APPENDIX D
ENVIRONMENTAL ASSESSMENT (EA)

STEVENSON CREEK
CLEARWATER, PINELLAS COUNTY, FLORIDA

SEPTEMBER 2003

FINAL DRAFT
ENVIRONMENTAL ASSESSMENT

STEVENSON CREEK ESTUARY ENVIRONMENTAL RESTORATION

CLEARWATER, PINELLAS COUNTY, FL

STEVENSON CREEK ESTUARY
SECTION 206 – ENVIRONMENTAL RESTORATION
CLEARWATER, PINELLAS COUNTY, FLORIDA

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the Environmental Assessment (EA) for the proposed action. This Finding incorporates by reference all discussions and conclusions contained in the Environmental Assessment enclosed hereto. Based on information analyzed in the EA, reflecting pertinent information obtained from agencies having jurisdiction by law and/or special expertise, I conclude that the proposed action will not significantly impact the quality of the human environment and does not require an Environmental Impact Statement.

Reasons for this conclusion are in summary:

a. A declining estuary will be restored to a self-sustaining aquatic system by re-establishing the biological, physical, and chemical dynamics. This objective will be achieved by increasing tidal circulation and providing intertidal wetland habitat.

b. The work proposes no adverse impacts which jeopardize the continued existence of any federally listed threatened or endangered species, and will not result in the adverse destruction or alterations to such species critical habitat.

c. The work will not adversely impact historic or pre-historic properties or resources eligible for inclusion in the *National Register of Historic Places*.

d. State water quality standards will be maintained within established parameters.

e. Standard precautionary guidelines will be implemented during construction to protect federally listed species.

f. Area aesthetics will benefit from the removal of exotic and nuisance species.

In consideration of the information summarized, I find that the proposed action will not significantly affect the human environment and does not require an Environmental Impact Statement.

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DATE

ROBERT M. CARPENTER
COLONEL, CORPS OF ENGINEERS
Commanding

STEVENSON CREEK ESTUARY
ENVIRONMENTAL RESTORATION
CLEARWATER, PINELLAS COUNTY, FLORIDA

DRAFT ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ENVIRONMENTAL ASSESSMENT
SECTION 206- ENVIRONMENTAL RESTORATION
STEVENSON CREEK ESTUARY
PINELLAS COUNTY, FLORIDA

1.0 PROJECT PURPOSE AND NEED FOR ACTION.

1.1 INTRODUCTION.

The Stevenson Creek is a 39-acre tidally influenced estuary located in one of the more urbanized and populated regions of Florida. Historically, prior to 1930, the lower portion of Stevenson Creek was a much larger estuarine system with multiple channels flanked by broad mangrove swamps. The only obstruction to flow in the lower portion of the steam was a railroad crossing north of Harbor Drive (Pinellas Trail) and Edgewater Drive (U.S. Alt. 19) at the mouth of the creek (Mayer 1996). Developmental pressures began during World War II, with a heavy concentration of estuary filling taking place from 1945 to 1954. The Douglas Avenue Bridge (one of three existing bridges within the scope of the project area) was constructed in the 1950's connecting Fairmont Street with County Route 345. By the late 1960's, the estuary had taken on its present day dimensions (mayer 1996). Channelization and side casting of dredged material also altered and eliminated historic flood plains and riparian habitat. The resulting effects of these past actions have left the estuary half it's original width and surrounding land more than 90 percent developed.

Stevenson Creek is the largest and more urbanized watershed in the City of Clearwater drains 6,286 acres (9.82 square miles) in western Pinellas County. About 65 percent (4,057 acres) of the watershed is within the city limits of Clearwater, 20 percent within the City of Dunedin (1,287 acres), 14 percent within unincorporated Pinellas County (859 acres), and 1 percent in the City of Largo (83 acres) [Parson 2001].

Over the years, the deposition of sediments has reduced flow, impacted water quality, reduced benthic production, obstructed manatee access, and reduced fish and wildlife habitat and foraging areas. Local residents report the presence of foul odors when existing sediments are exposed to the air during low tide cycles. Stevenson Creek is also included on Florida's impaired waters list (303(d)) due to concerns over dissolved oxygen, coliforms, and nutrients levels (Parson 2001). In

1992, the City of Clearwater took corrective actions to improve discharge waters from the Municipal Wastewater Management Plant (MWMP), by converting to an advance (tertiary) treatment facility. The City of Clearwater further proposes to address non-point pollution sources, habitat degradation, flooding and overflows to Stevenson Creek, by implementing a watershed management plan by 2004.

The Stevenson Creek Estuary is also located within an area designated a "Brownfield", (see **Figure 1**, Clearwater Designation Brownfield Areas). The project area has been chosen as a pilot project for the Brownfield Assessment Program. Brownfield areas as defined by the Environmental Protection Agency (EPA), are abandoned, idled, or underused industrial, commercial areas where expansion or redevelopment is complicated by real or perceived environmental contamination. The EPA's Brownfield init iative is intended to empower states, municipalities, and other stakeholders to work together to determine the optimal way to assess, safely cleanup, and develop Brownfields for sustainable uses that would improve the local community. In March 2002, Post, Buckley, Schuh and Jernigan, Inc., contracted by the City of Clearwater and under the direction of the Florida Department of Environmental Protection, conducted a Brownfield Site Assessment on the temporary dewatering site (Wolfe property). A final draft report was issued May 2003. A copy of this report can be found in Sub-Appendix F, Other Project Reports.

1.1.1 PROJECT AUTHORITY.

Project authorization is received under Section 206 of the Water Resources Development Act of 1996, as amended, for aquatic ecosystem restoration and protection.

1.1.2 PROJECT LOCATION.

Comprising a total 39 acres from Betty Lane at the east and the North Fort Harrison Avenue Bridge (Edgewater Avenue or Alternate 19) at the west, Stevenson Creek is a tidal east-west waterbody located in west central Pinellas County (see **Figure 2**, Project Location Map). Stevenson Creek drains a watershed of 6,286 acres or 9.82 square miles. Located also in an EPA designated Brownfield, the surrounding land contains 13 of 26 land use categories identified in the Southwest Florida Water Management District Land Classification System (see **Figure 3**, Stevenson Creek Watershed Land Use Classification Map). In the Stevenson Creek watershed, land use classifications vary from commercial to medium density residential to wetland. Residential development is concentrated on the north and south sides of the creek, comprising about 64 percent of the developed lands within the creek's watershed. The project area is confined to 29 acres (28.7 acres rounded) from the North Fort Harrison Bridge to the Pinellas Trail Bridge.

1.2 PROJECT NEED OR OPPORTUNITIES.

The purpose of the project is to provide a cost-effective project that restores self-sustaining aquatic functions to the Stevenson Creek Estuary. The project would further enable the creek to increase fish and wildlife values, retain public interest benefits, and aesthetics appeals. A heavy concentration of sediments within the estuary is contributing to fish and wildlife habitat loss, water quality decline, reduced tidal circulation, and sediment loading within the estuary. The existing sediments are also providing a medium for the accumulation, transport and storage of pollutants, including nutrients and metals. Sediment-bound pollutants are interacting with the water column through cycles of deposition, re-suspension, and re-deposition. Substantial intervention is required to achieve ecological, biological, chemical, and physical recovery of the creek at a self-sustaining level. In addition to, the proposed Federal action extensive intervention is required by the City of Clearwater to halt activities that degrade and prevent recovery of the estuary (i.e., direct stormwater discharges, leaking septic systems, and upstream erosion). The City of Clearwater proposes to address the identified concerns by implementing a watershed improvement plan by April 2005.

1.3 AGENCY GOALS AND OBJECTIVES.

1.3.1 OBJECTIVE ONE.

The primary objection of the proposed action is to effect long-term and self-sustaining recovery of the Stevenson Creek Estuary. In addition to, providing project components which benefit the continued survival of the West Indian manatee (*Trichechus manatus*).

1.3.2 OBJECTIVE TWO.

This objective would remove about 1 acre of exotics such as *Schinus terebinthifolius* (Brazilian pepper) and *Casuarina equisetifolia* (Australian pine) from the shorelines east of the North Fort Harrison Bridge (NFHB) in Reach 1, the temporary dewatering site, and shoreline east of the Pinellas Trail Bridge (PTB) and Douglas Avenue Bridge (DTB) in Reach 2.

1.3.3 OBJECTIVE THREE.

This objective would create wetland habitat to aid water quality improvements, food-chain production, fishery habitat, and provide fish and wildlife roosting, nesting and foraging areas.

