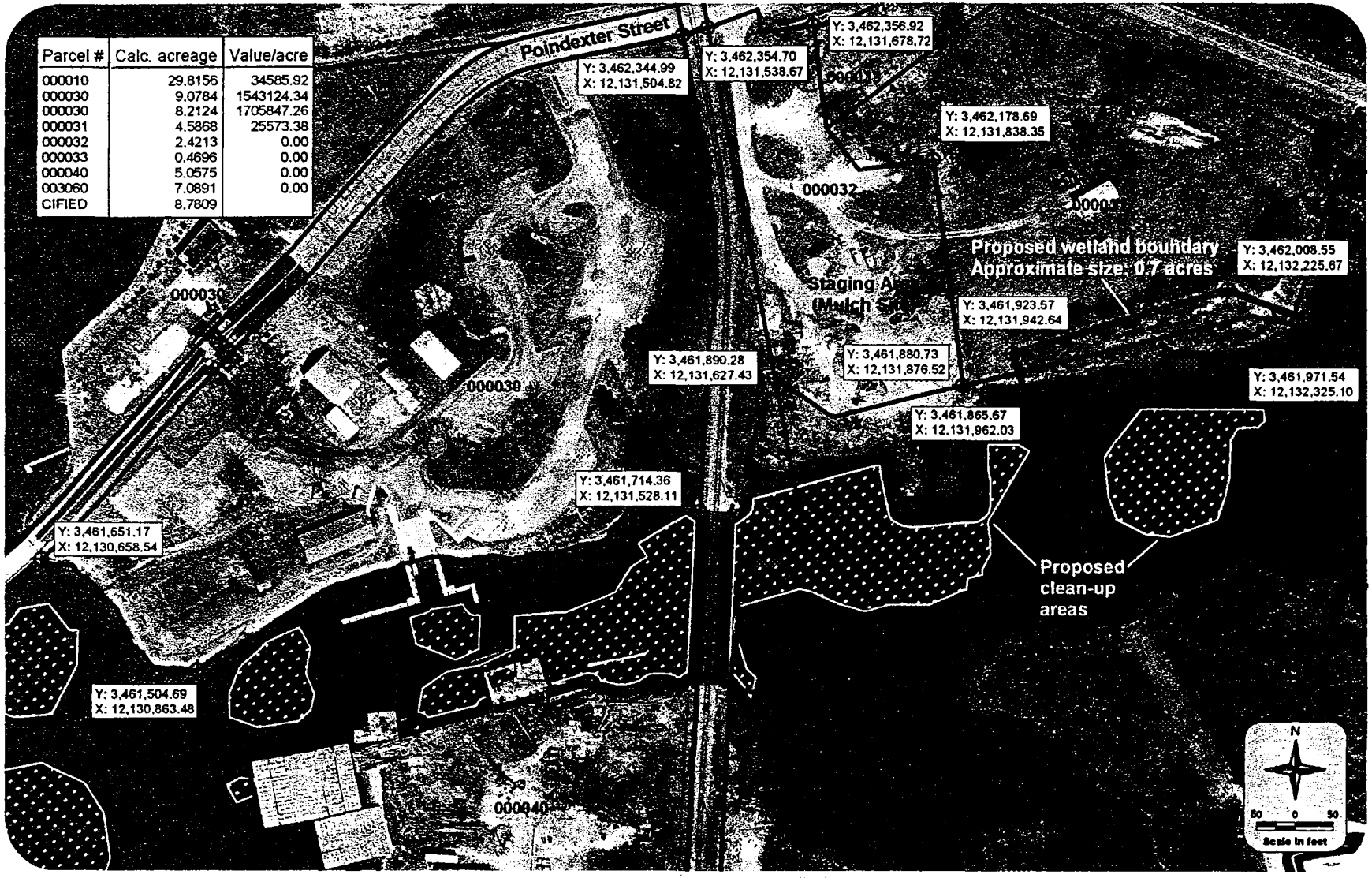


Woodstock Neighborhood Park

Candidate Wetland Site, City of Virginia Beach

Elizabeth River Environmental Restoration Feasibility Study

Exhibit 3



Scuffletown Creek

Candidate Wetland and Sediment Site, City of Chesapeake

Elizabeth River Environmental Restoration Feasibility Study

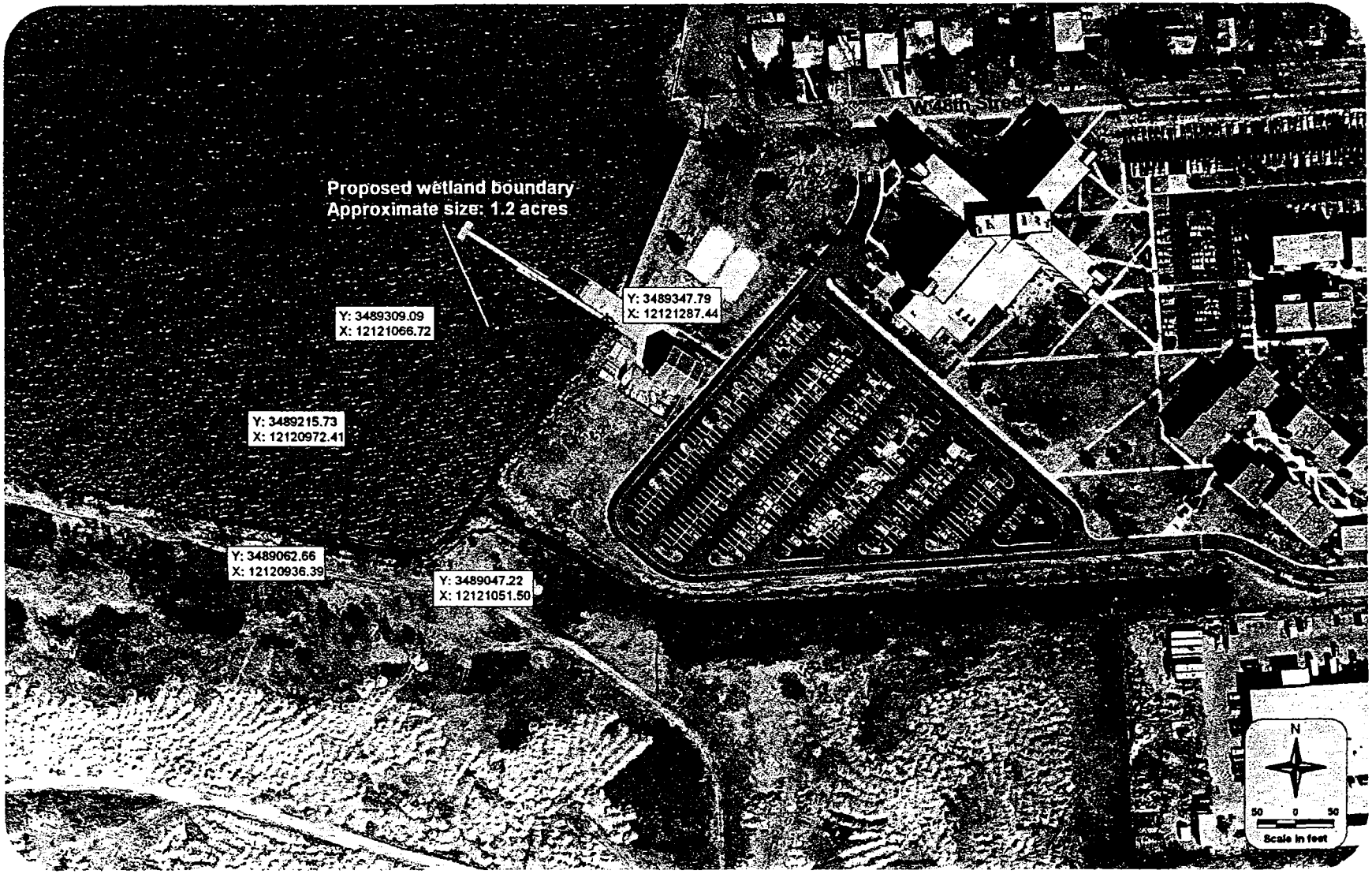
Exhibits 4 and 9

Grandy Village

Candidate Wetland Site, City of Norfolk

Elizabeth River Environmental Restoration Feasibility Study

Exhibit 5

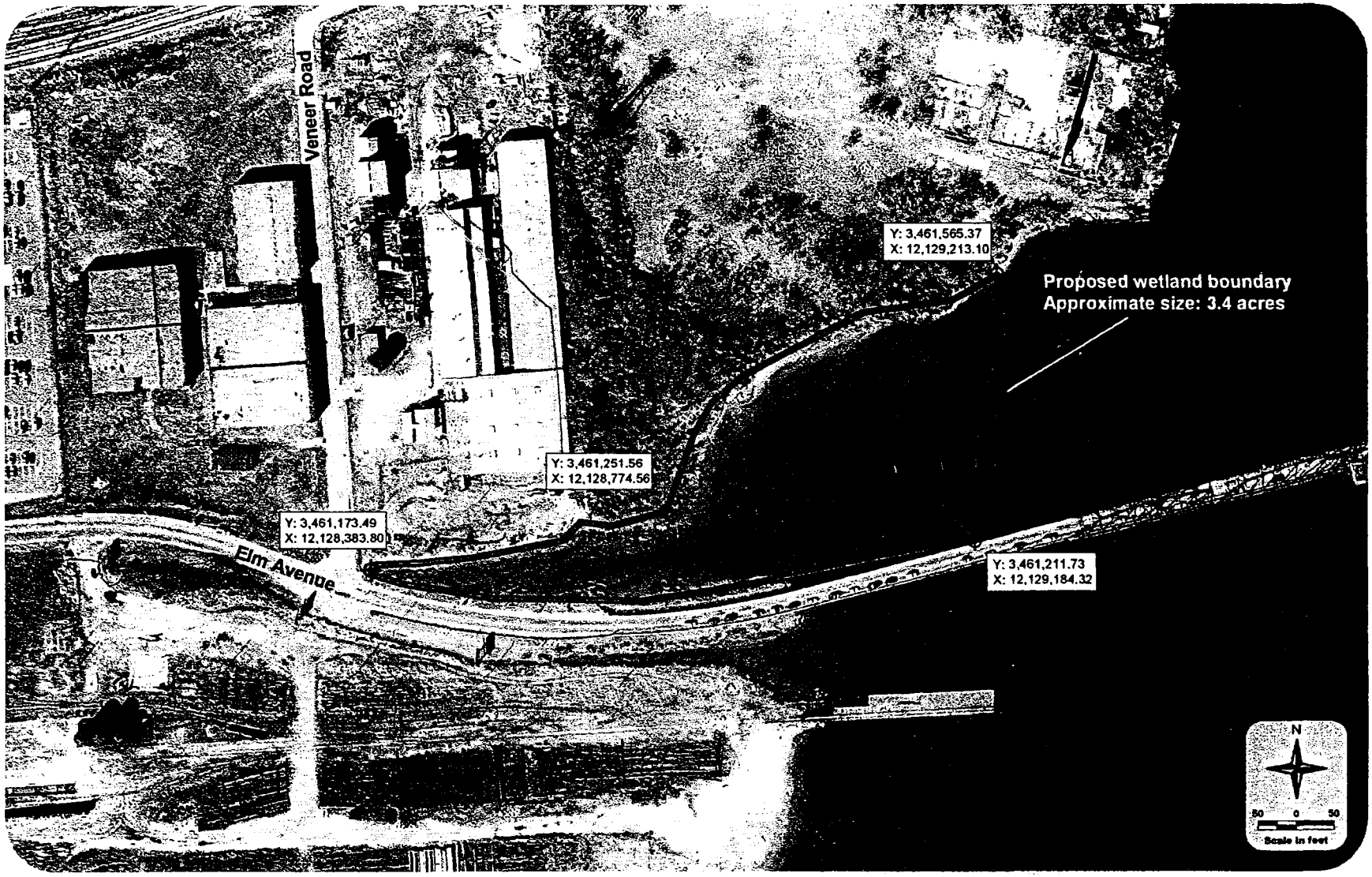


ODU Drainage Canal

Candidate Wetland Site, City of Norfolk

Elizabeth River Environmental Restoration Feasibility Study

Exhibit 6

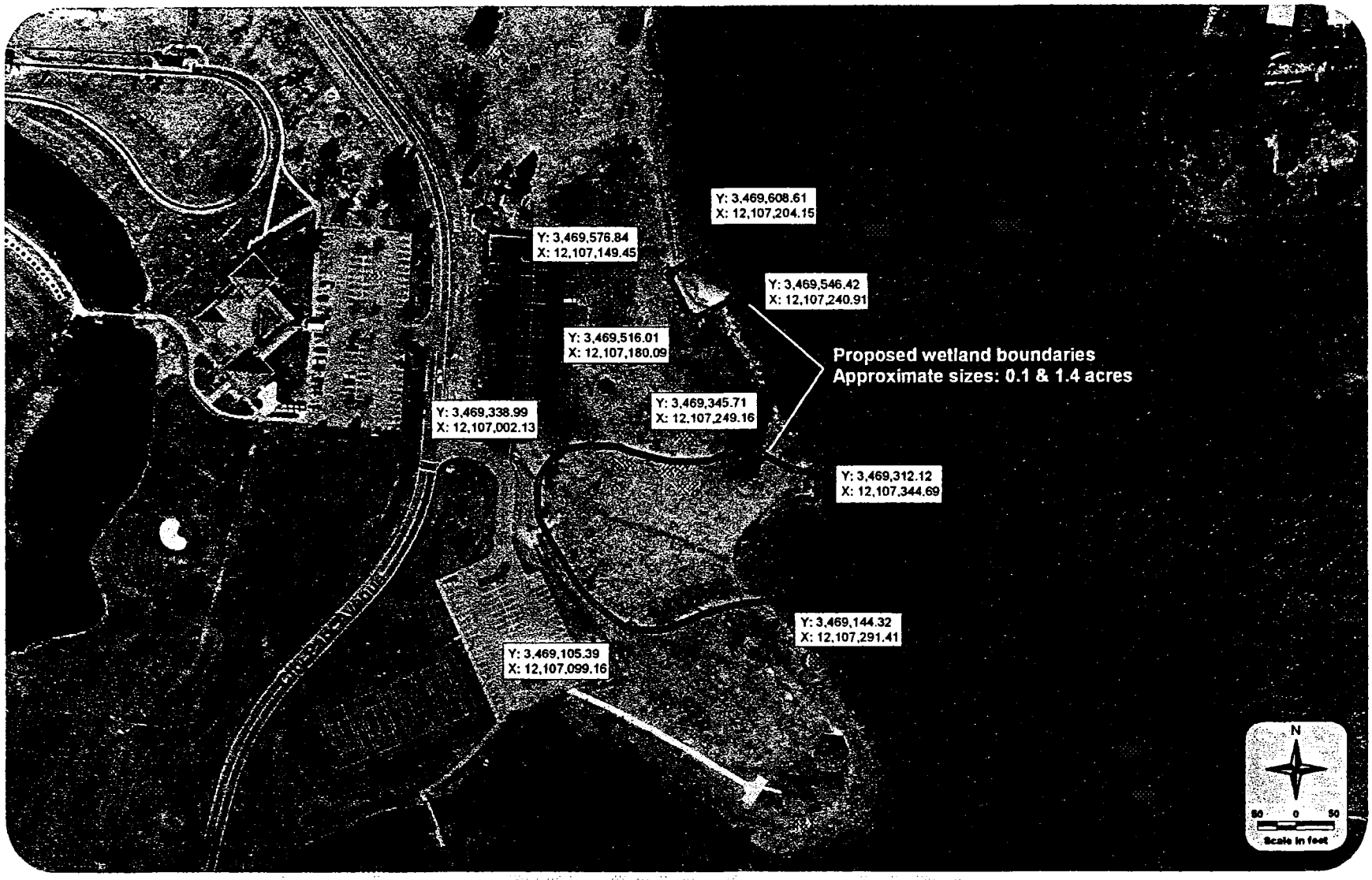


Jordan Bridge

Candidate Wetland Site, City of Portsmouth

Elizabeth River Environmental Restoration Feasibility Study

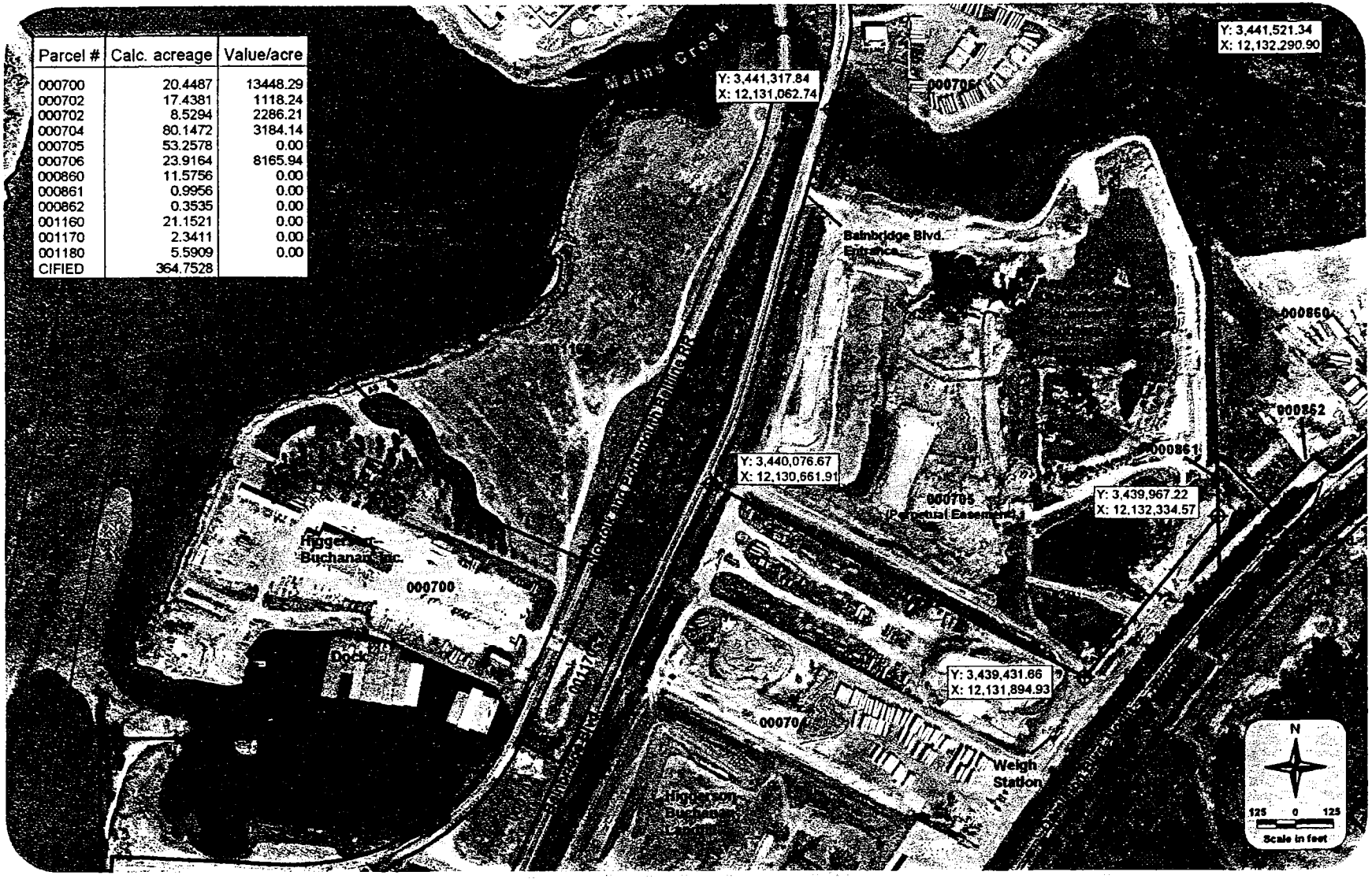
Exhibit 7



Portsmouth City Park

Candidate Wetland Site, City of Portsmouth
Elizabeth River Environmental Restoration Feasibility Study

Exhibit 8



Higgerson-Buchanan

Dredged Material Placement Site, City of Chesapeake

Elizabeth River Environmental Restoration Feasibility Study

Exhibit 10

APPENDIX C

Economics and Benefits Analysis

APPENDIX C
ECONOMICS AND BENEFITS ANALYSIS

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BENEFITS ANALYSIS

WETLANDS RESTORATION

Elizabeth River Environmental Restoration
Wetland Restoration Sites - Benefits
Habitat Evaluation Procedure (HEP)

Species selection for HEP was accomplished during the initial team meeting between the Corps of Engineers, U.S. Fish and Wildlife Service, and the Virginia Institute of Marine Science. The evaluation species was selected based on the restoration concepts and the current availability of species models. Initially the species selection included avian, mammalian and fish species common to the study area, however, very few of the available models were able to accurately reflect the habitat present at the current sites. For example, it is well known that tidal marshes are important muskrat habitat, but the available model is tailored to fluvial conditions, resulting in poor muskrat habitat values despite the fact that tidal marshes are excellent habitat for this species. The marsh wren (*Cistohorus palustris*), yellow crown night heron (*Nyctanassa violacea*), great egret (*Casmerodius albus*), and the fishes: juvenile spot (*Leiostomus xanthurus*) and croaker (*Micropogon undulatus*) were also considered but the model requirements did not fit the river and shoreline conditions in the urban and industrial sites proposed for restoration. Therefore, the evaluation species was limited to one avian species. This is appropriate due to the fact that the emergent marsh and shoreline habitat are critical habitat for a number of important bird species. The selected species has multiple life requisite factors (*ie.