FIGURE 1: CITY OF CLEARWATER DESIGNATED BROWNFIELD AREAS LOCATION MAP

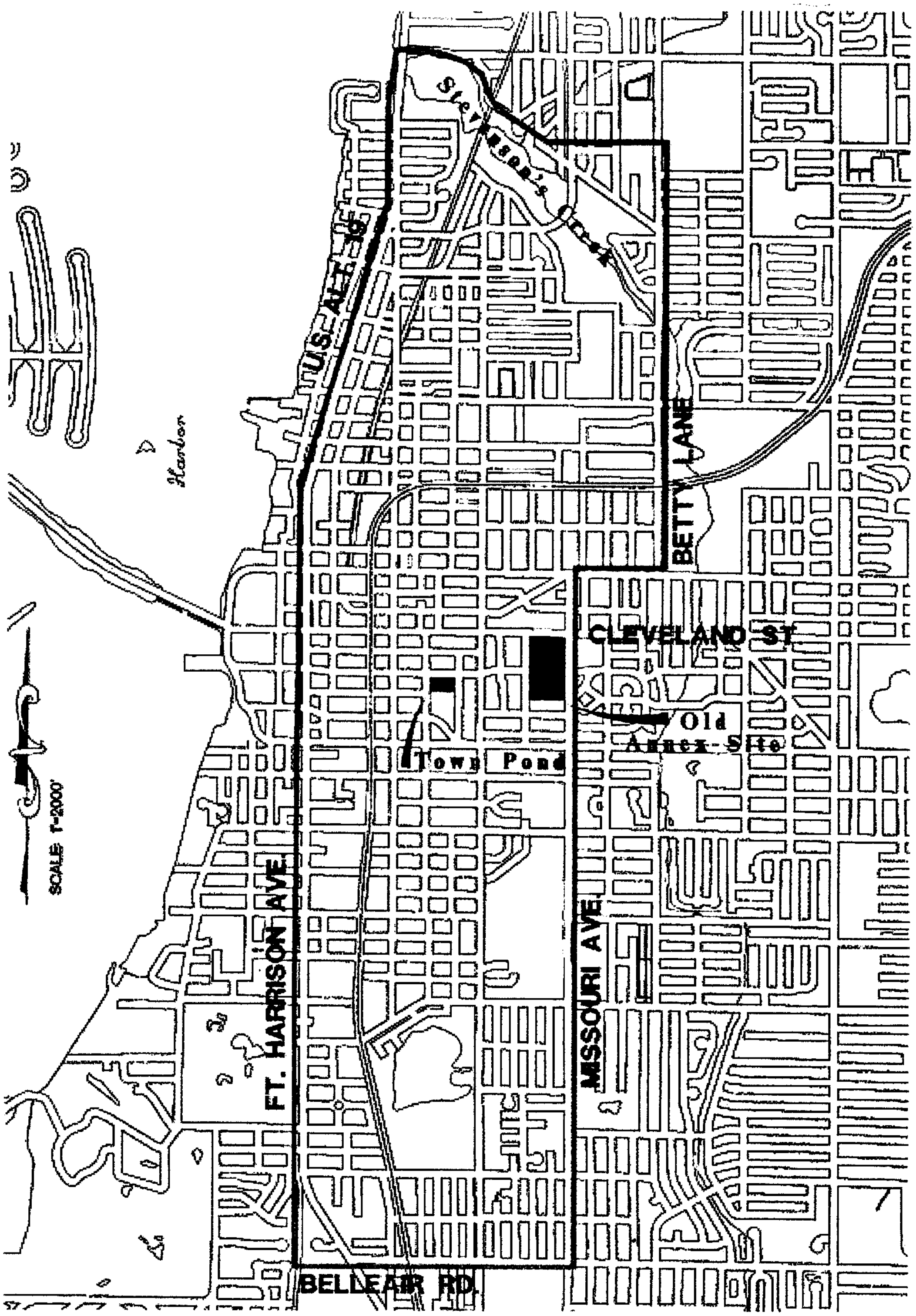


FIGURE 2: PROJECT LOCATION MAP

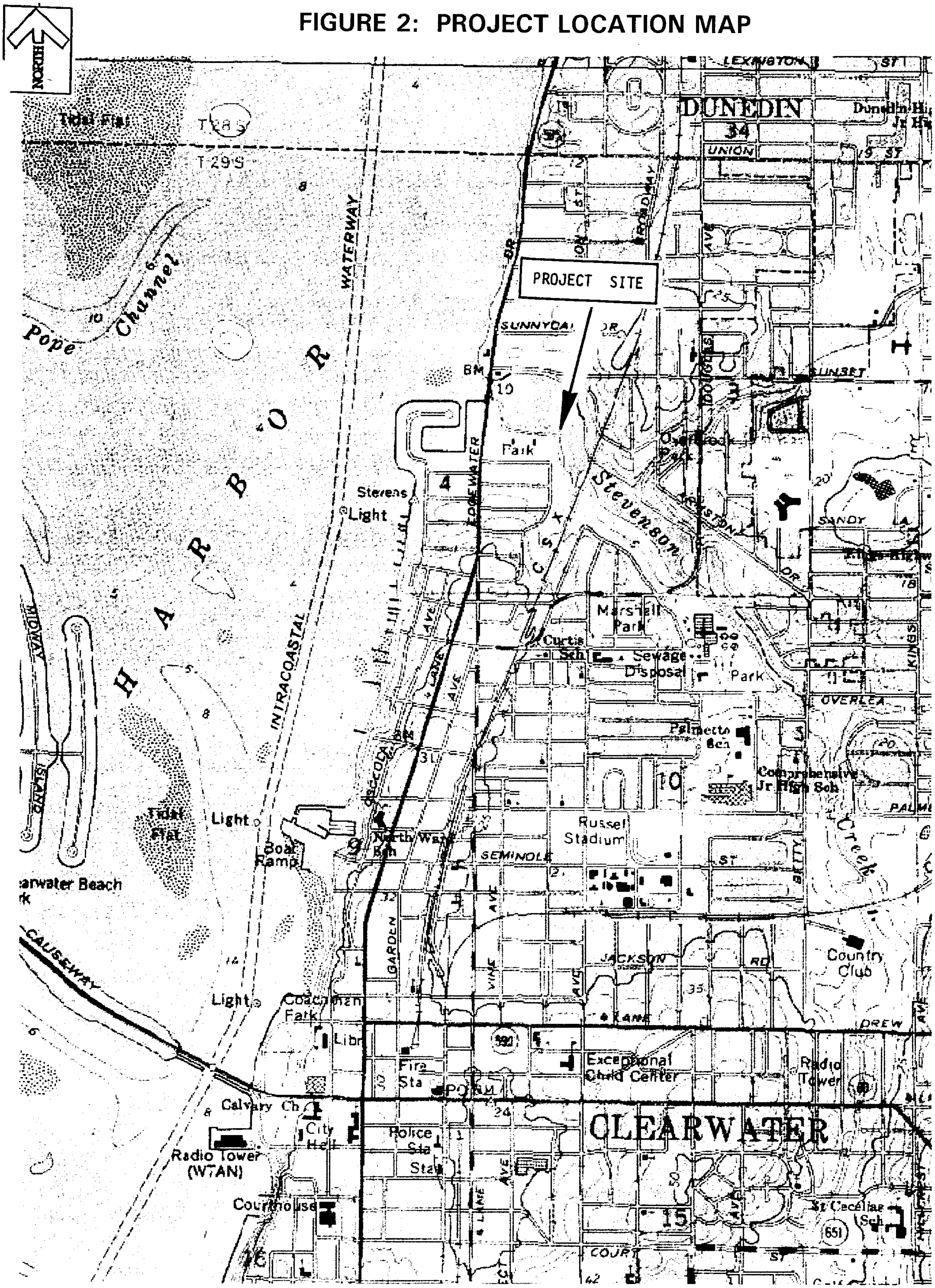
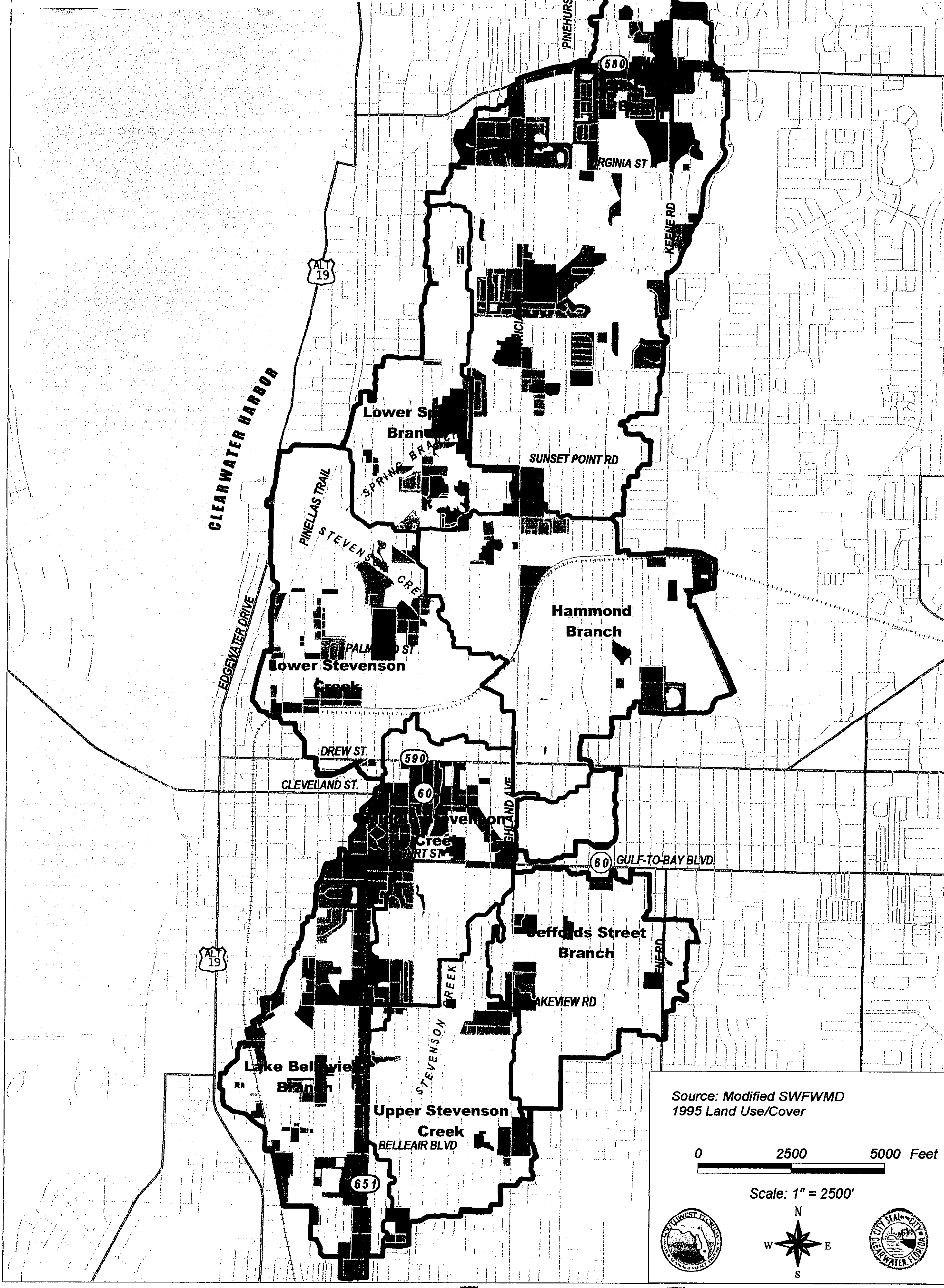


FIGURE 3: STEVENSON CREEK WATERSHED LAND USE CLASSIFICATION MAP



Stevenson Creek Watershed Land Use Classification Map

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Industrial
- Institutional
- Open Land/Recreation
- Cropland and Pastureland
- Specialty Farms
- Forest
- Wetland
- Transportation, Communications, and Utilities
- Water
- Major Subbasin Delineation
- Watershed Boundary

PARSONS ENGINEERING SCIENCE

1.3.4 PROPOSED ACTION.

Hydraulic dredging with pipeline discharge is proposed from the North Forth Harrison Bridge to the Douglas Avenue Bridge. Approximately 29 acres of the creek's bottom substrate would be dredged to remove about 111,000 cubic yards of material within Reach 1 and 86,300 cubic yards of material from Reach 2.

Onsite hydrocyclone separation of sand and muck is proposed. Muck material secured from the separation process, is proposed for pumping into geotechnical bags located on a temporary dewatering site. This site identified as the Wolf property is located northwest of North Fort Harrison (NFH) and east of the Pinellas Trail Bridge (see **Figure 4**, Temporary Dewatering Location Map). Once dried, the separated muck would be transported to a permanent disposal site located approximately 20 miles from the project area (see **Figure 5**, Permanent Disposal Site Location Map).

The project also proposes to use a total 31,800 cubic yards of reclaimed sand to create a total 3.2 acres of mangrove wetlands in R1. A 1.5-acre mangrove shelf would be created with 15,300 cubic yards of dredged sand along the southeasterly shoreline at elevation 1.0 foot NGVD with a 1.7-acre mangrove shelf created at the southwesterly shoreline with 16,500 cubic yards of dredged sand.

1.4 DECISION TO BE MADE

The decision to be made considers material quantities, stream conveyance, dredging extent and depths necessary to achieve a self-sustaining environmental recovery of the Stevenson Creek estuary. This decision would further consider the effect of the proposed actions on the manatee and the species' unimpeded access to the warmer waters associated with the Marshall Street Wastewater Treatment Plant. Ancillary environmental actions (i.e., wetland creation and exotic plant removal) would be reviewed to determine estuary and ecosystem benefits. Public interest values associated with the surrounding land designation as a "brownfield (see **Figure 1**, City of Clearwater Designated Brownfield Areas) would also weigh substantially into any proposed decision.

1.5 SCOPING AND ISSUES.

1.5.1 HISTORY OF PLANNING AND SCOPING PROCESS.

Public forums, issuance of a scoping letter, and available communication mediums were used to involve public and private organizations, State and Federal resource

FIGURE 4: INTERIM DISPOSAL SITE LOCATION MAP

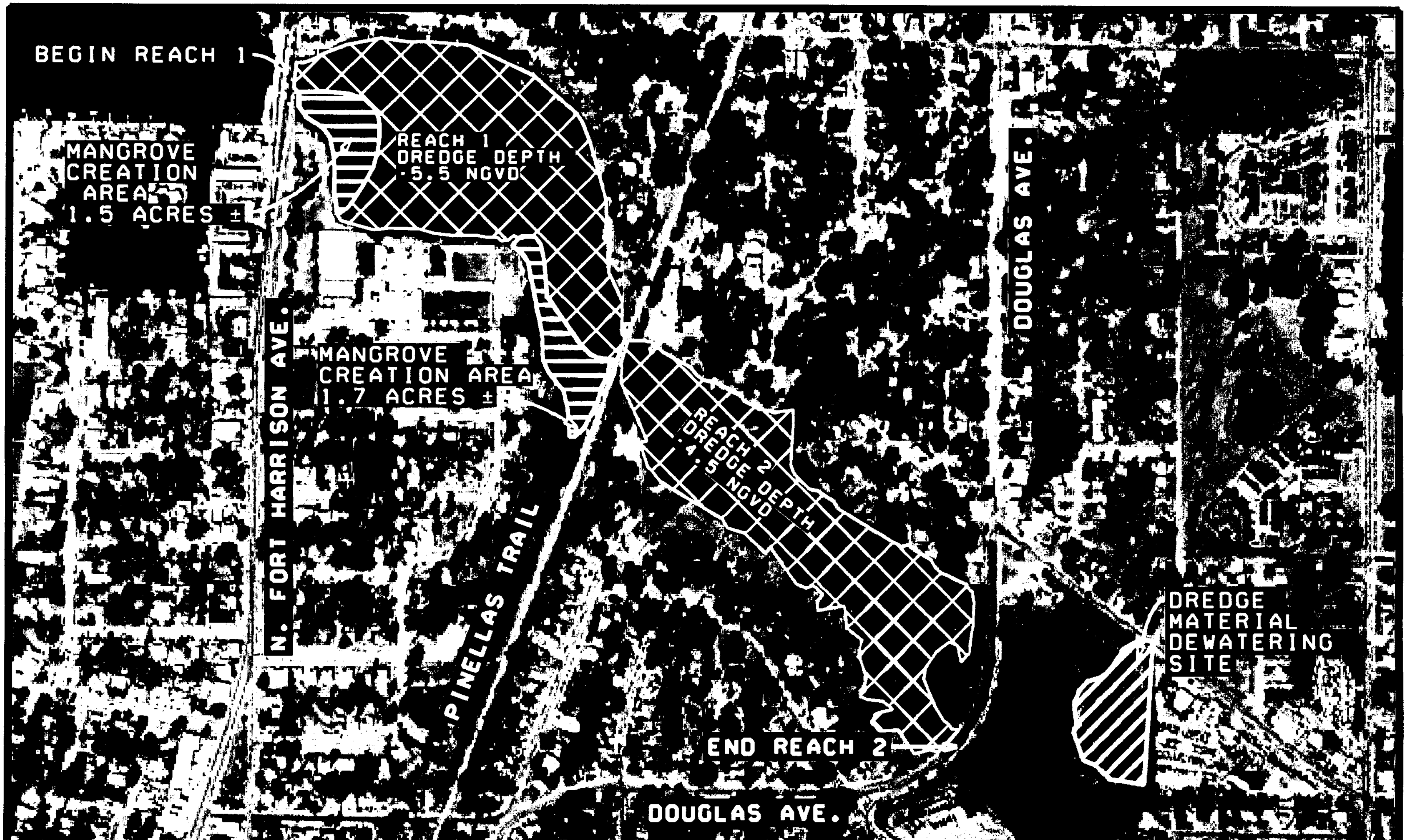
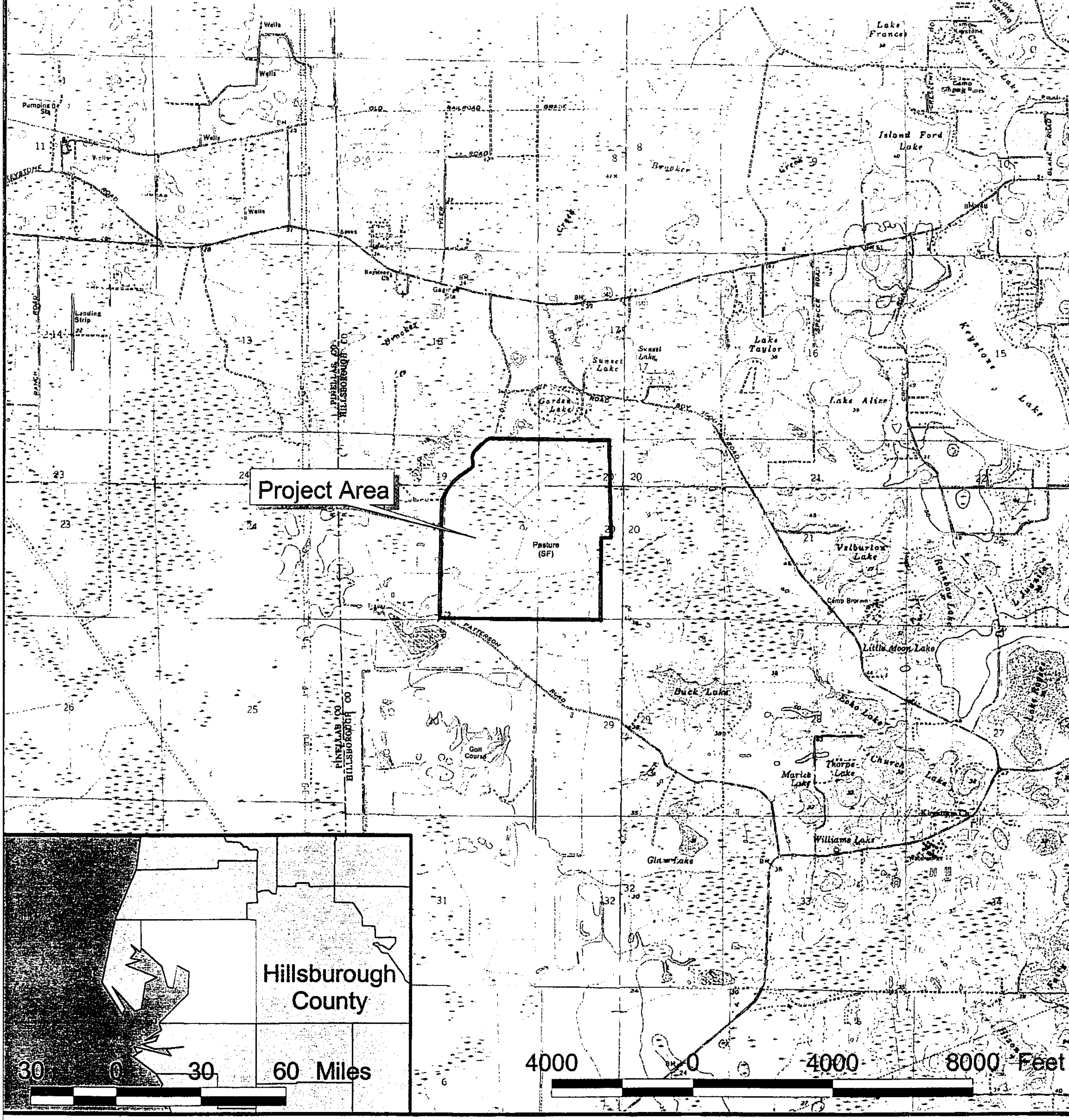
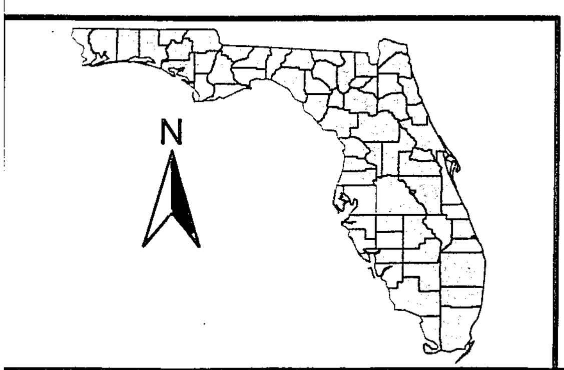


FIGURE 5	STEVENSON CREEK - CLEARWATER, FLORIDA RECOMMENDED PLAN ENGINEERING APPENDIX	File name: Reference files:	Designed by: J.W.M. Dwn by: J.W.M. Ckd by: J.W.M. Dated:	Scale: 1"=500' Plot date: Jan. 27, 2003 Plot scale: 1"=500'	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS JACKSONVILLE, FLORIDA	US Army Corps of Engineers Jacksonville District

FIGURE 5: PERMANENT DISPOSAL SITE LOCATION MAP





Location Map	
Stevenson Creek Restoration Candidate Spoil Disposal Site	
Scale 1" = 4000'	Drawn By: CSD
Date: July, 2002	
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J02-585
	Figure

agencies and all interested persons in the project's proposal and design. Approximately fifteen (15) problems were identified and twelve (12) opportunities were identified for environmental restoration. Project problems and opportunities identified are as following:

1.5.1.1 Problems Identified.

(1) Possible conveyance constriction at bridge crossings.

(2) Past estuary filling has significantly altered and reduced the creek's cross-section, flood plain, and riparian habitat.

(3) Decaying organics exposure during low tides may contribute to the area's air pollution.

(4) Photic zone obstructions are reducing benthos production.

(5) Existing Mudflats are considered essential fish habitat.

(6) Manatee use of the estuary is occasional and limited to high tides.

(7) Existing sandflats are utilized by shore, wading and migratory birds.

(8) Flooding occur to residential areas during storm events.

(9) Possible containments and pollutants are attached to the mucky bottom sediments.

(10) Upland disposal options are limited to non-existent.

(11) Containments may exit at the temporary dewatering site.

(12) A remnant wetland with altered hydroperiod exists at the proposed dewatering site.

(13) Permanent disposal options exist 20 or more miles from project area.

(14) Invasive exotic species established within the project area may require special handling under existing Florida Statutes.

(15) Historical surveys may be required at the project area, temporary dewatering site and permanent material placement site.

1.5.1.2 Opportunities Identified.

(1) Improving conveyance within the estuary would increase flow and circulation and enhance overall water quality.

(2) Removing obstruction to the upper photic zone would restore benthic Production, in addition to, increase utilization by pelagic species (i.e., plankton and nekton) and juvenile/adult fishery species.

(3) Increasing the waterway depth from the NFH Bridge to the DA Bridge would allow the manatee access to the fresh and warmwater discharged from the wastewater treatment plant.

(4) Wetland creation would provide increased aquatic benefits.

(5) Opportunities exist to improve shellfish propagation.

(6) Filling existing estuary holes in NFH area would create conditions favorable for seagrass recruitment within the areas of North Fort Harrison and Pinellas Trail.

(7) Creating island habitat between the Pinellas Trail Bridge and Douglas Avenue Bridge could provide habitat, foraging, and resting for shore, wading and migratory birds.
(8) Removing sediments within a naturally occurring thalweg (the low point of a streambed or longitudinal outline of a riverbed from bed source to mouth).
(9) Removing established exotics would improve area aesthetics and remove a source of competition with natural species.
(10) Olfactory annoyances to local residents may be eliminated.
(11) Dredging the upper and lower reaches of the estuary would improve the physical, chemical, and biological components of the waterbody.
(12) Recreational users would receive benefits that enhance navigation and fishing opportunities.

1.5.2 SCOPING AND ISSUES

1.5.2.1 Issues Evaluated in Detail.

The following issues were identified during scoping by the interdisciplinary team of preparers of this document and recommended for detail evaluation:

(1) Efforts necessary to achieve a self-sustaining estuary.
(2) Efforts necessary to increase or improve velocity and conveyance.
(3) Efforts necessary to achieve manatee return to or use of the estuary.
(4) Project actions impact or benefit to essential fishery habitat
(5) Levels of turbidity and sedimentation that might be harmful to hard-bottom and seagrass communities established in Clearwater Harbor and St. Joseph Sound.
(6) Impacts to or opportunities to improve water quality and alleviate or lessen flooding occurrences.
(7) Project components with public interest benefits (i.e., navigation and recreational opportunities).
(8) Opportunities to identify and remove exotic plants from estuary and temporary dewatering site.

1.5.2.2 Relevant Issues.

(1) Protected Species
(2) Vegetation
(3) Threatened and Endangered Species
(4) Hardground
(5) Fish and Wildlife Resources
(6) Essential Fish Habitat
(7) Historic Properties

(8) Navigation
(9) Water Quality
(10) HTRWs (Hazardous and Toxic Radioactive Wastes)
(11) Air Quality

1.5.3 IMPACT MEASUREMENT.

The following provides the means and rationale for measurement and comparison of impacts of the no-action alternative and recommended alternative. Table 1, outlines the impacts of project measures on proposed objectives.

TABLE 1 PROJECT MEASURES AND OBJECTIVES

OBJECTIVES	MEASURES							
	Dredge R1 to -3.5 ft NVGD	Dredge R2 Thalweg to -2.5ft NGVD	Dredge R2 to -2.5 ft NGVD	Create Mangrove Wetlands At elev. 1.0 ft NGVD	Remove 1 ac of Exotics From R1 & R2	Dredge R1 to -5.5 ft NGVD	Dredge R2 to -4.5 ft NGVD	Widen Bridge Cross Section NFH & PT
Protected Species	X	X	X	X		X	X	
Vegetation				X	X			
Hardgrounds	X	X	X	X		X	X	
Fish & Wildlife Resources	X	X	X	X	X	X	X	X
Essential Fish Habitat	X	X	X			X	X	X
Historic Properties	X	X	X		X	X	X	X
Navigation	X	X	X			X	X	X
Water Quality	X		X	X		X	x	X
Hazardous Toxic Radioactive Waste	X	X	X			X	X	X
Air Quality	X	X	X	X		X	X	

1.5.3.1 West Indian Manatee (*Trichechus manatus*).

The proposed alternatives would be evaluated for potential to impact and benefit the manatee. Based on input from Fish and Wildlife Service, U.S. Geological Survey (USGS) Florida Integrated Science Center Sirenia Project and other available information on the manatee utilization of Gulf Coast waters, it can be reasonably predicted the project would have a beneficial effect on the manatee's foraging and habitat areas.

1.5.3.2 Essential Fishery Habitat (EFH).

The project site provides habitat critical to the reproduction, growth, feeding, and movement of managed marine species, such as common snook (*Centropomis undecimalis),* gray snapper (*Lutjanus* griseus), spiny lobster (*Panulirus* argus), and pink shrimp (*Penaeus* duorarum), as determined by the Dial Cordy and Associates, Inc (November 2002). The proposed alternatives would be evaluated to assess the ecological impacts and benefits to these resources and their essential habitat areas.

1.5.3.3 Other Impacts.

The basis for other impact measurements and comparison including air quality, navigation, and recreation, in addition to other measures, as more specifically stated in Section 4.0, Environmental Consequences, and other sections of this document and its appendices.

1.5.4 MEASURES ELIMINATED FROM FURTHER STUDY

1.5.4.1 Remove and Replace Existing North Fort Harrison Bridge (NFHB).
Constructing a longer span was considered to improve conveyance at this location. However, this alternative would require extensive coordination with State and Federal Transportation Authorities, in addition to, absorbing over 58 percent of project funding. Hydrodynamic modeling of the existing bridge and proposed replacement did not achieve a noticeable difference in existing circulation patterns to pursue this option.

1.5.4.2 Remove and Replace Existing Pedestrian Bridge at Pinellas Trail (PT).
The Pinellas Trail Bridge (PTB) was once a railroad bridge and pilings are spaced about 20 feet apart. Substantial fill was placed in the waterway to support the structure and its past use in rail transport. A lighter bridge with wider spacing between pilings was considered since the bridge's current use is recreational. Removal of the existing bridge did not reflect a noticeable difference in conveyance when hydrodynamic modeling was performed. This alternative would be about 8 percent of project funding, requires major construction, and substantial cost. The alternative was eliminated from further study

1.5.4.3 Install Conveyance Culverts at NFHB and PTB.

This alternative was initially considered a more cost effective method to achieve flushing and biological connectivity to existing wetland at dewatering site. However, if culverts were placed beneath the NFHB and PTB the structural foundations would be weakened and a danger posed to commuters and recreational users. Culvert modification at the NFHB would require approval from the Federal Department of Transportation (FDOT). Verbal communication from FDOT officials indicated that a replacement structure is scheduled at NFH within the next

10 years. FDOT approval for replacement bridge construction with this project would not be forthcoming. The placing of culverts at the PTB would require extensive excavation and benefits were out of line with associated cost and required construction.

1.5.4.4 Dredge West of NFHB.

Dredging west of the NFHB has the potential to impact at a minimum 104.9 acres of submerged aquatic vegetation (SAV) established within the adjacent Intracoastal Waterway and Clearwater Harbor. Clearwater Harbor has substantial SAV, primarily *Halodule wrightii* (shoal grass). (Dial Cordy Sept 2001). Project actions undertaken in this area would have little effect on achieving restoration that benefits the Stevenson Creek estuary and would have adverse impacts to SAV resources in the area.

1.5.4.5 Dredge East of Douglas Avenue Bridge (DAB).

This alternative would not realize any major benefits for fish and wildlife species. The creek naturally narrows at this location and extensive muck removal may be required to achieve conveyance with little environmental benefit components. Sediment removal east of the DAB would have a high probability of containing contaminants, which exceed current regulatory standards.

1.5.4.6 Plant Seagrass East of NFHB.

This alternative would have a high probability of failure due to tidal dynamics and failure of seagrasses to previously recruit in the area. This alternative was eliminated by consensus of the project's interdisciplinary team members.

1.5.4.7 Widening the NFHB and PTB Cross-Sections.

Hydrodynamic modeling of this alternative did not result in substantial improvements to velocity and waterway conveyance. This alternative has been maintained for comparison of environmental habitat units and direct and indirect project impacts. However, this alternative has not been evaluated beyond the indicated area and is later eliminated from any further analysis.

1.6 PERMITS, LICENSES, AND ENTITLEMENTS.

The project is subject to State water quality certification and consistency with the State's Coastal Zone Management Plan (CZMP). All efforts would be employed by the U.S. Army Corps of Engineers (Corps) to ensure the project met all applicable standards to the fullest extent possible. Coordination with the Florida State Historic Preservation Office has been concluded. The project proposes no impacts to cultural or historical resources.

1.7 PROJECT METHODOLOGY.

An interdisciplinary team used a systematic approach, including hydrodynamic modeling and incremental analysis of environmental factors to determine probable environmental effects in preparation this Environmental Assessment (EA).

2. ALTERNATIVES

2.1 INTRODUCTION.

This section describes in detail the no-action alternative, the proposed action, and other reasonable alternatives studied in detail. Based on best available information and analysis presented in Section 3, Affected Environment and Section 4, the Affected Environment and Probable Impacts, this section presents the beneficial and adverse environmental effects of all alternatives in comparative form, providing a clear basis for choice among the options for the decision makers and the public.

2.1.1 DESCRIPTION OF ALTERNATIVES.

Sedimentation of the waterway is so substantial that any restoration efforts would need to consider tidal velocity, surface water elevation, circulation patterns, flow, and conveyance capacity in order to achieve an effective environmental restoration plan (see Engineering Appendix B - Hydrodynamic Model Alternative Assessments). With exception of alternatives 10, 11, and 12, each considered alternative has received hydrodynamic modeling to assess potential improvements to circulation and tidal exchange. The hydrodynamic modeled alternatives have been extensively factored into the proposed alternatives. Hydrodynamic modeling was also performed to ensure the project would achieve the necessary hydrology to sustain the creek's capac ity to provide aquatic benefits and values (i.e., food chain production, fish and wildlife habitat, nesting, foraging values, and manatee access). **Table 2** presents each alternative as decided by the project's interdisciplinary team members with input from the sponsor. Hydrodynamic functioning of the creek weighed substantially in the proposed alternatives.