* food, cover, breeding and water) within the (proposed) restoration habitats identified. The HEP models consider individual life requisite factors based on several conditions that must be considered together in order to evaluate the individual life requisite. One species representing various life requisite factors was selected to evaluate the proposed emergent marsh restoration. The (selected) emergent marsh species was the clapper rail (*Rallus longirostris*).

The HEP species model evaluates life requisite factors (primarily food, cover, breeding and water) on a scale of 0 to 1.0. The individual life requisite factors are usually based on several conditions that must be considered together in order to evaluate a life requisite. For example, the "food/cover" life requisite for the clapper rail is based on three habitat variables (V_1-V_3): percentage of wetland shoreline that borders flat to gently sloping banks or tidal flats exposed at low tide; percentage of total area that is salt or brackish emergent or scrub/shrub wetlands; percentage of area of emergent or scrub/shrub wetlands within 15m of tidally influenced bodies of water. Numerical values between 0 and 1.0 are assigned or calculated for each condition, which is the SI_V . The life requisite value is then calculated by taking the cubed root of the product of the SI_V. This is only valid for the clapper rail model because species models may vary considerably on how life requisite values are calculated and used to determine habitat suitability indices (HSI's).

Field Assessment and Data Analysis. For the baseline habitat evaluation, site visits were conducted on October 28, 1998 and November 5, 1999 to evaluate the field parameters associated with the species models. Topographic surveys, aerial photographs, and wetland delineation maps were also used to evaluate the baseline and (proposed) constructed wetland field parameters associated with the species model.

Elizabeth River Habitat Evaluation Procedure (HEP)

Baseline Calculation of Habitat Units for Species Evaluated	Wetland Site Location											
	Scuffletown Creek		ODU Drainage Canal		Somme Avenue		Grandy Village		Portsmouth City Park		NW Side Jordan Bridge	
	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres
Clapper Rail	0.53	0.08	0.25	0.03	0.53	0.07	0.63	2.9	0.58	0.16	0.46	0.095
Habitat Units (HU's)	0.04		.008		0.03		1.83		0.09		.04	

Constructed Project Calculation of Habitat Units for Species Evaluated	Wetland Site Location											
	Scuffletown Creek		ODU Drainage Canal		Somme Avenue		Grandy Village		Portsmouth City Park		NW Side Jordan Bridge	
	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres
Clapper Rail	1.0	0.33	0.97	0.6	1.0	0.58	0.84	7.0	0.91	0.85	1.0	1.2
Habitat Units (HU's)	0.33		0.58		0.58		5.9		0.77		1.2	

Elizabeth River Habitat Evaluation Procedure (HEP) cont'd

Baseline Calculation of Habitat Units for Species Evaluated	Wetland Site Location											
	Sugar Hill		Crawford Bay		Carolanne Farms Park		Woodstock Neighborhood Park		Lancelot Drive Avalon Hills			
	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres
Clapper Rail	0.76	0.16	0	0	0.46	0.22	0.43	0.11	0.63	1.3		
Habitat Units (HU's)	0.12		0		0.56		0.05		0.8			

Constructed Project Calculation of Habitat Units for Species Evaluated	Wetland Site Location											
	Sugar Hill		Crawford Bay		Carolanne Farms Park		Woodstock Neighborhood Park		Lancelot Drive Avalon Hills			
	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres
Clapper Rail	0.96	0.4	0.92	1.3	0.96	1.22	1.0	1.6	1.0	5.4		
Habitat Units (HU's)	0.38		1.2		1.17		1.6		5.4			

Functional Values Measures – Wetlands Restoration

➢ Primary Production
1. Organic Production – capacity to produce plant material, (i.e., carbon) which serves as food source for aquatic organisms 2. Decomposition – capacity of wetland plant material to decay, or break down, and become bioavailable; fed on by microrganisms (bacteria, fungi), which in turn become food for higher trophic levels (fish, crabs, etc.) 3. Availability – availability of plant material food to aquatic ecosystem and aquatic organisms; function of tidal range (regularly flooded, irregularly flooded, or infrequently flooded)
➢ Fish & Wildlife (assume similar salinity)
1. Tidal Regime – (subtidal, intertidal, supratidal) – bioavailability of wetland to aquatic organisms greater in lower tidal regimes 2. Ratio of cover to open water – availability of "edge" environment; proportion of wetland to open water; and open water access (fish, crabs, and other aquatic organisms) to interior areas of wetland 3. Ratio of shoreline to total wetland area – measure of habitat diversity, and "edge" effect 4. Habitat diversity (cover types) – number of different adjoining wetland habitat types (e.g., shallow water, mud flats, emergent wetland, high marsh shrubs, forest)
➢ Water Quality
1. Watershed area – is wetland connected to watershed and what proportion of drainage is passing through the wetland 2. Detention time – channelization/restricted outlet – will drainage be retained and for how long; function of connection to open water – straight channel connection or winding and meandering, more restricted, outlet 3. Width of wetland – greater width of wetland has greater capacity to retain and filter sheet flow (nutrients, sediments, contaminants, etc.) before entering open water 4. Percent cover – density of wetland plant vegetation; higher density provides more potential filtering and nutrient uptake per square foot 5. Stormwater features –wetlands located and designed that specifically treat stormwater runoff; stormwater features, such