The Corps contracted with Dial Cordy and Associates, Inc, to evaluate project components associated with the proposed alternatives and to establish the environmental habitat units each alternative would yield. A copy of this report can be found in Appendix F – Project Study Reports (Environmental Benefits of Stevenson Creek, Revised November 2002). **Figure 6** shows the established environment benefits zones. Project alternatives were later re-evaluated by the project's interdisciplinary team members, and the environmental benefits and habitat units as measured by Dial Cordy were no longer applicable. The environmental habitat units as calculated in this report were formulated by the preparer of this document, interdisciplinary team members, and through discussion with the USGS (U.S. Geological Survey), and the National Oceanic and Atmospheric Administration (NOAA) NMFS. **Table 3** provides an outline of the existing and potential Environmental Habitat Values and Habitat Units. **Table 4** provides an outline of the project' s alternatives and environmental habitat units, while **Table 5** lists the ongoing impacts to the estuary should the " no action" (status quo) alternative be recommended, and **Table 6** ranks the environmental and hydrodynamic derived alternatives with resulting habitat units.

TABLE 2 **PROPOSED ALTERNATIVES**

ALTERNATIVES	MEASURES											
	Dredge R1 to –3.5 ft NVGD	Dredge R2 Thalweg to -2.5ft NGVD	Dredge R2 to -2.5 ft NGVD	Create Mangrove Shelf		Remove Exotics From R1 & R2		Widen Bridge Cross Section		Dredge R1 to -5.5 ft NGVD	Dredge R2 to -4.5 ft NGVD	Dred. R1 to 5.5 & R2 to -4.5
				R1 1.5	**R2 1.7**	**R1 .45**	**R2 .55**	**NFH**	**PT**			
	X1a	X2a	X1b	X1a	X1a	X1a	X2a	W1	W2	X3a	X3b	X4
1	X			X		X						
2	X	X		X	X	X	X					
3	X	X		X	X	X	X					
4	X	X		X	X	X	X	X	X			
5	X	X		X	X	X	X	X	X			
6	X		X	X	X	X	X	X	X			
7	X		X			X	X	X	X			
9	X		X	X	X	X						
EXPANDED ALTERNATIVES												
10				X	X	X				X		
11				X	X		X			X	X	
12				X	X	X	X					X

LEGEND

NFH(B) = North Fort Harrison (Bridge)
PT(B) = Pinellas Trail (Bridge)
DA(B) = Douglas Ave. (Bridge)
R1 = Reach 1 Area between NFH and PT
R2 = Reach 2 Area between PT and DA
X1a = Deepen R1 entire area to –3.5 ft NGVD, Create 3.2 ac. of mangrove shelves (1.5 ac. R1 [SE] &1.7 ac. R1 [SW]) and Remove .45 ac. exotics from R1
X1b = Deepen R1 to 3.5 ft NGVD without wetland shelves
X2a = Deepen R2 Thalweg only to –2.5 ft. NGVD, Create 3.2 ac. mangrove Wetland shelves, Remove 0.45 ac. of Exotics from R1and .55 ac. from R2
X2b = Deepen R2 entrie area to –2.5 ft NGVD, Create 3.2 ac. of mangrove wetland shelves, remove 0.45 ac. of exotics from R1 and .55 ac. from R2
X3a = Deepen R1 entire area to –5.5 ft. NGVD, Create 3.2 ac of mangove shelves (1.5 ac. R1 [SE] & 1.7 ac R1 [SW}), remove ..45 ac. of exotics from R1.
X3b = Deepen R1 and deepen R2 entire area to –4.5 ft. NGVD, create 3.2 ac of mangrove Shelves (1.5 ac. at R1 [SE] & 1.7 ac. at R1 [SW]) & remove .45 ac of exotics from R1
X4 = Deepen R1 to –5.5 ft NGVD and R2 to –4.5 ft NGVD, Create 3.2 ac of mangrove Shelves (1.5 ac R1[SE] & 1.7 ac R2 {SW]), remove 1 ac. of exotic (.45 ac (R1) and .55 ac [R2]).

W1 = Increase NFH Cross-Section width by 135 ft. (from 115 ft to 250 ft)
W2 = Increase PT Cross-Section width by 115 ft (from 117 ft to 232 ft)

NOTE: Alternatives do not include an Alternative 8.

FIGURE 6: ENVIRONMENTAL BENEFITS ZONE DELINEATION

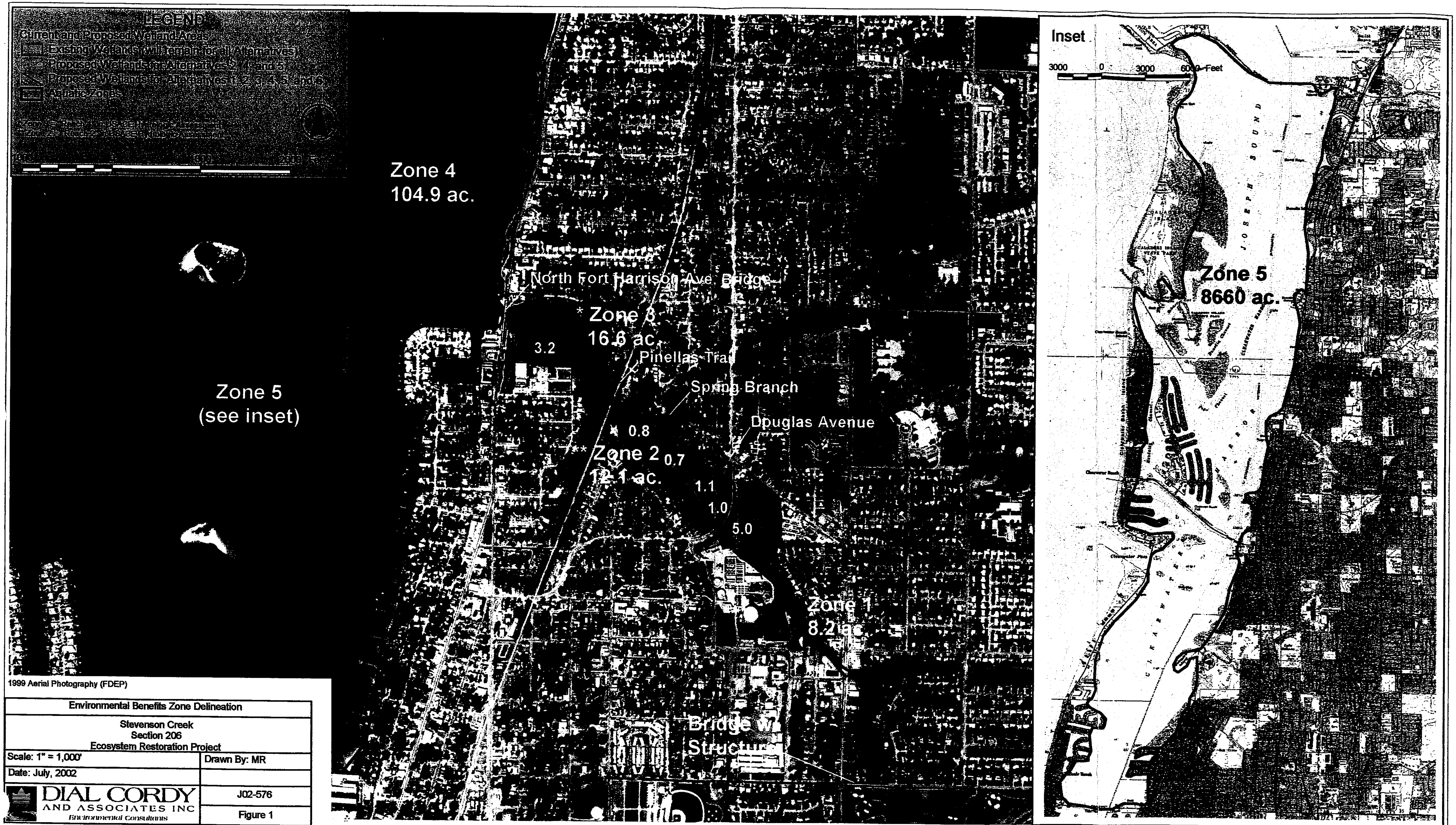


TABLE 3	EXISTING AND POTENTIAL ENVIRONMENTAL HABITAT VALUES AND HABITAT UNITS						
ALTERNATIVES INDEX	EXISTING ACRES	EXISTING VALUE (0-1)	EXISTING HABITAT UNITS	WITH PROJECT ACRES	WITH PROJECT HABITAT VALUE (0-1)	WITH PROJECT HABITAT UNITS	**DIFF INC (+) or DEC (-)**
Dredge R1 to –3.5 ft NGVD	16.60	.50	8.30	16.60	.80	13.28	**+ 4.98**
Dredge R2 to –2.5 ft NGVD	12.10	.40	4.84	12.10	.80	9.68	**+ 4.84**
Dredge R1 & R2 –3.5 ft & -2.5 ft	28.70	.45	12.92*	28.70	.80	22.96	**+ 10.04**
Dredge R 2 THALWEG ONLY to –2.5 ft	3.60±	.40	1.44	3.60	.45	1.62	**+ 0.18**
R1 Dredged to -5.5 ft NGVD	16.60	.50	8.30	16.60	.87	14.44	**+ 6.14**
R2 Dredge to -4.5 ft NGVD	12.10	.40	4.84	12.10	.87	10.53*	**+ 5.69**
R1 & R2 Dredged to –5.5 & -4.5 ft	28.70	.45	12.92*	28.70	.87	24.97	**+ 12.05**
Widen NFHB Cross-Section	0.34±	.50	.17	.34	.62	.21	**+ .04**
Widen PTB Cross-Section	0.21±	.45	.09	.21	.62	.13	**+ .04**
Widen NFHB & PTB Cross-Sect.	0.55	.47	.26*	.55	.62	.34	**.08**
Create 1.5 ac Wetland in R1 (NFH)	1.50	.50	.75	1.50	.75	.1.13*	**+ .38**
Create 1.7 ac Wetland in R1 (PT)	1.70	.50	.85	1.70	.75	1.30*	**+ .45**
Create 3.2 ac Wetland in R1 (NFH & PT)	3.20	.50	1.60	3.20	.75	2.40*	**+ .80**
Remove.45 ac of Exotics in R1	.45	.15	.07*	.45	.55	.25*	**+ .18**
Remove .55 ac of Exotics in R2	.55	.15	.08	.55	.55	.30	**+ .22**
Remove 1 ac of Exotics R1[.45] R2 [.55]	1.00	.15	.15	1.00	.55	.55	**+ .40**

TABLE 4 ALTERNATIVES ENVIRONMENTAL HABITAT UNITS

ALTERNATIVES	ACRE(S)		VALUE		UNITS
ALTERNATIVE 1					
1) Dredge R1 to –3.5 ft NGVD	16.60 ac	x	.80	=	13..28
2) Create 1.5 ac Wetland (R1 at SE)	1.50 ac	x	.75	=	1.13
3) Remove.45 acre of Exotics (R1)	.45 ac	x	.55	=	.25*
	TOTAL HABITAT UNITS				14.66
ALTERNATIVE 2					
1-3) Dredge R1 (-3.5 ft), Create Wetland & Rem Exotics					14.66
4) Dredge R2 Thalweg Only (–2.5 ft NGVD)	3.60 ac	x	.45	=	1.62
5) Create 1.7 ac Wetland (R1 at SW)	1.70 ac	x	.75	=	1.30*
6) Remove .55 ac of Exotics (R2)	.55 ac	x	.55	=	.30
	TOTAL HABITAT UNITS				17.88
ALTERNATIVE 3					
1) Dredge R1 (-3.5 ft)					13.28
2) Create 3.2 ac Wetland R1[SE]1.5 ac & R1[SW]1.7 ac	3.20 ac	x	.75	=	2.40*
3) Remove 1.0 ac Exotics R1[.45 ac] & R2[.55 ac]	1.00 ac	x	.55	=	.55
4) Widen NFH Cross-Section (R1)	,34 ac	x	.62	=	.21*
	TOTAL HABITAT UNITS				16.44
ALTERNATIVE 4					
1-3) Dredge R1 (–3.5 ft) Create Wetland, Rem.Exotics					16.23
4) Dredge R2 Thalweg Only (-2.5 ft)					1.62
5) Widen NFH Cross-Section					.21
	TOTAL HABITAT UNITS				18.06
ALTERNATIVE 5					
1-3) Dredge R1(-3.5 ft), Create Wetland, & Rem.Exotics					16.23
4-5) Dredge R2 Thalweg Only & Widen NFHB X-Sect					1.83
6) Widen PTB Cross-Section	.21 ac	x	.62		.13
	TOTAL HABITAT UNITS				18.19
ALTERNATIVE 6					
1) Dredge R1 (-3.5 ft) & R2 Entire Area (-2.5 ft)	28.70 ac	x	.80	=	22.96
2-3) Create Wetland (3.2 ac) & Remove Exotics (1 ac)					2.95
4) Widen NFHB & PTB Cross-sections	.55	x	.62		.34
	TOTAL HABITAT UNITS				26.25
ALTERNATIVE 7					
1) Dredge R1 (–3.5 ft) & R2 (-2.5 ft)					22.96
2) Widen NFHB & PTB Cross-Sections					.34
3) Remove Exotics R1[.45 ac] & R2 [.55 ac]					.55
	TOTAL HABITAT UNITS				23.85
ALTERNATIVE 9					
1) Dredge R1 (-3.5 ft) & R2 (-2.5 ft)					22.96
2) Create 3.2 ac Wtlnd R1[SE]1.5 ac & R1[SW]1.7ac					2.40
3) Remove 1 ac of Exotics R1[.45 ac]& R2 (.55 ac)					.55
	TOTAL HABITAT UNITS				25.91
EXPANDED ALTERNATIVES ENVIRONMENTAL HABITAT UNITS					
ALTERNATIVE 10					
1) Dredge R1 to –5.5 ft NGVD	16.60 ac	x	.87	=	14.44
2) Create 3.2 ac Wtlnd R1 [SE]1.5 ac & R1[SW]1.7 ac					2.40
3) Remove Exotics (.45 ac in R1)	.45 ac	x	.55		.25*
	TOTAL HABITAT UNITS				17.09
ALTERNATIVE 11					
1-3) Dredge R1 (-5.5 ft),Create Wetland& Rem. Exotics					17.09
4) Dredge R2 to –4.5 ft NGVD	12.10 ac	x	.87		10.53*
	TOTAL HABITAT UNITS				27.62
ALTERNATIVE 12					
1) Dredge R1(-5.5 ft) & R-2 (-4.5 ft)	28.70 ac	x	.87	=	24.97*
2) Create 3.2 ac Wetland R1 (1.5 ac[SE]& 1.7 ac[SW])					2.40
3) Remove Exotics R1 [.45 ac] & R2 [.55 ac])	1.00 ac	x	.55	=	.55
	TOTAL HABITAT UNITS				27.92

LEGEND NFH = North Fort Harrison (Bridge) R1 = Reach 1 (Area between NFH & PT)

* Figure Rounded PT = Pinellas Trail (Bridge) R2 = Reach 2 (Area between PT & DA)

2.1.2 INCREMENTAL ANALYSIS FOR EACH ALTERNATIVES WITH HABITAT UNITS

To provide a method for comparing the individual alternatives, an incremental analysis was used as a means of assigning environmental value and determining environmental habitat units. Numeric values from 0 to 1 were assigned by the preparer of this document after discussion with interagency team members, senior biologists, federal resource agencies, and a review of historic data and environmental reports submitted by the Corps contractor, Dial Cordy Associates, Inc. A value of 0 was assigned for little or no submerged or emergent resources, little or no benthic values, poor water quality, and little to no fish and wildlife utilization. A value of 1 was assigned for pristine habitat with little to no habitat alteration, with substantial utilization by fish and wildlife resources, in addition to, providing recreational and other public interest values. See **Table 3** which lists existing and potential values with derived habitat units, and gives the difference between existing and proposed alternative conditions. **Table 4** provides components of each alternative and their derived environmental habitat units.

2.1.3 . NO ACTION ALTERNATIVE (STATUS QUO)

A " no action" alternative would allow ecological succession to continue. Such an alternative would realize extensive sedimentation of open water habitat areas with eventual shifts in species composition and community structure. A no action alternative would further reduce area recreational values and other public interest benefits. The ability of the Stevenson Creek basin to provide drainage for a watershed of 6,286-acres would be severely impeded. Flooding potential would exponentially increase to surrounding lands. **Table 5** provides a summary of impacts associated with the " no action" alternative.

TABLE 5-NO ACTION (STATUS QUO)

Action	Ongoing Impact
Sedimentation	X
Photosynthesis	X
Fish and Wildlife	X
Benthic Organisms	X
Manatee	X
Navigation	X
Flooding	X
Water Quality	X
Seagrass	X(sediment deposition on seagrasses in harbor)
Wetland	X

2.1.4 ALTERNATIVE 1–DREDGE REACH 1 BETWEEN NFH AND PT TO –3.5 FT.

This alternative would dredge R1 between NFH (North Fort Harrison) to PT (Pinellas Trail) to a depth of –3.5 feet NGVD, to remove 80,000 cubic yards of material, primarily 56 percent muck, create a 1.5-acre wetland in R1 at elevation +1.0 ft. with dredged sand, and remove from public land .45 acre of exotics in R1.

This alternative would provide environmental benefits of 14.66 habitat units.

2.1.5 ALTERNATIVE 2 – DREDGE THALWEG OF REACH 2 (R2)

This alternative would dredge R1 to –3.5 ft, create a 1.5 acre wetland shelf in R1 (SE), create a 1.7-acre wetland shelf in R1 (SW), remove from public land .45 acre of exotics in R1, remove from public land .55 acre of exotics in R2, dredge a natural occurring thalweg in R2 between PT and DA (Douglas Avenue) to–2.5 ft. to remove from 7,500 to 10,000 cubic yards of material, primarily sand. Note: a thalweg is defined as a low are in a stream or a longitudinal outline of a riverbed from source to mouth.

This alternative would provide environmental benefits of 17.88 habitat units.

2.1.6 ALTERNATIVE 3 – DREDGE R1 AND WIDEN R1 NFH CROSS-SECTION

This alternative would dredge R1 to –3.5 ft., create a 1.5-acre wetland shelf in R1 (SE), create a 1.7-acre wetland shelf in R1 (SW), widen NFH cross-section in R1 by 135 ft. (increasing the cross-section from 115 ft. to 250 ft.)

This alternative would provide environmental benefits of 16.44 habitat units.

2.1.7 ALTERNATIVE 4 – DREDGE R1 AND THALWEG IN R2.

This alternative would dredge R1 dredging to –3.5 ft., create a 1.5 acre wetland shelf in R1 (SE), create a 1.7 acre wetland shelf in R1 (SW), widen NFH cross-section in R1 to –3.5 ft., remove from public land .45 acre of exotics in R1 and .55 acre of exotics in R2, and dredge R2 thalweg to –2.5 ft.

This alternative would provide environmental benefits of 18.06 habitat units.

2.1.8 ALTERNATIVE 5 – DREDGE R1 AND WIDEN PT CROSS SECTION IN R2.

This alternative would dredge R1 dredging to –3.5 ft., create a 1.5-acre wetland shelf in R1 (SE), create a 1.7-acre wetland shelf in R1 (SW), dredge NFH cross-section to–3.5 ft., remove from public land.45 acre of exotics in R1 and .55 acre of exotics in R2, dredge R2 thalweg, and dredge PT cross-section in R2 to –2.5 ft.

This alternative would provide 18.19 habitat units of environmental benefits.

2.1.9 ALTERNATIVE 6 – DREDGE R1 AND R2 AND WIDEN CROSS-SECTIONS.

This alternative would dredge R1 –3.5 ft., create a 1.5-acre wetland shelf in R1 (SE), create a 1.7-acre wetland shelf in R1 (SW), widen NFH cross-section in R1, widen PT cross-section in R2, remove from public land .45 acre of exotics in R1 and .55 acre in R2, dredge R2 entire area to –2.5 ft. to remove 35,000 cubic yards of material, primarily sand.

This alternative would provide 26.25 habitat units of environmental benefits.

2.1.10 ALTERNATIVE 7 – DREDGE R1, R2, AND REMOVE EXOTICS.

This alternative would dredge R1 to –3.5 ft. and R2 to –2.5 ft, widen the cross-section at NFH and PT, and remove 1.0 acre of exotics (.45 ac. & .55.ac.).

This alternative would provide 23.85 habitat units of environmental benefits.

2.1.11 ALTERNATIVE 9 - DREDGE R1 AND R2, CREATE WETLANDS SHELVES AND REMOVE EXOTICS.

This alternative would dredge R1 to –3.5 ft. to remove 80,000 cubic yards of material and dredge R2 to –2.5 ft. to remove 35,000 cubic yards of material, create a 1.5-acre wetland shelf in R1 (SE) and create a 1.7-acre wetland shelf in R1 (SW) at +1.0 ft., and remove .45 acre of exotics in R1 from public land, and remove .55 acre of exotics from R2 public lands.

This alternative would provide 25.91 habitat units of environmental benefits.

2.1.12 ALTERNATIVE 10- DREDGE R1 TO –5.5 FT NGVD.

This alternative would dredge R1 to –5.5 ft. to remove 111,000 cubic yards of material (45 percent muck and 55 percent sand), create a 1.5-acre wetland shelf in R1 (SE) from15,300 cubic yards of dredged sand, create a 1.7-acre wetland shelf in R1 (SW) from 16,500 cubic yards of dredged sand, and remove .45 acre of exotics in R1 from public land.

This alternative would provide 17.09 habitat units of environmental benefits.

2.1.13 ALTERNATIVE 11- DREDGE R1 TO –5.5 FT. AND R2 TO –4.5 FT.

This alternative would dredge R1 to –5.5 ft. to remove 111,000 cubic yards of material (45 percent muck and 55 percent sand), dredge R2 to –4.5 ft. to remove 86,300 cubic yards of material, create a 1.5-acre wetland shelf in R1 (SE) from 15,300 cubic yards of dredged sand, create a 1.7-acre wetland shelf in R1 (SW) from 16,500 cubic yards of dredged sand, and remove .45 acre of exotics in R1 from public land.

This alternative would provide 27.62 habitat units of environmental benefits.

2.1.14 ALTERNATIVE 12 – DREDGE R1 TO –5.5 FT., R2 TO –4.5 FT., CREATE WETLAND SHELVES AND REMOVE EXOTICS.

This alternative would dredge R1 to –5.5 ft. and R2 to –4.5 ft., create a 1.5-acre wetland shelf in R1 (SE), create a 1.7 acre wetland shelf in R1 (SW), remove from public land .45 acre of exotics in R1 and .55 acre of exotics in R2.

This alternative would provide 27.92 habitat units of environmental benefits.

2.2 ISSUES AND BASIS FOR CHOICE.

The preferred alternative would have the capacity to restore the biological, chemical, ecological, and physical functions necessary for the estuary to be self-sustaining system. Restoring these components would increase fish and wildlife utilization, restore benthic productivity, provide aquatic habitat, and increase velocity/flow conveyance. Secondary components would improve water quality, eliminate a source of air pollution, provide flooding relief, eliminate a source of sedimentation to seagrasses established in the receiving waters of Clearwater Harbor, and provide recreational and other public interest benefits.

Hydrodynamic modeling determined that noticeable changes in surface water elevations occurred during the lower low water tide cycles. Elevations ranged from 0.05 to 0.65 feet below existing conditions. Overall, tidal fetch within the estuary would be evident with dredging the entire area of Reach 1 and Reach 2. Velocity magnitude changes (ebb and flood) were evident with alternatives 6 and modeling Alternative 9. (Please note for purposes of data accuracy, the proposed alternatives do not include an Alternative 8. Alternatives numbering as found in the Hydrodynamic modeling report are carried throughout this document). The hydrodynamic modeling results also indicated the more efficient alternative would be Alternative 9. A more efficient tidal circulation and exchange would be achieved, in addition to, enhancing of flood conveyance 35 to 40 percent. No negative hydrodynamic impacts were identified with inclusion of a mangrove shelf at elevation +1.0-foot NGVD. (see Engineering Appendix B, Hydrodynamic Alternatives Assessment, Tables 8, 9, and 10).

The Environmental Benefits Analysis performed by Dial Cordy and Associates, Inc., November 2002, found that significant environmental benefits could be achieved with widening the cross-section at NFH and PT, dredging the complete area of R1 and dredging only the thalweg of R2, with creation of 3.2 acres of mangroves in R1 and 2.6 acres of mangroves creation in R2, and filling of existing anaerobic holes within R1. This analysis also concluded that beneficial components of the proposed action would provide refugia for juvenile shrimps and snook, detritus for the aquatic food web, favorable substrate for the recruitment of benthos, fauna, and possibly seagrass. Other identified benefits included water quality improvements, increased fishery foraging habitat, and potential seagrass improvements west of the NFH Bridge and Clearwater Harbor. This report established environmental zones that served as a reference for the identified alternatives and treatments. However, due to substantial project revisions, habitat units as evaluated were no longer applicable. The derived habitat units were extensively weighed with project components as listed above that were later removed from consideration due either to economics concerns, safety concerns, structural replacement needs, or lack of viable benefits. Measures factored in the report's environmental benefits and habitat units were later eliminated as detailed in Section 1.5.4. A copy of the Dial Cordy report can be found in Sub-Appendix F, Project Study Reports. Please note due to the report's volume, only the main text has been included. The full report with appendices can be reviewed at the Corps' Jacksonville District Office.

Given the need to re-establish environmental habitat units, the project's interdisciplinary team members, senior biologist along with Federal resource agency input agreed on values to be assigned for "future without project" and "future with project" measures and alternatives. **Table 3** lists existing and potential values with derived habitat units, and provides the differences between existing and proposed alternative conditions. **Table 6** provides a side by side ranking of the revised environmental and hydrodynamic alternatives and habitat unit.

TABLE 6 RANKING OF ENVIRONMENTAL AND HYDRODYNAMIC MODELING ALTERNATIVES BENEFITS and PROVIDED HABITAT UNITS

RANK PER HABITAT UNITS	ENVIRONMENTAL ALTERNATIVES	HABITAT UNITS	HYDRODYNAMIC MODELING BENEFITS WITHOUT ENVIRONMENTAL TREATMENT	ENVIRONMENTAL UNITS
1	Alternative 12*	27.92	Alternative 6	66.69
2	Alternative 11*	27.62	Alternative 5	63.82
3	Alternative 6	26.25	Alternative 4	63.40
4	Alternative 9	25.91	Alternative 9	45.14
5	Alternative 7	23.85	Alternative 3	43.94
6	Alternative 5	18.19	Alternative 2	41.27
7	Alternative 4	18.06	Alternative 7	41.07
8	Alternative 2	17.88	Alternative 1	34.15
9	Alternative 10*	17.09		
10	Alternative 3	16.44		
11	Alternative 1	14.66		

NOTE: Alternatives Do not Include an Alternative 8
***Expanded Alternatives 10, 11, & 12 Included**

2.3 PREFERRED ALTERNATIVE(S).

2.3.1 HYDRODYNAMIC CONVEYANCE ALTERNATIVE.

The preferred alternative identified from hydrodynamic modeling is Alternative 9. This alternative proposes dredging within Reach 1 to remove 80,000 cubic yards of muck and dredging within Reach 2 to remove 35,000 yards of sand, with creation of a mangrove shelf at elevation 1.0 foot NGVD. This alternative would increase flushing and circulation, water quality, and increase wildlife values, with improved substrate for benthos production, in addition to, providing flood conveyance improvements. The alternative would provide 69.13 habitat units/acres which include benefits to seagrasses established within Clearwater Harbor, by eliminating a source of sedimentation. This alternative would also require the least maintenance and would achieve the project goals communicated by the sponsor.

2.3.2 ENVIRONMENTAL BENEFITS ALTERNATIVE.

The preferred and least cost environmental alternative identifies Environmental Alternative 12, as providing more aquatic benefits (27.92 habitat units). This alternative would dredge R1 and R2 as outlined, create a total 3.2 acres of mangrove wetlands, and would remove a total 1.0 acre of exotics from public land in R1 and R2. Higher dredging costs appear to be associated with this alternative, but less maintenance dredging would be required given the dynamics of the system. Over time this alternative would provides more stability to bottom substrate and would help support self-sustaining functions by reducing sedimentation and improving water quality. This alternative would also meet the goals and objectives of the sponsor.

Nursery grown (3 to 5 gallon container species) or approved donor species of red and black mangroves are proposed for planting on 3-foot centers over the identified 3.2 acres. A total quantity of 4,840 plants would be achieved. The projected cost of mangrove planting with removal of approximately 1.0 acre of invasive (nuisance and exotic) species from the areas immediate adjacent the NFH, PT, and DA bridges shoreline would cost from $50k to $62K in 2002 dollars. Shoreline planting (as identified in the Preliminary Restoration Report, October 2000) could include brackish tolerant species such as black needlerush, leather fern, and bulrush planted on 2-foot centers over the 3.2 acres at slightly higher elevations (00.0 ft. to -0.5 ft.). A minimum planting of 10,840 plants could be achieved over the 3.2 acres. **Table 7** provides a more complete list of vegetative planting in the freshwater, brackish water, and saltwater environments existing in the project area.