as detention ponds, built into wetland design
➢ Erosion Buffer
1. Vegetative cover type – different types of wetland vegetation provide more erosion buffer than others; Spartina sp., Distichlis spicata, Juncus roemerianus provide high value; Baccharis sp., Iva sp. (saltbushes) provide less; Salicornia sp. (saltwort) provides little to none 2. Width of marsh – greater width of wetland along shoreline provides greater erosion buffer potential 3. Slope of marsh – more gradual slope of wetland provides greater erosion buffer potential 4. Elevation of marsh – wide, low marsh has higher erosion buffer potential than high marsh alone
➢ Flood Buffer
1. Storm tide volume – bigger and wider wetland (adjacent to upland development) is better; provides place for storm tides to go 2. Floodplain width – distance between lower edge of wetlands and upland; greater distance is better; prevents water from rising rapidly, slows current velocities, etc.
➢ Aesthetics
1. "Greenspace" available – capacity of wetland to provide "green", undeveloped, open areas relative to existing conditions 2. Existing degradation – existing visual and sensory degradation 3. Site visibility – can wetland site be observed easily and from different perspectives
➢ Public Accessibility/Educational Value
1. Accessibility of site – can wetland site be visited easily 2. Proximity to schools/universities/neighborhoods – does wetland site afford students, neighborhoods access to educational opportunities 3. Recreational opportunities - does wetland site afford students, neighborhoods, public access to (low impact) recreational opportunities such as bird watching, nature appreciation, hiking, etc.

Elizabeth River Wetlands - Functional Values Assessment

Functional Value	Wetland Site Location											
	Scuffletown Creek		ODU Drainage Canal		Somme Avenue		Grandy Village		Portsmouth City Park		NW Side Jordan Bridge	
	Base	Const	Base	Const	Base	Const	Base	Const	Base	Const	Base	Const
1. Primary Production	3	4	3	5	1	5	3	5	2	5	3	5
2 Fish and Wildlife	2	4	3	5	2	4	2	5	2	5	3	5
3. Water Quality	3	4	2	5	2	4	4	5	2	4	1	5
4. Erosion Buffer	3	4	4	4	4	4	4	4	4	4	2	5
5 Flood Buffer	4	4	4	4	3	4	4	4	4	4	4	4
6. Aesthetics	2	4	3	5	3	5	2	5	3	5	1	3
7. Public Accessibility and Education	2	2	3	5	2	2	2	5	3	5	1	1
a. Subtotal	19	26	22	33	17	28	21	33	20	32	15	28
b. Acres	.08	.33	.03	0.6	.07	.58	2.9	7.0	.16	.85	.09	1.2
c. Subtotal (a X b)	1.52	8.58	0.66	19.8	1.19	16 24	60.9	231 0	3.2	27 2	1.35	33.6
Functional Benefit Score (Constr. minus Base)	7.06		19.14		15.05		170.1		24.0		32.25	

FUNCTIONAL VALUE				
Low		Medium		High
1	2	3	4	5
SCORE				

Functional Value	Wetland Site Location											
	Sugar Hill		Crawford Bay		Carolanne Farms Park		Woodstock Neighborhood Park		Lancelot Drive (Avalon Hills)			
	Base	Const	Base	Const	Base	Const	Base	Const	Base	Const	Base	Const
1. Primary Production	1	4	1	5	3	5	2	5	3	5		
2. Fish and Wildlife	1	4	2	4	3	5	2	5	3	5		
3. Water Quality	2	3	2	3	3	4	3	4	3	4		
4. Erosion Buffer	4	4	4	4	4	4	2	5	4	4		
5. Flood Buffer	4	4	4	4	3	4	4	4	4	4		
6 Aesthetics	1	3	3	5	3	5	3	5	3	5		
7 Public Accessibility and Education Value	2	2	3	3	2	4	2	4	2	4		
a. Subtotal	15	24	19	28	21	31	18	32	22	31		
b. Acres	.16	0.4	0	1.3	0.22	1.22	0.11	1.6	1.3	5.4		
c. Subtotal (a X b)	2.4	9.6	0	36.4	4 62	37.82	1.98	51.2	28.6	167.4		
Functional Benefit Score (Constr. minus Base)	7.2		36.4		33.2		49.22		138 8			

FUNCTIONAL VALUE				
Low		Medium		High
1	2	3	4	5
SCORE				

BENEFITS ANALYSIS
SEDIMENT CLEAN-UP

Description of Environmental Benefits – Sediment Cleanup

The benefits of each of the alternative restoration plans were characterized in terms of a functional score based on five separate measurements of the health of the Scuffletown Creek ecosystem. The five measurement techniques consisted of a benthic index of biotic integrity (B-IBI); the toxicity of the surface layer (1-2 cm deep) of bottom sediment to benthic (bottom dwelling) organisms; the toxicity of the sub-surface layer to same; histopathology and the presence of neoplasms (cancer) in fish species; and sediment quality as expressed as the presence of contaminant consituents in the sediment exceeding sediment quality criteria (TEL/ERL or PEL/ERM). The following table explains how these measurements indicate the relative health of the ecosystem.

SEDIMENT RESTORATION INDICES AND EXPLANATIONS

Index of Sediment Restoration	Explanation
B-IBI	B-IBI is a multi-metric index that scores benthic community metrics (abundance, biomass, species diversity, etc.) compared to reference locations. Sediment clean-up can begin recovery of benthos (bottom dwelling organisms). Benefits related to improvement in B-IBI scores (indicative of improved benthic community health).
Toxicity of Surface Layer	Surface (surficial) layer defined as top 1- 2 cm of river bottom sediment. Some benthic organisms live on or in only this top layer. Fishes, etc., feed on these organisms. Surface layer typically less well consolidated (i.e., "fluff"), and often subject to change (both chemically and physically). Benefits related to toxicity reductions and more abundant, non-toxic, fish food in this layer.
Toxicity – Subsurface Layer	Subsurface layer defined as sediment below top 2 cm of surface. Subsurface layer often related to historical deposition of sediment. Deeper burrowing organisms, a variety of clams, worms and other invertebrates, inhabit these sediments. Benefits related to toxicity reductions and more abundant, diverse (deeper dwelling), non-toxic, fish food.
Histopathology - Fish tumors, cancers, and deformities	Contaminated sediment may contribute to fish tumors, cancers, deformities, and death. Clean-up that reduces contaminants will restore those populations and make fish less susceptible to these diseases. Benefits are related to healthier, more abundant and diverse fish populations.
Contaminated Bottom Sediment (Sediment Quality)	If contaminated sediment has contributed to degradation of fish and wildlife habitat, then reductions in gross levels of contaminants will lead to restoration of fish & wildlife populations. Benefits are related to reduction in contaminant levels and correlated restoration of fish and wildlife habitat and species populations.

A panel of subject matter experts (Sediment Subcommittee members) developed a functional numerical index in which the values recorded for each measurement technique were assigned a score of between 1 (poor) to 7 (excellent) to describe conditions of ecosystem health. For example, in characterizing the toxicity surface layer measurement technique, a functional index score of 1 (poor) would reflect high toxicity (less than 50% survival rate); a score of 3 (fair), moderate toxicity (50-80% survival rate); a score of 5 (good), low toxicity (over 80% survival rate); and a score of 7 (excellent), no toxicity (100% survival rate). The following tables give a complete presentation of sediment restoration measurement techniques and corresponding functional index scores.

The expert panel judged the existing condition, the expected future without-project condition, and the expected future conditions under the three alternative restoration plans, on the 1 to 7 scale for each of the five measurements of ecosystem health. The five separate functional index scores were weighted equally and then summed to provide a more complete representation of ecosystem health. The highest possible score (a functional score of 7 for all five measurement techniques) was therefore calculated to be a score of 35. Projected scores ranged from 14 for the without project future condition to 19 for the 0.8 mean ERM SQV alternative; 22 for the 0.6 mean ERM SQV alternative; and 24.5 for the 0.4 mean ERM SQV alternative. Expected functional scores under each alternative restoration plan were compared to the expected future without-project score (and the difference calculated) to yield an overall numerical value of ecosystem improvement or benefit.