Onsite hydrocyclone processing of dredged material would take place at the proposed temporary disposal and staging area. Sand secured from this process, approximately 31,800 cubic yards would be used to create wetland shelves as outlined previously. Muck from the separation process, approximately 94,500 cubic yards would be pumped to geotechnical bags for drying. Once dried, the material would be transported to a permanent disposal site is located exactly 21.6 miles (from the project area) in neighboring Hillsborough County. This site is a 444-acre parcel owned by the City of Clearwater. The site was once used for the disposal of wastewater sludge from 1984 to 1991. The more direct route to the permanent disposal site is via 1.9 miles of 2-lane residential roads, 15 miles of 4-lane urban/suburban highway, 3.8 miles of a 2-lane suburban road, and .8 mile of a secondary 2-lane suburban/rural road. Residents located along the 2-lane roadways would require notification of heavy vehicles commuting requirements during construction hours.

TABLE 7: VEGETATION PLANTING AT VARYING DEPTHS

VEGETATION		PLANTING ELEVATION (IN FEET TO MLW)			
SCIENTIFIC NAMES	COMMON NAMES	>0.0	0.0 to -.05	-0.5 to -1.0	-1.0 to -2.5
TREES					
Acer rubrum	Red Maple	X	X		
Avicennia germinans **	Black Mangrove			X	
Rhizophora mangle **	Red mangrove			X	
Taxodium spp.	Cypress		X	X	
SHRUBS					
Cephalanthus occidentalis	Button bush		X	X	
HERBACEOUS					
Acrostichum aureum *	Golden/Leather fern		X		
Juncus roemerianus **	Black needlerush		X		
Scirpus validus	Bulrush			X	X

*Indicates tolerance of brackish water (5.0 to 7.5 ppt)

**Indicates tolerance of salt water (7.8 to 26.6 ppt)

2.4 ALTERNATIVES FURTHER ELIMINATED FROM DETAILED EVALUATION

Alternatives were eliminated which failed to provide the necessary conveyance, environmental benefits, and national economic development contributions. The eliminated alternatives are listed below.

2.4.1 WIDENING THE CROSS-SECTION AT THE NORTH FORT HARRISON BRIDGE AND PINELLAS TRAIL BRIDGE.

Only nominal circulation improvements would be achieved as determined in the hydrodynamic modeling conducted over a 14-day tidal cycle. Environmental benefits were negligible and costs associated with the alternatives were cost prohibited for benefits that would be received. Additionally, the sponsor desired a more cost effective alternative which stayed within projected and allocated cost communicated during the scoping and preliminary project phase.

2.4.2 DREDGING ONLY THE THALWEG OF REACH 2 (R2).

Environmental analysis conducted by Dial Cordy (2002) indicated limited to no aquatic improvement from dredging of only the thalweg area in R2. Environment benefit could only be realized with habitat creation in R2 and backfilling of existing waterway holes. Elimination of this alternative did not impact negatively on conveyance capacity and circulation desired for the estuary. Creation of mangrove island habitat in R2 between Douglas Avenue and Pinellas Trail could possibly create unfavorable navigation conditions and hazards to recreational users of the waterway. This alternative would also require periodic maintenance dredging to maintain project velocity and circulation patterns. The sponsor also desired a project whose secondary components would alleviate flooding conditions and enhanced navigation.

2.4.3 BACKFILLING ESTUARY HOLES IN THE NFH AREA.

This alternative would eliminate habitat currently utilized by fishery species and was not considered an aquatic or environmental preferred alternative.

2.4.4 CREATION OF MANGROVE WETLANDS WITHIN REACH 2.

The creation of mangrove wetland within R2 would have desirable environmental benefits. The benefits included stabilizing creek banks, creating EFH areas, leaving existing sandflats in place, providing detritus input to the food web, providing a substrate for young shrimp, crabs, small fishes, worms, filter-feeding oysters and clams, in addition to providing attachment area for small invertebrate animals and microscopic organisms, habitat for nesting birds, and tidally inundated foraging areas for fishery species. However, this alternative would increase construction and maintenance costs and was not an alternative supported by the sponsor.

2.5 ALTERNATIVES NOT WITHIN JURISDICTION OF LEAD AGENCY

a. Creek bank stabilization in Spring Branch to remove a source of major source of sedimentation to the estuary.

b. Culverts replacement needed within the Creek's watershed.

c. Construction of offline treatment facilities within drainage sub basins.

d. Forming community awareness outreach programs to inform of environmental issues.

e. Providing needed flood relief to 237 structures within the creek's 100 - year flood plain.

f. Dredging of navigation channel for larger draft vessels.

2.6 COMPARISON OF ALTERNATIVES

Table 8 lists considered alternatives and summarizes the major features and consequences of the proposed (direct and indirect impacts) actions and alternatives. See section 4.0 Environmental Effects for a more detailed discussion of impacts of alternatives.

2.7 MITIGATION

Mitigation is not a component of the project. The project would restore a declining estuary to a self-sustaining system. Wetland habitat creation of 3.2 acres is a component but is not provided as mitigation to offset project related impacts.

3. AFFECTED ENVIRONMENT

3.1 GENERAL ENVIRONMENTAL SETTING.

The Affected Environment section succinctly describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section, in conjunction with the description of the "no-action" alternative forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives (see **Table 8** for a summary of direct and indirect project-related impacts).

3.1.1 STEVENSON CREEK ESTUARY.

Stevenson Creek is a 39-acre tidally influenced waterbody. Environmental restoration would affect 29 acres of the estuary from west of the North Fort Harrison Bridge to west of the Douglas Avenue Bridge. Salinity levels vary from 15.49 ppt (part per thousand) to 14.55 ppt to the Douglas Avenue Bridge east of the Pinellas Trail Bridge. Spring Branch the major tributary to the creek has salinity levels that vary from 26.10 ppt to 15.19 ppt.

According to the U.S. Fish and Wildlife Service *Classification of Wetlands and Deepwater Habitats of the United States*, December 1979, Stevenson Creek is classified as an estuarine system with an intertidal subsystem. The water regime is regularly flooded with a mixohaline water chemistry. The Florida Department of Environmental Protection (FDEP) 1993 Surface Water Quality Standards Chapter 17-302.520(3)(e), classify the creek as a marine system. The mouth of the estuary is located about 500 feet from the nearest seagrass beds in Clearwater Harbor and about 1,900 feet from the near edge of the Intracoastal Waterway (IWW) in the Harbor.

A review of historic aerial photographs showed that substantial sediment accumulation in the estuary began to appear within the last 35 years.

Sediments depth range from 0-31 centimeters (cm) east of the Pinellas Trail Bridge (PTB), 0-52 cm west of the PTB, 0-63 cm in the central area of the North Fort Harrison Bridge (NFHB), and 0-89 cm immediately east of the NFH Bridge crossing. Water and sediment studies indicated trace amounts of arsenic, barium, cadmium, chromium, nickel, selenium, and zinc, in addition to, elevated levels of lead, copper, iron, and mercury.

3.1.2 TEMPORARY DEWATERING SITE.

The temporary dewatering site is located near the southwest corner of Overbrook Drive and Pineland Drive, and east of Stevenson Creek (see Figure 2 – Disposal Site Location Map). Identified as the Wolf Property, this parcel contains approximately 8 acres which include 2 acres of a remnant coastal upland hammock. The remaining acreage following the contour of the western shoreline is comprised of black mangroves (*Avicennia germinans*) and red mangroves (*Laguncularia racemosa*). Saltmarsh and openwater are found waterward of the mangroves. Sand fill berms approximately 15 feet in elevation are found to the east. A hardwood oak hammock with nuisance and exotic species of ear tree (*Enterolobium contortisiliquum*), lead tree (*Leucaena leucocephala*), Caesar weed (*Urena lobata*), castor bean (*Ricinus communis*), beggar's tick (*Biden pilosa*), Australian Pine (*Casuarina equisetifolia*), Brazilian pepper (*Schinus terebinthifolius*), and unidentified noxious weeds are also found at the temporary dewatering site. See **Table 9** for a complete list of invasive, exotic, or prohibited plant species occurring at the Temporary dewatering site. This area also contains saw palmetto (*Serenoa repens*), cat briar (*Smilax bona-nox*), and wild grape (*Vitis sp.*). East of the berms is a 4-acre parcel that supports an auto-salvage yard.

The Wolfe property is undeveloped but has been filled with construction debris and other similar materials. Some dredged sand berms leftover from the dredging of Stevenson Creek in the 1960's or 1970's still remain on the property. Aerial photographs from 1954 to 1996 indicated the presence of the auto salvage yard east of the Wolfe parcel. Apparent extension of the auto salvage yard onto the Wolfe property appears in both a 1979 and 1984 photograph. A later 1994 photograph shows no evidence of the extension (Post, Buckley, Schuh & Jernigan 2002).

TABLE 8 SUMMARY OF DIRECT AND INDIRECT PROJECT IMPACTS

	ALT 0	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5
Environment Factors	**No Action**	**X1**	**X1a X2a**	**X1a W1**	**X1a X2a W1**	**X1a X2a W1 W2**
Protected Species	a. Manatee access limited to only North Fort Harrison during high tide cycles b Attempts to access at any other time may require relief efforts	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb.	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. 3.2 ac. mangrove wetland provide secondary food source for manatee foraging & provide detritus to aquatic foodweb d. R2 Manatee access limited to area of thalweg with potential boating impacts	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb d. R2 Manatee access imited to area of thalweg with potential boating impacts	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. . 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb d. R2 Manatee access imited to area of thalweg with potential boating impacts
Vegetation	Exotics would continue to proliferate and out-compete native species	Potential temporary indirect impacts to submerged aquatic resources (SAV) inHarbor from turbidity and sediments suspension during dredging	Potential temp. & indirect impact to SAVs in Harbor from temp sediment suspension .45 ac of exotics removal from R1 helps control exotics that out- compete native species	Temp indirect. Impacts to SAV in Harbor from proj suspension. 1 ac. of exotics removal helps control exotics that out compete native species. Creation of 3.2 ac of Wtlnd provide additional forgage area and adds to marine foodweb	Temp indirect. Impacts to SAV in Harbor from proj turbidity 1 ac. of exotics removal helps the survial of native species. Creation of 3.2 ac of Wtlnd provide additional forgage area and adds to marine foodweb	Temp indirect. Impacts to SAV in Harbor from proj turbidity. 1 ac. of exotics removal helps the survial of native species. Creation of 3.2 ac of Wtlnd provide additional forgage area and adds to marine foodweb
Hardground	No Impact	Adverse impacts to shellfish areas and resources Approx.16 ac. .	Adverse impacts to shellfish area and resources, Approx 16 ac 3.2 acre wetland creation may offset shor-tterm impacts over 6 mo to 1 yr and provide growing and collection areas	Adverse impacts to shellfish area and resources, Approx 16 ac 3.2 acre wetland creation may offset short-term impacts over 6 mo to 1 yr and provide growing and collection areas.	Adverse impacts to shellfish area and resources, Approx 16 ac 3.2 acre wetland creation may offset short-term impacts over 6 mo to 1 yr and provide growing and collection areas.	Adverse impacts to shellfish area and resources, Approx 16 ac 3.2 acre wetland creation may offset shortterm impacts over areas 6 mo to 1 yr and provide growing and collection areas.

TABLE 8 SUMMARY OF DIRECT AND INDIRECT PROJECT IMPACTS

	ALT 0	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5
Environment Factors	No Action	X1	X1a X2a	X1a, W1	X1a X2a W1	X1a X2a W1 W2
Fish and Wildlife Resources	Ongoing Decline and loss of habitat and diversity	Temporary impact to bottom substrate and Decline in oxygen levels from sediment suspensio n during dredging	Temporary dredging impacts from reduced oxy., Noise, disturbed habitat and foraging areas Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetlnd	Temporary dredging impacts from reduced oxy., Noise, disturbed habitat and foraging areas Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetland	Temporary dredging impacts from reduced oxy., Noise, disturbed habitat and foraging areas Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetland	Temporary dredging impacts from reduced oxy., Noise, disturbed habitat and foraging areas Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetland
Water Quality	Continued Declined	Temporary impacts from turbidity during dredging	Temp impacts during dredging Improvements to water qual from increased flushing, water clarity, light penetration to photic zone increase oxyg overall benefits to bio, physical & chemical characteristics 3.2-ac wetland creation enhances water quality	Temp impacts during dredging Improvements to water qualityfrom increased flushing, water clarity, light penetration to photic zone increase oxygen benefits to overall bio, physical & chemical characteristicsr 3.2-acre wetland creation also enhances water quality	Temp impacts during dredging Improvements to water qualityfrom increased flushing, water clarity, light penetration to photic zone increase oxygen benefits to overall bio, physical & chemical characteristicsr 3.2-acre wetland creation enhances water quality	Temp impacts during dredging Improvements to water qualityfrom increased flushing, water clarity, light penetration to photic zone increase oxygen benefits to overall bio, physical & chemical characteristicsr 3.2 acre-wetland creation enhances water quality
Essential Fish Habitat	No Impact	Impacts to benthic substrate in R1 and artifical reef created from past ship wrecks	Impacts benthic substrate in R1 and artifical reef created from past ship wrecks	Impact benthics substrate in R1 and artifical reef created from past ship wrecks, with over 3 ac of impact in R2 from thalweg Dredging 3.2 ac wetland creation will contribute to EFH foodweb,production and habitat	Impacts benthic substrate in R1 and artifical reef created from past ship wrecks with over 3 ac of impact in R2 from thalweg Dredging 3.2 ac wetland creation will contribute to EFH foodweb,production and habitat	Impacts benthic substrate in R1 and artifical reef created from past ship wrecks with over 3 ac of impact in R2 from thalweg Dredging 3.2 ac wetland creation will contribute to EFH foodweb,production and habitat

TABLE 8 SUMMARY OF DIRECT AND INDIRECT PROJECT IMPACTS

	ALT 0	ALT 1	ALT 2	ALT 3	ALT 4	ALT 5
Environment Factors	**No Action**	**X1**	**X1a X2a**	**X1a, W1**	**X1a X2a W1**	**X1a X2a W1 W2**
Historic Properties	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Navigation	Continued impact limiting boating access to periods of high tides cycles	Benefits to General navigation Vessel access won't be limited to high tide cycles	Benefits to General navigation Vessel access not limited to high tide cycles	Benefits to General navigation Vessel access not limited to high tide cycles	Benefits to General navigation Vessel access not limited to high tide cycles	Benefits to General navigation Vessel access not limited to high tide cycles
Hazardous Toxic and Radioactive Wastes (HTRWs)	No Impact	Potential release of metals (lead copper & ,mercury) contained in muck sediments	Potential release of metals (lead copper &,mercury) contained in muck sediments	Potential release of metals (lead copper &,mercury) contained in muck sediments	Potential release of metals (lead copper &,mercury) contained in muck sediments	Potential release of metals (lead copper &,mercury) contained in muck sediments
Air Quality	No Impact	Possible contributor to poor air quality removed with organics contained in muck substrate	Possible contributor to poor air quality removed with organics contained in muck substrate	Possible contributor to poor air quality removed with organics contained in muck substrate	Possible contributor to poor air quality removed with organics contained in muck substrate	Potential contributor to air quality decline removed with organics contained in muck substrate

LEGEND
- NFH(B) = North Fort Harrison (Bridge)
- PT(B) = Pinellas Trail (Bridge)
- DA(B) = Douglas Ave. (Bridge)
- R1 = Reach 1 Area between NFH and PT
- R2 = Reach 2 Area between PT and DA
- X1a = Deepen R1 entire area to –3.5 ft NGVD, Create 3.2 ac. of mangrove shelves (1.5 ac. R1 [SE] &1.7 ac. R1 [SW]) and Remove .45 ac. exotics from R1
- X1b = Deepen R1 to 3.5 ft NGVD without wetland shelves
- X2a = Deepen R2 Thalweg only to –2.5 ft. NGVD, Create 3.2 ac. mangrove Wetland shelves, Remove 0.45 ac. of Exotics from R1and .55 ac. from R2
- X2b = Deepen R2 entrie area to –2.5 ft NGVD, Create 3.2 ac. of mangrove wetland shelves, remove 0.45 ac. of exotics from R1 and .55 ac. from R2
- X3a = Deepen R1 entire area to –5.5 ft. NGVD, Create 3.2 ac of mangove shelves (1.5 ac. R1 [SE] & 1.7 ac R1 [SW}), remove ..45 ac. of exotics from R1.
- X3b = Deepen R1 and deepen R2 entire area to –4.5 ft. NGVD, create 3.2 ac of mangrove Shelves (1.5 ac. at R1 [SE] & 1.7 ac. at R1 [SW]) & remove .45 ac of exotics from R1
- X4 = Deepen R1 to –5.5 ft NGVD and R2 to –4.5 ft NGVD, Create 3.2 ac of mangrove Shelves (1.5 ac R1[SE] & 1.7 ac R2 {SW]), remove 1 ac. of exotic (.45 ac (R1) and .55 ac [R2]).
- W1 = Increase NFH Cross-Section width by 135 ft. (from 115 ft to 250 ft)
- W2 = Increase PT Cross-Section width by 115 ft (from 117 ft to 232 ft)

NOTE: Alternatives do not include an Alternative 8I

TABLE 8 SUMMARY OF DIRECT AND INDIRECT PROJECT IMPACTS

	ALT 0	ALT 6	ALT 7	ALT 9	ALT 10	ALT 11
ENVIRONMENT **Factors**	**No Action**	X1a X2b W1 W2	X1b X2b W1 W2	X1a X2b	X3a	X3a X4a
Protected Species	Manatee access limited to only North Fort Harrison during high tide cycles Attempts to access any other time may require relief efforts	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. . 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb d. R2 Manatee access obstructed	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. . 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb d. R2 Manatee access obstructed	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. . 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb d. R2 Manatee access obstructed	a. Possible impacts to manatee during dredging b. R1 Dredge depth –5.5 ft limits manatee access to NFH c. . 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb	a. Possible impact to manatee during dredging b. R1 Dredge depth –3.5 ft limits manatee access to NFH c. . 3.2 ac. mangrove wetland provide secondary food source, foraging, & detritus to foodweb d. R2 Manatee access obstructed
Vegetation	Exotics would continue to proliferate and out-compete native species	Potential temporary indirect impacts to submerged aquatic resources (SAV) inHarbor from turbidity and sediments suspension during Dredging Creates 3.2 ac of Mangrove Wetland	Potential temp.& indirect impact to SAVs in Harbor from sediment suspension Remove 1 ac of exotics which out compete native species	Potential temp.& indirect impact to SAVs in Harbor from sediment suspension Creates 3.2 ac of mangrove wetland and Remove 1 ac of exotics which out compete native species	Potential Temp & indirect. Impacts to SAV in Harbor from project' s. turbidity Remove .45 ac.of Create 3.2 ac of wtlnd to marine foodweb	Potential Temp & indirect. Impacts to SAV in Harbor from project' s. turbidity Remove .45 ac.of Exotics Create 3.2 ac of wetland to marine foodweb
Hardground	No Impact	Adverse impacts to shellfish areas and resources Approx.16 ac.in R1 .	Adverse impacts to shellfish area and resources, Approx 16 ac,R1 3.2 acre wetland creation some benfits over time	Adverse impacts to shellfish area and resources, Approx 16 ac,R1 3.2 acre wetland creation may enhance production short-term impacts over 6 mo to 1 yr	Adverse impacts to shellfish area and resources, Approx 16 ac, R1 3.2 ac wetland creation may enhance production	Adverse impacts to shellfish area and resources, Approx 16 ac R1 3.2 ac wetland creation may enhance production

TABLE 8 SUMMARY OF DIRECT AND INDIRECT PROJECT IMPACTS

	ALT 0	ALT 6	ALT 7	ALT 9	ALT 10	ALT 11
ENV. Factors	No Action	X1a X2b W1 W2	X1b X2b W1 W2	X1a X2b	X3a	X3a X4a
Fish and Wildlife Resources	Ongoing Decline and loss of habitat and diversity	Temporary dredging impacts from reduced oxygen, Noise, disturbed habitat and foraging areas & Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetlnd	Temporary dredging impacts from reduced oxygen, Noise, disturbed habitat and foraging areas & Potential Uptake of released metals	Temporary dredging impacts from reduced oxygen, Noise, disturbed habitat and foraging areas & Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetland	Temporary dredging impacts from reduced oxygen, Noise, disturbed habitat and foraging areas & Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetland	Temporary dredging impacts from reduced oxygen, Noise, disturbed habitat and foraging areas & Potential Uptake of released metals Benefits to Food web from 3.2 ac of created wetland
Water Quality	Continued Declined	Improvements to with removal of Sediments and 3.2 creation of wetland	Improvements to with removal of Sediments and 3.2 creation of wetland	Improvements to with removal of Sediments and 3.2 creation of wetland	Improvements to with removal of Sediments and 3.2 creation of wetland	Improvements to with removal of Sediments and 3.2 creation of wetland
Essential Fish Habitat	No Impact	Adverely impact artificial created from wrecked ships, eliminates sand and mud flats, eliminates shellfish area 3.2 acres of created wetland overtime will enhance shellfish Habitat & production	Adverely impact artificial created from wrecked ships, eliminates sand and mud flats, eliminates shellfish area 3,2 acres of created wetland overtime will enhance shellfish Habitat & production	Adverely impact artificial created from wrecked ships, eliminates sand and mud flats, eliminates shellfish area 3,2 acres of created wetland overtime will enhance shellfish Habitat & production	Adverely impact artificial created from wrecked ships, eliminates sand and mud flats, eliminates shellfish area 3,2 acres of created wetland overtime will enhance shellfish Habitat & production	Adverely impact artificial created from wrecked ships, eliminates sand and mud flats, eliminates shellfish area 3,2 acres of created wetland overtime will enhance shellfish Habitat & production
Historic Property	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Navigation	Continued Access during period of High Tides	Improvement to general navigation. safety and access	Improvement to general navigation. safety and access	Improvement to general navigation. safety and access	Improvement to general navigation. safety and access	Improvement to general navigation. safety and boat access
HTRW		Possible suspension of contaminants and pollutnts at East DA	Possible suspension of contaminants and pollutnts at East DA	Possible suspension of contaminants and pollutnts at East DA	Possible suspension of contaminants and pollutnts at East DA	Possible suspension of contaminants and pollutnts at EA
Air Quality		Possible Benefits with organics removal	Possible Benefits with organics removal	Possible Benefits with organics removal	Possible Benefits with organics removal	Possible Benefits with organics removal

TABLE 8 SUMMARY OF DIRECT AND INDIRECT PROJECT IMPACTS

	ALT 0	ALT 12		ALT 0	ALT 12
	No Action	X3b X4a		No Action	X3b X4a
Protected Species	Manatee access limited to only the area of North Fort Harrison at high tides	Possible impact to manatee during dredging Access to R1 habitat and foraging areas and R2 warm and freshwater at Marshall St. Treatment Plant 3.2 ac forgage provided with 3.2 acres of wtland	Essential Fish Habitat	No Impact	Adverely impact artificial reef created from wrecked ships, impacts to sand and mud flats, eliminates shellfish area
Vegetation	Exotics would continue to proliferate and out-compete native species	Potential Temp & indirect. Impacts to SAV in Harbor from project' s. turbidity Remove .45 ac.of Exotics Create 3.2 ac of wetland to marine foodweb	Historic Property	No Impact	No Impact
Hardground	No Impact	Adverse impacts to shellfish area and resources, Approx 16 ac, R1 3.2 acre wetland eventual enhance growth	Navigation	Improvement to gen nav. safety and boating access	Improvement to gen nav. safety and boating access
Water Quality	Continued Declined	Temporary impacts during dredging Improvements to water quality from increased flushing, water clarity, light penetration to photic zone, increased oxygen Benefits wo overall bio, phsical, chemical characteristics 3.2 acre wetland creation also enhances quality	HTRW	No Impact	Possible suspension of contaminants and pollutnts
Essential Fish Habitat	No Impact		Air Quality	No Impact	Possible Benefits with organics removal

LEGEND

- NFH(B) = North Fort Harrison (Bridge)
- PT(B) = Pinellas Trail (Bridge)
- DA(B) = Douglas Ave. (Bridge)
- R1 = Reach 1 Area between NFH and PT
- R2 = Reach 2 Area between PT and DA
- X1a = Deepen R1 entire area to –3.5 ft NGVD, Create 3.2 ac. of mangrove shelves (1.5 ac. R1 [SE] &1.7 ac. R1 [SW]) and Remove .45 ac. exotics from R1
- X1b = Deepen R1 to 3.5 ft NGVD without wetland shelves
- X2a = Deepen R2 Thalweg only to –2.5 ft. NGVD, Create 3.2 ac. mangrove Wetland shelves, Remove 0.45 ac. of Exotics from R1and .55 ac. from R2
- X2b = Deepen R2 entrie area to –2.5 ft NGVD, Create 3.2 ac. of mangrove wetland shelves, remove 0.45 ac. of exotics from R1 and .55 ac. from R2
- X3a = Deepen R1 entire area to –5.5 ft. NGVD, Create 3.2 ac of mangove shelves (1.5 ac. R1 [SE] & 1.7 ac R1 [SW}), remove ..45 ac. of exotics from R1.
- X3b = Deepen R1 and deepen R2 entire area to –4.5 ft. NGVD, create 3.2 ac of mangrove Shelves (1.5 ac. at R1 [SE] & 1.7 ac. at R1 [SW]) & remove .45 ac of exotics from R1
- X4 = Deepen R1 to –5.5 ft NGVD and R2 to –4.5 ft NGVD, Create 3.2 ac of mangrove Shelves (1.5 ac R1[SE] & 1.7 ac R2 {SW]), remove 1 ac. of exotic (.45 ac (R1) and .55 ac [R2]).

NOTE: Alternatives do not include an Alternative 8

TABLE 9 **INVASIVE SPECIES OCCURRING AT TEMPORARY DEWATERING SITE**

SCIENTIC NAME	COMMON NAME	SPECIAL HANDLING REQUIRED YES	NO
Biden pilosa	Beggar's tick		X
Casuarina equisetifolia	Australian Pine	X	
Enterolobium contortisiliquum	ear tree		X
Leucaena leucocephala	Lead tree		X
Ricinus communis	*Castor bean*		X
Schinus terebinthifolius	Brazilian pepper	X	
Serenoa repens	Saw palmetto		X
Urena lobata	Caesar weed	X	
Vitis sp	Wild grape		X

NOTE: Plants that require special handling are State prohibitive species, DEP permit required for handling, treatment, removal, and disposal

3.1.3 PERMANENT DISPOSAL SITE.

Approximately 20 acres within a 400-acre parcel were identified for permanent placement of dredged material (primarily muck) from the project area. This area is located about 21.5 miles from Stevenson Creek within Hillsborough County, about 1 mile south of Highway 582 (Lake Fern/Tarpon Springs Road) and 6 miles from the City of Tarpon Springs (**Figure 3**, Permanent Disposal Site Location Map). No jurisdictional wetlands exist within the parcel identified for placement of dredged material. The disposal area is about 50 feet from the canopy and understory associated of existing wetlands (Dial Cordy 2002). Past use of the area has been by the City of Clearwater as a depository for municipal sludge. This action concluded in 1991.

The primary use of the area is currently as pasture for cattle and horses. The surrounding area is agricultural/rural and is presently experiencing developmental pressures. Soils underlying the disposal area are Zolof fine sand, Myakka fine sands and Pomello fine sands. The soils range from poorly drained to moderately well drained. The Zolfo series sands comprise the majority of the substrate under the disposal area. Where sludge was deposited, native soils are found only inches below the surface (Dial Cordy). (see Appendix F, Study Report, Dial Cordy 2002). The dominant plant species in the proposed permanent disposal site were various grasses (*Digitria sp*), sedges (*Cyperus sp*), Thoroughwort (*Eupatorium sp*), (*Lippia nodiflora*) and (*Ambrosia sp)*.

3.2 VEGETATION.

3.2.1 STEVENSON CREEK ESTUARY.

Mangrove wetlands and some exotics (Australian pine and Brazilian pepper) exist along the eastern banks of the creek from North Fort Harrison to west of the Pinellas Trail Bridge. See Table 18A for a listing of vegetation observed within the project area.

3.2.2 TEMPORARY DEWATERING SITE.

A remnant hardwood system with exotics and nuisance species exist to the east with mangrove wetland established along the bank. A more exhaustive listing of vegetation occurring at the Temporary dewatering site can be found at 3.1.2.