SEDIMENT RESTORATION GOALS/BENEFITS
BASE (EXISTING) CONDITIONS

Measure	Excellent	SCORE	Good	SCORE	Fair	SCORE	Poor	SCORE
BIBI	Reference (BIBI score of 5)	7	Close to Reference (BIBI score of 3-5)	5	Marginally Degraded (BIBI score of 2-3)	3	Severely Degraded (BIBI score of <2)	1 **2***
Toxicity Surface Layer (1-2 cm)	No Toxicity	7	Low Toxicity (>80% survival)	**5**	Moderate Toxicity (50-80% survival)	3	High Toxicity (<50% survival)	1
Toxicity Sub-Surface	No Toxicity	7	Low Toxicity (>80% survival)	5	Moderate Toxicity (40-80% survival)	3	High Toxicity (0-40% survival)	**1**
Histopathology	Background levels: AHF <5% Neoplasms: 0%	7	AHF @ low prevalence (5-20%); no neoplasms (0%)	**5**	AHF @ moderate Prevalence (20-30%); neoplasms low (<5%)	3	AHF @ high prevalence (>30%); neoplasms high (>5%)	1
Sediment Quality	No exceedences of TEL or ERL	7	At least one constituent <ERM/PEL	5	At least one constituent <2X ERM/PEL	3	At least one constituent >2X ERM/PEL	**1**
SUBTOTAL				**10**				**4**
TOTAL	**14**							

*score represents base (existing) condition between fair and poor

SEDIMENT RESTORATION GOALS/BENEFITS

RESTORATION (CLEAN UP) LEVEL

SEDIMENT QUOTIENT VALUE OF 0.4

Measure	Excellent	SCORE	Good	SCORE	Fair	SCORE	Poor	SCORE
BIBI	Reference (BIBI score of 5)	7	Close to Reference (BIBI score of 3-5)	**4.5**	Marginally Degraded (BIBI score of 2-3)	3	Severely Degraded (BIBI score of <2)	1
Toxicity Surface Layer (1-2 cm)	No Toxicity	7	Low Toxicity (>80% survival)	**5**	Moderate Toxicity (50-80% survival)	3	High Toxicity (<50% survival)	1
Toxicity Sub-Surface	No Toxicity	7	Low Toxicity (>80% survival)	**5**	Moderate Toxicity (40-80% survival)	3	High Toxicity (0-40% survival)	1
Histopathology	Background levels: AHF <5% Neoplasms: 0%	7	AHF @ low prevalence (5-20%); no neoplasms (0%)	**5**	AHF @ moderate Prevalence (20-30%); neoplasms low (<5%)	3	AHF @ high prevalence (>30%); neoplasms high (>5%)	1
Sediment Quality	No exceedences of TEL or ERL	7	At least one constituent <ERM/PEL	**5**	At least one constituent <2X ERM/PEL	3	At least one constituent >2X ERM/PEL	1
SUBTOTAL				**25**				
TOTAL	**24.5**							

SEDIMENT RESTORATION GOALS/BENEFITS

RESTORATION (CLEAN UP) LEVEL

SEDIMENT QUOTIENT VALUE OF 0.6

Measure	Excellent	SCORE	Good	SCORE	Fair	SCORE	Poor	SCORE
BIBI	Reference (BIBI score of 5)	7	Close to Reference (BIBI score of 3-5)	5	Marginally Degraded (BIBI score of 2-3)	3 **4***	Severely Degraded (BIBI score of <2)	1
Toxicity Surface Layer (1-2 cm)	No Toxicity	7	Low Toxicity (>80% survival)	**5**	Moderate Toxicity (50-80% survival)	3	High Toxicity (<50% survival)	1
Toxicity Sub-Surface	No Toxicity	7	Low Toxicity (>80% survival)	5	Moderate Toxicity (40-80% survival)	3 **4***	High Toxicity (0-40% survival)	1
Histopathology	Background levels: AHF <5% Neoplasms: 0%	7	AHF @ low prevalence (5-20%); no neoplasms (0%)	**5**	AHF @ moderate Prevalence (20-30%); neoplasms low (<5%)	3	AHF @ high prevalence (>30%); neoplasms high (>5%)	1
Sediment Quality	No exceedences of TEL or ERL	7	At least one constituent <ERM/PEL	5	At least one constituent <2X ERM/PEL	3 **4***	At least one constituent >2X ERM/PEL	1
SUBTOTAL				**10**		**12**		
TOTAL	**22**							

*score represents restoration condition between good and fair

SEDIMENT RESTORATION GOALS/BENEFITS

RESTORATION (CLEAN UP) LEVEL

SEDIMENT QUOTIENT VALUE OF 0.8

Measure	Excellent	SCORE	Good	SCORE	Fair	SCORE	Poor	SCORE
BIBI	Reference (BIBI score of 5)	7	Close to Reference (BIBI score of 3-5)	5	Marginally Degraded (BIBI score of 2-3)	**3**	Severely Degraded (BIBI score of <2)	1
Toxicity Surface Layer (1-2 cm)	No Toxicity	7	Low Toxicity (>80% survival)	**5**	Moderate Toxicity (50-80% survival)	3	High Toxicity (<50% survival)	1
Toxicity Sub-Surface	No Toxicity	7	Low Toxicity (>80% survival)	5	Moderate Toxicity (40-80% survival)	**3**	High Toxicity (0-40% survival)	1
Histopathology	Background levels: AHF <5% Neoplasms: 0%	7	AHF @ low prevalence (5-20%); no neoplasms (0%)	**5**	AHF @ moderate Prevalence (20-30%); neoplasms low (<5%)	3	AHF @ high prevalence (>30%); neoplasms high (>5%)	1
Sediment Quality	No exceedences of TEL or ERL	7	At least one constituent <ERM/PEL	5	At least one constituent <2X ERM/PEL	**3**	At least one constituent >2X ERM/PEL	1
SUBTOTAL				**10**		**9**		
TOTAL	**19**							

RECREATION BENEFITS ANALYSIS

RECREATION BENEFIT ANALYSIS

The proposed project contains several recreation features that meet the criteria for recreation development at ecosystem restoration projects, as described in Appendix B, EP 1165-2-502. Recreation features at Portsmouth City Park and Grandy Village were evaluated.

Benefits arising from recreation opportunities created by a project are measured in terms of willingness to pay. Economic Guidance memorandum 01-01 (Unit Day Values for Recreation, Fiscal Year 2001) was used to assign values to recreation. The 1996 Virginia Outdoors Plan was utilized to assess demand for recreation. The Hampton Roads Planning District Commission was contacted to discuss data sources used to facilitate this analysis.

Without Project Condition

As prescribed in the IWR Planning Manual (IWR Report 96-R-21, dated November 1996), proper project without project condition analysis includes a comprehensive, rational, alternative future oriented, honest, and inclusive evaluation. The following assumptions pertain to the without project conditions at Portsmouth City Park and Grandy Village.

Table C-1. WITHOUT PROJECT CONDITIONS

Item	Portsmouth City Park	Grandy Village
Tennis Courts[1]	Yes	No
Walking Areas[1]	Yes	No
Public Golf Course[1]	Yes	No
Boat Ramp[1]	Yes	No
Open Areas[1]	Yes	No

[1]General Recreation

As regards the future, the requirements contained in ER 1105-2-100 (Planning Guidance Notebook, 22 April 2000) are that a reasonable effort be made to identify future without project conditions. Grandy Village is a multi-family residential housing complex currently experiencing an urban renewal. For example Housing and Urban Development (HUD) funds are being used to renovate and replace the aging housing stock.

As regards recreational use of Portsmouth City Park and Grandy Village, the following describes the annual existing visitation (visitor days) by recreational experience (trip purpose).

Table C-2. EXISTING RECREATIONAL USE
(VISITOR DAYS)

Trip Purpose	Portsmouth City Park	Grandy Village
General Recreation[1]	250,000	0
Specialized Recreation[2]	0	0

[1]General activities that are common to the region (e.g., general recreation)

[2]High quality activities that are not common to the nation

As regards the value of recreational use, the unit day value (UDV) methodology was selected. The UDV method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Federal or Federally assissted recreation resources. If it can be demonstrated that more reliable TCM or CVM estimates are either not feasible or not justified for the particular project under study, the UDV method may be used. By applying a carefully thought-out and adjusted UDV to estimated use, an approximation is obtained that may be used as an estimate of project recreation benefits. When the UDV method is used for economic evaluations, planners will select a specific value from the range of values provided annually. Application of the selected value to estimated annual use over the project life,

in the context of the with- and without-project framework of analysis, provides the estimate of recreation benefits. In that connection, table C-3 was utilized to assign points for general recreation. Three experienced planners evaluated the five (5) criteria of recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental. Tables C-4 and C-5 summarizes the results of this evaluation for Portsmouth City Park and Grandy Village, respectively.

Table C-3. Guidelines for Assigning Points for General Recreation

Criteria	Judgment factors				
Recreation experience[1] Total Points: 30 Point Value:	Two general activities[2] 0-4	Several general activities 5-10	Several general activities: one high quality value activity[3] 11-16	Several general activities; more than one high quality high activity 17-13	Numerous high quality value activities; some general activities 24-30
Availability of opportunity[4] Total Points: 18 Point Value:	Several within 1 hr. travel time; a few within 30 min. travel time 0-3	Several within 1 hr. travel time; none within 30 min. travel time 4-6	One or two within 1 hr. travel time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying capacity[5] Total Points: 14 Point Value:	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14

Table C-3. Guidelines for Assigning Points for General Recreation (cont'd)

Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental Total Points: 20 Point Value:	Low esthetic factors[6] that significantly lower quality[7] 0-2	Average esthetic quality; factors exist that lower quality to minor degree 3-6	Above average esthetic quality; any limiting factors can be reasonably rectified 7-10	High esthetic quality; no factors exist that lower quality 11-15	Outstanding esthetic quality; no factors exist that lower quality 16-20

[1]Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
[2]General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
[3]High quality value activities include those that are not common to the region and/or Nation, and that are usually of high quality.
[4]Likelihood of success at fishing and hunting.
[5]Value should be adjusted for overuse.
[6]Major esthetic qualities to be considered include geology and topography, water, and vegetation.
[7]Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

Table C-4. SUMMARY OF POINT VALUES – PORTSMOUTH CITY PARK

Item	Score 1	Score 2	Score 3	Average
Recreation Experience	7	7	9	7.6
Availability of Opportunity	1	1	1	1
Carrying Capacity	7	7	7	7
Accessibility	11	11	11	11
Environmental	3	4	3	3.3
TOTAL	29	30	31	29.9

Table C-5. SUMMARY OF POINT VALUES – GRANDY VILLAGE

Item	Score 1	Score 2	Score 3	Average
Recreation Experience	0	0	0	0
Availability of Opportunity	1	1	1	1
Carrying Capacity	1	1	1	1
Accessibility	1	2	1	1.3
Environmental	1	2	1	1.3
TOTAL	4	6	4	4.6

The point values identified in tables C-4 and C-5 were then related to the point value ranges contained in table C-6 to arrive at UDV for recreation under the without project condition. The resulting UDVs are $4.18 per visitor day at Portsmouth City Park and $3.06 per visitor day at Grandy Village. Multiplying the visitation estimates in table C-2 for Portsmouth City Park by the UDV in table C-6 yields an annual recreation value of $1,045,000. Because there is no existing recreational use of the Grandy Village site, there are no existing recreation benefits.

Table C-6. CONVERSION OF POINTS TO DOLLAR VALUES[1]

Point Values	General Recreation Values ($)
0	2.82
10	3.35
20	3.70
30	4.23
40	5.29
50	6.00
60	6.52
70	6.88
80	7.58
90	8.11
100	8.46

[1]From EGM 01-01, 1 Nov 00

With Project Condition

A similar analysis was made for the with project condition at each site. Table C-7 summarizes the components of the with project condition.

Table C-7. WITH PROJECT CONDITIONS

Item	Portsmouth City Park	Grandy Village
Tennis Courts[1]	Yes	No
Walking Areas[1]	Yes	Yes
Public Golf Course[1]	Yes	No
Boat Ramp[1]	Yes	No
Open Areas[1]	Yes	Yes

[1]General Recreation

As regards recreational use of Portsmouth City Park and Grandy Village, the following describes the annual with project visitation (visitor days) by recreational experience (trip purpose).

Table C-8. WITH PROJECT ANNUAL RECREATIONAL USE (VISITOR DAYS)

Trip Purpose	Portsmouth City Park	Grandy Village
General Recreation[1]	250,000	10,290
Specialized Recreation[2]	0	0

[1]General activities that are common to the region (e.g., general recreation)

[2]High quality activities that are not common to the nation

As was done with the without project condition, point values were assigned to the with project condition. Tables C-9 and C-10 summarize the point values for Portsmouth City Park and Grandy Village, respectively.

Table C-9. SUMMARY OF POINT VALUES – PORTSMOUTH CITY PARK

Item	Score 1	Score 2	Score 3	Average
Recreation Experience	9	10	10	9.7
Availability of Opportunity	1	1	1	1
Carrying Capacity	8	8	8	8
Accessibility	11	11	11	11
Environmental	8	8	7	7.7
TOTAL	37	38	37	37.4

Table C-10. SUMMARY OF POINT VALUES – GRANDY VILLAGE

Item	Score 1	Score 2	Score 3	Average
Recreation Experience	9	8	7	8
Availability of Opportunity	1	1	1	1
Carrying Capacity	6	6	6	6
Accessibility	6	4	5	5
Environmental	8	7	9	8
TOTAL	30	26	28	28

The point values identified in tables C-9 and C-10 were then related to the point value ranges contained in table C-6 to arrive at UDV for recreation under the with project condition. The resulting UDVs are $5.01 per visitor day at Portsmouth City Park and $4.12 per visitor day at Grandy Village. Multiplying the visitation estimates in table C-8 for Portsmouth City Park by the UDV yields an annual recreation value of $1,252,500. Multiplying the visitation estimates in table C-8 for Grandy Village by the UDVs yields an annual recreation value of $42,400.

Adequate support facilities are in place to support the projected visitation.

Average Annual Benefits

The measure of annual benefits is the difference between benefits in the with and without project condition. Total average annual benefits are thus $249,900 as shown in table C-11.

Table C-11. AVERAGE ANNUAL BENEFITS

Item	Portsmouth City Park	Grandy Village
With Project Condition	$1,252,500	$42,400
Without Project Condition	$1,045,000	0
Average Annual Benefit	$207,500	$42,400
TOTAL AVERAGE ANNUAL BENEFITS	$249,900	

APPENDIX D

Pertinent Correspondence

APPENDIX D

PERTINENT CORRESPONDENCE

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Craig Seltzer
U.S. Army Corps of Engineers
Norfolk District
803 Front St.
Norfolk, Virginia
23510-1096

May 22, 2001

Re: Elizabeth River Restoration Study

Dear Mr. Seltzer:

The Environmental Protection Agency (EPA) has reviewed the subject study and Environmental Assessment that outlines a series of environmental enhancements in portions of the Elizabeth River watershed. EPA has no objection to the proposals outlined in this study.

If you have any questions regarding this letter please feel free to contact me at 703-648-4292.

Sincerely,

Peter M Stokely
Virginia Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

April 30, 2001

Colonel Allan B. Carroll
District Engineer
Norfolk District, Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

Attn: Craig Seltzer

Re: Elizabeth River Environmental Restoration

Dear Colonel Carroll:

This constitutes the Final Report of the U.S. Fish and Wildlife Service (Service) on Norfolk District Corps of Engineer's (Corps) proposed environmental restoration project for the Elizabeth River in the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach, Virginia. It is submitted in accordance with Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 884, as amended; 16 U.S.C. 661 *et seq*) and Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). The purpose of this report is to present an evaluation of the project alternatives and to set forth the Service's official position on the recommended project as described in the Draft Feasability Study and Draft Environmental Assessment dated March 2001, the Formulation Analysis Notebook dated September 2000, the Project Study Plan dated July 1998, and other project-related documents. The Service previously submitted a Draft Fish and Wildlife Coordination Act Report dated November 2000.

INTRODUCTION

The Elizabeth River watershed encompasses approximately 300 square miles within the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach, Virginia. A tidal tributary to the Chesapeake Bay, the Elizabeth River has become heavily impacted by industrial and urban development over the years resulting in many environmental problems. Three hundred years of industrial pollution have made the Elizabeth River one of the most polluted rivers in the United States. Over the years, stormwater runoff, point source discharges, and spills from commercial, industrial, and military sources have contaminated river sediments and lowered water quality Industrial and urban development and related filling activities have destroyed many wetland

(...SEE EA - APPENDIX 1 FOR COMPLETE U.S. FISH AND WILDLIFE SERVICE FINAL COORDINATION ACT REPORT)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

JUN -7 2001

Colonel Allan B. Carroll
Distinct Engineer
U.S. Army Corps of Engineers
803 Front Street
Norfolk, Virginia 23510-1096

ATTN: Craig L. Seltzer

Ref.: Elizabeth River Restoration Environmental Assessment

Dear Colonel Carroll:

This is in reference to the **Draft Feasibility Study and Draft Environmental Assessment Main Report** for the Elizabeth River Basin, Virginia Environmental Restoration. We have reviewed the Environmental Assessment pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and the Fish and Wildlife Coordination Act, and have the following comments and recommendations.

We support efforts to clean up and restore the Elizabeth River. The removal of the contaminated sediments in Scuffletown Creek, a tributary of the Southern Branch of the Elizabeth River, along with the creation and restoration of 18 acres of wetland habitat, is a good beginning to restore the river.

Essential Fish Habitat

We reviewed the essential fish habitat (EFH) assessment section of the report, and we disagree with the findings of the assessment that proposed work will not adversely affect EFH. The proposed dredging of contaminated sediments could adversely impact juvenile fish, including anadromous fish species. This portion of the Elizabeth River is documented habitat for juvenile fish which serve as forage for federally managed species such as bluefish, which could be adversely affected by increased suspended contaminated sediment in the water column. Pursuant to Section 305(b)(4)(9A) of the MSFCMA, we offer the following Conservation Recommendation: that no dredging take place from February 15 through June 30, to reduce any potential adverse impacts from the proposal.

Section 305(b)(4)(B) of the MSFCMA requires the Army Corps of Engineers (ACOE) to provide a detailed written response to our EFH conservation recommendation, including a description of measures adopted by the ACOE for avoiding, mitigating, or offsetting the impact of the project on EFH. In the case of a response that is inconsistent with NMFS' recommendations, the ACOE must explain its reasons for not following the recommendation, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action.

and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(j)].

Fish and Wildlife Coordination

This portion of the Elizabeth River is documented habitat for migrating adults, larva, and juvenile fish of the following anadromous fish: alewife, blueback herring, white perch, yellow perch, and American shad. The proposed dredging of contaminated sediments has the potential of re-suspending contaminants in the water column, and we recommend that no dredging take place from February 15 through June 30, to reduce the adverse impacts on anadromous fish. As you will note, these recommendations are the same as our EFH Conservation Recommendations.

If you have any questions concerning this matter, please call Rod Schwarm of our Oxford, Maryland field office at 410-226-5771.

Sincerely.

Peter D. Colosi, Jr.
Assistant Regional Administrator
for Habitat Conservation

cc: HCD - Oxford, Sandy Hook

Elizabeth - 013

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

James S. Gilmore, III
Governor

John Paul Woodley, Jr.
Secretary of Natural Resources

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Dennis H. Treacy
Director

(804) 698-4000
1-800-592-5482

April 30, 2001

Mr. Mark T. Mansfield
Chief, Planning Branch
U.S. Army Corps of Engineers, Norfolk District
803 Front Street (Fort Norfolk)
Norfolk, Virginia 23510

RE: Draft Feasibility Study and Environmental Assessment:
Elizabeth River Basin Environmental Restoration
DEQ-01-050F

Dear Mr. Mansfield:

The Commonwealth of Virginia has completed its review of the Draft Feasibility Study and Environmental Assessment for the Environmental Restoration of the Elizabeth River. The Department of Environmental Quality is responsible for coordinating Virginia's review of federal environmental documents and responding to appropriate federal officials on behalf of the Commonwealth. The following agencies and locality joined in this review:

Department of Environmental Quality
Virginia Institute of Marine Science
Marine Resources Commission
City of Portsmouth.

In addition, the following agencies, planning district commission, and locality were invited to comment:

Department of Health
Department of Historic Resources
Department of Game and Inland Fisheries
Department of Conservation and Recreation
Chesapeake Bay Local Assistance Department
Hampton Roads Planning District Commission

City of Norfolk
City of Chesapeake
City of Virginia Beach.

Notwithstanding the degree of review participation indicated here, a number of agencies of the Commonwealth, along with the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach, have worked with the Corps of Engineers on this project for several years now, and it is fair to state that the Commonwealth strongly supports the Elizabeth River Restoration Project.

Project Description

The Corps proposes, with the assistance of its state and local partners, to accomplish a two-part project in the Elizabeth River watershed. One aspect of the project will address sediment conditions in Scuffletown Creek, a tributary to the Southern Branch of the Elizabeth River. This will be done by dredging of 60,270 cubic yards of contaminated sediment from that creek so that aquatic life, including bottom-dwelling species, may prosper once again (EA, page 2). The other aspect involves wetland restoration at eight different sites in the river system, which is intended to result in creation and/or restoration of approximately 18 acres of wetland habitat, 3 acres of riparian buffer habitat, and 1 acre of tidal creeks. The recommended plan involves a 65% federal, 35% non-federal cost share of the first cost ($11,281,853), and non-federal operation and maintenance estimated at $1,438 per year thereafter. (Feasibility Report Syllabus; EA, pages 1-2.)

Environmental Impacts and Mitigation

The Commonwealth would agree with a Finding of No Significant Impact (FONSI) for this project that follows, or substantially follows, the Draft FONSI in the document. Our comments on particular aspects of the project follow.

1. Water Quality and Wetlands. With regard to the remediation of contaminated sediments in Scuffletown Creek, the Draft EA discusses several alternative dredging methods and types of equipment contemplated for use (pages 25-29). We recommend that, for each area, the least environmentally damaging, practicable alternative be chosen. The different areas may require different dredging methods to be most effective in the restoration effort.

With respect to the wetland restoration and creation effort, we recommend preservation of the completed sites in perpetuity. We further recommend that deed restrictions be approved and recorded for as many of the eight sites as practicable.

We encourage the use of erosion and sediment control measures, adherence to stormwater management requirements, and careful construction practices to minimize temporary impacts to State waters during all construction activities.

In addition to testing the sediment to determine whether it has become re-contaminated (Study, page 104), we recommend that the Corps consider the Benthic IBI (index of biotic integrity) as a way to measure the success of the project.

As the EA indicates, the project will be subject to water resources permitting and federal consistency review (page 63). Additional detail on these and related matters appears in the discussion of "Regulatory and Coordination Needs," below.

2. Air Quality. The EA mentions that construction equipment will generate exhaust fumes when used, and states that both dredging and wetland restoration activities will result in some "volatilization of contaminants" (i.e., contaminants will evaporate or become airborne). The EA mentions canopy cover measures as a means to address this impact (page 51). We recommend that the Corps consider appropriate measures to control dust, in accordance with the Virginia Regulations for the Control and Abatement of Air Pollution 9 VAC 5-50-60 et seq.).

The Elizabeth River is in a maintenance area for ozone (O_3), and an emission control area for volatile organic compounds (VOCs) and oxides of nitrogen (NO_x). Accordingly, all reasonable precautions should be taken to limit the emissions of VOCs and NO_x. These precautions may include shutting down fuel-burning machinery when it is not in use.

3. Solid and Hazardous Waste Management. The Draft EA proposes storing some or all of the dredged sediments temporarily at the Craney Island Dredged Material Management Area (CIDMMA), with final disposal at the Higgerson Buchanan site on the Southern Branch of the Elizabeth River (page 43).

4. Endorsements. The City of Portsmouth believes that the combined document accurately reflects policy deliberations and technical analyses that took place over the course of the Feasibility Study. The City supports and endorses the "Views of the Non-Federal Sponsor" on page 151 of the Feasibility Study part of the document.

Similarly, the Virginia Institute of Marine Science, which has been thoroughly involved with the development of this project, agrees with the Draft EA and the Report.

Regulatory and Coordination Needs

1. Water Resources Permitting. As indicated above, the dredging and wetland restoration activities comprising this project will require water resources permitting within the Joint Federal-State Permit Process which involves the Corps, the DEQ, and the Marine Resources Commission. The Joint Federal-State Permit Application (JPA) should be filled out and submitted to the Marine Resources Commission (P.O. Box 756, Newport News, 23607), and all relevant permits must be obtained before the work begins.

The Marine Resources Commission administers two permit programs that may apply. For the dredging in Scuffletown Creek, a subaqueous bed encroachment permit may be required if that creek bed constitutes state-owned riverbed. The subaqueous bed encroachment permit may also apply to one or more of the wetland restoration sites, depending on its relation to state-owned bottomlands. For the wetland restoration and re-creation activities, tidal wetland permits may also be needed to allow encroachment on the intertidal zone between mean low water and mean high water lines. Additional information on this matter is available from the Commission (Traycie West, telephone (757) 247-2200).

The DEQ's Tidewater Regional Office has responsibility for the Virginia Water Protection Permit that is likely to apply to both the dredging and the wetland restoration aspects of this project. Additional information is available from that Office (Sheri Kattan, telephone (757) 518-2156 or Bert Parolari, telephone (757) 518-2166).

2. Air Quality Regulation. A permit is required for any open burning of land-clearing debris, pursuant to the Regulations for the Control and Abatement of Air Pollution, 9 VAC 5-40-5600 et seq.). If any open burning is contemplated, application must be made to the DEQ's Tidewater Regional Office. For information and requirements, please contact the Office (Jane Workman, telephone (757) 518-2112).

3. Federal Coastal Zone Management Act Consistency. The Virginia Coastal Resources Management Program (VCP) is comprised of a network of programs administered by several agencies. In order to be consistent with the VCP, the Corps of Engineers, as the applicant in this case, must obtain all the applicable permits and

approvals listed under the Enforceable Programs of the VCP prior to commencing the project (see attached list). **Based on the consistency determination** (Draft EA, page 58) **that the Corps will obtain and comply with all approvals from agencies administering the applicable enforceable policies, as well as the foregoing comments and analysis, we concur with the finding that this proposed project is consistent with the VCP.** Other state requirements which may be applicable to this project are not included in this consistency concurrence.

If you have questions relative to federal consistency, please feel free to contact Charlie Ellis of this office (telephone (804) 698-4488).

The Document

We have a few suggestions to make regarding the Draft Feasibility Study that may improve its final version.

Page 29 (2nd paragraph). The Study says that states are developing action plans for Regions of Concern. In fact, action plans have been developed (or are being updated) and are being implemented.

Page 105. The term "functional score" appears for the first time in Table 18. We recommend that the reader be referred to pages 106-111 for the explanation of this concept.

Page 111. The Study indicates that the President of the United States was among the signatories of the Chesapeake Bay 2000 Agreement. In fact, the federal signatory was the EPA Administrator rather than the President. (The other signatories included the governors of Virginia, Maryland, and Pennsylvania, the Mayor of Washington, D.C., and the Chairman of the Chesapeake Bay Commission.)

Page 135. This page appears twice in a row.

Thank you for the opportunity to review this document. As previously stated, the Commonwealth of Virginia supports this effort to clean up the Elizabeth River. We look forward to reviewing the Final Study, EA, and FONSI.

Sincerely,

Michael P. Murphy, Director
Division of Environmental Enhancement

Enclosures
cc: Wendy Kedzierski, DEQ-VWPP
James P. Ponticello, DEQ-DAPC
Mark Richards, DEQ-CBP
Thomas A. Barnard, Jr., VIMS
Arthur Kapell, DEQ-OWP
James J. Gildea, City of Portsmouth
Traycie L. West, MRC
Sheryl A. Kattan, DEQ-TRO
Derral Jones, DCR
Catherine Harold, CBLAD
Raymond T. Fernald, DGIF
John M. Carlock, Hampton Roads PDC

WILLIAM & MARY
VIMS
Virginia Institute of Marine Science
School of Marine Science

CCRM
Center for
Coastal Resources Management

April 20, 2001

Mr. Charles H. Ellis, III
Environmental Programs Planner
Department of Environmental Quality
Office of Environmental Impact Review
629 East Main Street, 6th Floor
Richmond, VA 23219

RE: Elizabeth River Basin Environmental Restoration EA

Dear Charlie,

We have reviewed the above titled Environmental Assessment from a marine environmental perspective and found it to be a relatively thorough, well researched document. As you are aware, at the request of the Elizabeth River Project, VIMS has been involved from the earliest planning stages of this restoration program and thus our input has been incorporated regularly as the plan has evolved. Based on the information presented to this point, we concur with the approach described and have no further comments to make at the present time.

If I may answer any questions with regard to these comments, please do not hesitate to contact me.

Sincerely,

Thomas A. Barnard, Jr.
Marine Scientist

cc:
Mory Roberts, VIMS
Walter Priest, VIMS

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DEQ VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

MEMORANDUM

Chesapeake Bay Program
(804) 698-4392 Voice ♦ (804) 698-4319 Fax

Subject: Review of Draft Feasibility Study and Draft Environmental Assessment Main Report

To: Charlie Ellis,

From: Mark Richards

Date: April 20, 2001

Copies: File

Thanks for coordinating agency comments. Since I have served on the Steering Committee, and an associated technical committee, which have directed this process, I am very familiar with this project. Therefore, my comments are fairly minor.

Draft Feasibility Study

1) Page 29 (2nd paragraph) – "The Chesapeake Bay Program designated these three areas as 'Regions of Concern' (Figure 6), and ...are developing action plans to address toxic pollution problems in each location."

   Action plans have already been developed (or are in the process of being updated) in each ROC. Currently, these plans are being implemented. This clarification should be made in the text.

2) Page 105 (Table 18) – "Functional Score" has been included in the table. This is the first time this concept has surfaced in the document. It is suggested that the reader be referred to pages 106-111 for the explanation behind this concept.

3) Page 104 (paragraph under Table 17) – "These costs of $2,000 every five years include costs for testing the sediment to ensure the area has not become re-contaminated."

It is suggested that the Benthic IBI also be considered as a way to measure for the success of this project.

4) Page 111 (paragraph under Table 21) – "The Chesapeake Bay Agreement 2000, signed by the governors of three states (Maryland, Pennsylvania, and Virginia), the District of Columbia, and the President of the United States..."

For purposes of clarification, Carol Browner, EPA's Administrator at that time, was the Federal Signatory for the C2K document, not the President of the United States.

5) Pages 135 (HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE) – The first three paragraphs under this heading have been replicated twice (i.e., there are two pages listed as 135).

Draft Environmental Assessment

No Comments.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

James S. Gilmore, III
Governor

John Paul Woodley, Jr.
Secretary of Natural Resources

5636 Southern Boulevard
Virginia Beach, VA 23462
Tel# (757) 518-2000
http://www.deq.state.va.us

Dennis H. Treacy
Director

Francis L. Daniel
Tidewater Regional Director

May 24, 2001

Mr. William Sorrentino, Jr.
Chief, Technical Services Division
Norfolk District Corps of Engineers
803 Front Street
Norfolk, VA 23510-1096

Re: Elizabeth River Restoration Feasibility Report

Dear Mr. Sorrentino:

This letter is in reference to the Elizabeth River Basin, Environmental Restoration feasibility investigation conducted by the Corps of Engineers, Norfolk District, in cooperation with five local cost-sharing sponsors: the Commonwealth of Virginia, and the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach. During the last three and a half years, this office has had the opportunity to serve on the Steering Committee, a Sediment Subcommittee, and a Wetlands Subcommittee representing the Department of Environmental Quality (DEQ) as this investigation has proceeded. The committees have worked diligently to develop feasibility level concepts for restoring both wetlands and bottom sediment quality in the Elizabeth River.

A Draft Feasibility Report was prepared by the Corps and furnished to this office in March 2001. The recommended plan presented in the document includes sediment clean-up at Scuffletown Creek, a tributary to the Southern Branch of the river, and wetland restoration at eight different sites located throughout the river system.

Based upon our involvement in developing the recommended plan, and the information presented in the draft feasibility document, the proposed activities appear to be permittable under DEQ's authority to grant Virginia Water Protection permits issued pursuant to the State Water Control Law and Section 401 of the Clean Water Act. Final permitting of these projects will be completed upon review of the detailed plans and specifications which will be provided as part of a formal permit application during the Preconstruction, Engineering, and Design phase of this project.

The Department of Environmental Quality looks forward to continuing our involvement in this worthwhile and exemplary partnership.

Sincerely,

Bert W. Parolari, Jr.
Water Resource Programs Manager

CC: Mr. Craig Seltzer

COMMONWEALTH of VIRGINIA

James S. Gilmore, III
Governor

John Paul Woodley, Jr.
Secretary of Natural Resources

Marine Resources Commission
2600 Washington Avenue
P.O. Box 756
Newport News, Virginia 23607-0756

William A. Pruitt
Commissioner

May 29, 2001

Mr. William Sorrentino, Jr.
Chief, Technical Services Division
Norfolk District Corps of Engineers
803 Front Street
Norfolk, VA 23510-1096

Re: Elizabeth River Environmental Restoration Projects

Dear Mr. Sorrentino:

This letter is in reference to the Elizabeth River Basin, Environmental Restoration feasibility investigation that was conducted by the Norfolk District USACOE, in conjunction with five local cost-sharing sponsors: the Commonwealth of Virginia, and the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach. During the last three and a half years, this agency has participated on both the Executive Steering Committee and a Wetlands Subcommittee as the investigation proceeded. The committees worked diligently to develop feasibility level concepts for restoring both wetlands and bottom sediment quality in the Elizabeth River.

A Draft Feasibility Report was prepared by the Corps and furnished to this office in March 2001. The recommended plan presented in the document includes sediment clean up at Scuffletown Creek, a tributary to the Southern Branch of the Elizabeth River, as well as wetland restoration at eight different sites located throughout the river system.

Based upon the information presented in the draft feasibility document, and our involvement in developing the recommended plan, the proposed activities appear to be permittable under VMRC's authority to issue permits for reasonable uses of state-owned bottomlands pursuant to §28.2-1204 of the Code of Virginia.

Final permitting of these projects, however, will only be possible upon completion of our review of the detailed plans and specifications that are to be

An Agency of the Natural Resources Secretariat
Telephone (757) 247-2200 (757) 247-2292 V/TDD Information and Emergency Hotline 1-800-541-4646 V/TDD

provided as part of the formal permit application to be submitted during the Preconstruction, Engineering, and Design phase of this project.

Should you have any questions concerning the foregoing, please feel free to contact me at (757) 247-2250.

Sincerely,

Robert W. Grabb
Chief, Habitat Management Division

RWG/
HM
cc: William A. Pruitt
Craig L. Seltzer

RECEIVED
APR 20 2001
DEQ-Office of Environmental Impact Review

THE CITY OF
PORTSMOUTH

April 18, 2001

Mr. Charles H. Ellis III
Department of Environmental Quality
Office of Environmental Impact Review
629 East Main Street, Sixth Floor
Richmond, VA 23219

Re: Environmental Review Request
Project Number: 01-050F
Project Title: Elizabeth River Basin Environmental Restoration
Project Sponsor: DOD/Army Corps of Engineers

Dear Mr. Ellis:

The City Manager has requested that I respond to your request for review and comment on the Draft Feasibility Study and Draft Environmental Assessment: Elizabeth River Basin Environmental Restoration.

The City of Portsmouth has been a participant in the deliberations that led to the completion of the dual feasibility study and draft environmental assessment.

We believe that this combined report accurately reflects both the technical/ scientific inputs from the many involved agencies and individuals as well as the policy deliberations and decisions which took place over the course of the study. Thus, we support and endorse the language found at page 151 of the report in the section entitled "Views of the Non-Federal Sponsor."

Thank you for this opportunity to comment.

Sincerely,

James J. Gildea

James J. Gildea, AICP
Director of Policy and Research

Office of the City Manager
P. O. Box 820 • Portsmouth, Virginia 23705-0820 • (757) 393-8641 • Fax (757) 393-5241