3.2.3 PERMANENT DISPOSAL SITE.

Jurisdictional wetlands are located 50 to 100 feet from the proposed permanent disposal site. Wetlands are not in the area proposed for material disposal. See 3.1.3 for a list of vegetation observed at the Permanent Disposal Site.

3.3 THREATENED AND ENDANGERED SPECIES SEA TURTLES.

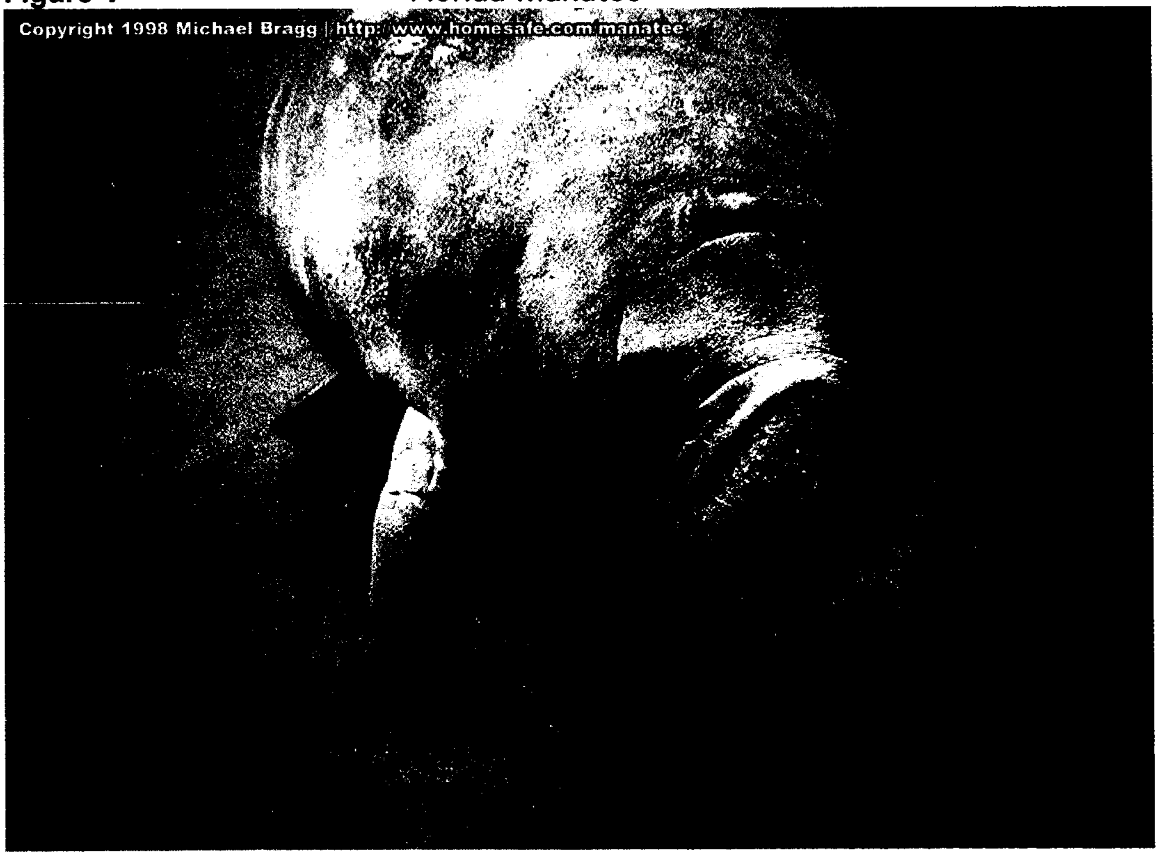
3.3.1 SEA TURTLES.

The estuary does not support sea turtle habitat or nesting areas.

3.3.2 MANATEE.

The endangered West Indian manatee (*Trichechus manatus*) **(see Figure 7)** is occasionally observed within the area of NFH. Manatee warning signs are also posted in this area. During winter months manatee travel seeking warm-water refugia and are known to travel the waters of the Intracoastal Waterway (IWW). The near edge of the IWW is about 1,200 feet from the NFH Bridge. The project area is also located north of Citrus County (Crystal River and Homosassa Springs) and south of Hillborough County (TECO Port Sutton Plant and TECO Big Bend Power) places usually used by manatees as winter aggregation areas.

Figure 7 Florida Manatee



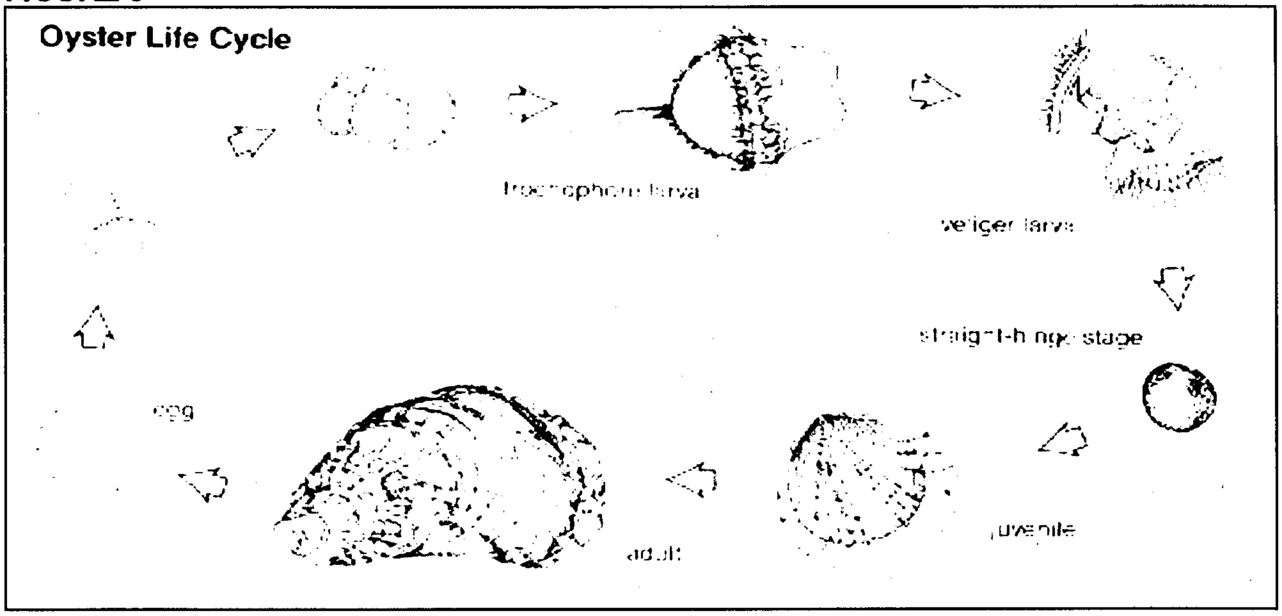
3.4 HARDGROUNDS.

Surveys conducted in the area do not record occurrences of rock outcrop, worm rock, or coral reefs in the project area. The bottom substrate of the areas proposed for dredging consists primarily of muck and sand (16 acres) and a sparse coverage of oysters. A typical life cycle of the oyster is shown in **Figure 8.**

3.5 FISH AND WILDLIFE RESOURCES

Benthic infauna occupies the soft bottom substrates of mostly sand, mud, and silt. Fauna within these communities are several taxa of polychaetes, oligochaetes, mollusks, sipunculans, peracarid crustaceans, platyhelminthes, and nemerteans. Other frequent occupants of these habitats include demersal fish (e.g.: flounders) bivalves, decapods crustaceans, and shrimp.

FIGURE 8



Source: http://www.csc.noaa.gov/scoysters/html/links.htm

3.6 FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act of 1996 requires the identification of Essential Fish Habitat (EFH) for Federally managed fishery species in the nation' s marine and estuarine environments. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The Gulf of Mexico Fisheries Management Council (GMFMC 1998) designate unvegetated bottom and water column areas within the study areas as EFH, in compliance with the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 18011882), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). Managed species that commonly inhabit the project study area are shown in **Table 10.**

TABLE10 Managed Species Commonly Occurring within the Project Area

Common Name	Scientific Name
Juvenile Red Snapper	*Lutjanus campechanus*
Cobia	*Rachycentron canadum*
King mackerel	*Scomberomorus cavalla*
Bluefish	*Pomatomus saltatrix*
Dolphin	*Coryphaena hippurus*
Red Drum	*Sciaenops ocellatus*
Brown Shrimp	*Penaeus aztecus*
Pink Shrimp	*P. duorarum*
White Shrimp	*P. setiferus*

Source: Gulf of Mexico Fisheries Management Council 1998/9

The Gulf of Mexico in this region also provides essential forage, cover, and nursery habitats for other species that are important to the commercial and recreational fishing industries. These species include the blue crab (*Callinectes sapidus*), flounder (*Syacium caprinus*), and dwarf goatfish (*Upeneus parvus*) (Hammer, et. Al 2000). A summary of managed species and their seasonal occurrence within the area is shown in **Table 11**, Species Managed by the Gulf of Mexico Fishery Management Council.

Table 11 Species Managed by the Gulf of Mexico Fishery Management Council

Species	Seasonal Occurrence	Habitat Affinity
Brown Shrimp(Penaeus aztecus)	Adults – Year Round	Soft Bottom
Pink Shrimp(Penaeus duorarum)	Adults – Year Round	Soft Bottom
White Shrimp(Penaeus setiferus)	Adults - Year Round	Soft Bottom
Stone Crab(Meninne mercineria)	Adults - Year Round	Soft Bottom
Gag (Mycteronerca microlenis)	Adults - Year Round	Hard Bottom
Scamp (Mycteronerca nhenax)	Adults - Year Round	Hard Bottom
Cobia (Rachycentron canadum)	Adults - Year Round	Water Column
Red Drum (Sciaenons ocellatus)	Adults - Year Round Spawning – Fall and Winter	Soft Bottom
Greater Amberjack (Seriola dumerilli)	Adults - Year Round	Hard Bottom
Red Snapper (Lutianus campechanus)	Juveniles – Year Round	Soft Bottom
Lane Snapper (Lutianus synagris)	Adults – Year Round	Hard Bottom
King Mackerel (Scomberomorous cavalla)	Adults – Year Round	Water Column
Spanish Mackerel (Scomberomorous maculates)	Adults – Year Round	Water Column

Source: Gulf of Mexico Fishery Management Council 1998.

3.7 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW).

Water and sediments studies were conducted to determine the presence of priority pollutants. Sediments were analyzed for arsenic, cadmium, chromium, iron, nickel, lead, mercury, and organic priority pollutants. Standard elutriate tests were conducted for priority pollutants. Representative sediments were obtained in area of muck at 3-foot thickness resting on top of sandy bottom substrates. Test results indicated a detectable concentration of cadium, chromium, copper, lead, nickel, and iron. However, the concentrations were below background and not toxic or contaminant. Contaminants are chemical constituents of soil, water, air, or tissue that are considered to have originated from anthropogenic (human) sources and are above natural background in concentrations likely to exceed published standards.

An assessment of sediment quality in the Stevenson Creek estuary was prepared for the Board of Commissioners, City of Clearwater (Mayer 1996). This report indicates that contaminants are carried into the system by stormwaters. The City of Clearwater proposes major improvements within the watershed of Stevenson Creek which would substantially treat and improve stormwaters before their release into Stevenson Creek.

3.8 COASTAL BARRIER RESOURCES

The project proposes no direct or indirect impact to these resources. Barrier islands are located approximately 13,000 feet or more northwest of the project site.

3.9 WATER QUALITY

Area waters are listed by the State of Florida as Class III, Recreational. Stevenson Creek is also included on Florida's list of impaired waters {303(d) List} due to concerns over dissolved oxygen, coliforms, and nutrients (Parson 2001).

Preliminary bacterial source tracking (Harwood Oct. 2000) was performed to identify the source of fecal coliforms (e.g., human, dog, wild animal) found in Stevenson Creek. Five sites with high levels of input to the Creek's waters were monitored from June to December 2000 (during dry conditions).

a. golf course located on the main branch of Stevenson Creek (Comp1)
b. Spring Branch off King Highway (Comp2)
c. Spring Branch (STC1)
d. Hammond's Branch (STC2)
e. Evergreen Avenue (STC5)

This preliminary analysis found that during most months (June – Sept.) wild animal isolates dominated the majority of the sites, with exception of September. During this month, at least 60 percent of the isolates were identified as human. Spring Branch (STC1) was the most consistently impacted by human pollution, showing significant human contamination (25% or more of isolates) at three of the four monitoring events, and had the highest mean percentage of human isolates from June to September (Harwood 2000).

Bacterial monitoring continued until December 2000 found wild animals to be the predominant contributors to fecal contamination marked by elevated fecal coliform levels. Small populations of human isolates were found, suggesting that human sources contribute to low-level background contamination. There was little evidence of acute human fecal contamination on a large scale across the five sites examined. However, there was considerable human source influencing monitoring Stations STC1 (Spring Branch) and STC2 (Hammond Branch). These sites were impacted by human fecal sources with the highest frequency and magnitude of the five sites. Human fecal coliforms densities were 11,400 CFU (colony forming units/100ml for STC1 and 2,400 human CFU/100ml for STC2, exceeding the limit of 200CFU/100ml (Harwood 2001). (see Sub-Appendix F, Project Study Reports)

Metal detected in the Stevenson Creek surface waters included aluminum, barium copper, lead and zinc. Aluminum, lead, and zinc are common for urban development. Other metals were either below water quality standard or not detected. Sediments did not contain hazardous materials. One semi-volatile constituent (Benzo(a)pyrene) was detected at a concentration of 0.1 mg/kg, and hydrocarbon which include oil and grease were both detected over 60 mg/kg. Arsenic, barium, chromium, copper, lead, nickel, selenium, silver and zinc were all detected at some concentration but didn't exceed regulatory thresholds.

3.10 AIR QUALITY

Air quality in the project area is good. The project site is a coastal community that received benefit of ocean breezes. Local residents do complain of noxious odors produced by decaying organics and waterway sediments exposed during low tides.

3.11 NOISE

Ambient noise levels in the project area are low to moderate. The major noise producing sources are from commuting traffic patterns and domestic animals.

3.12 AESTHETIC RESOURCES.

The general aesthetics of the area is that of a developed urban coastal community. The general appearance of the creek and surrounding area would remain unchanged. Exotic and nuisance species would be controlled or eradicated were possible in the public easement areas of R1 and R2.

3.13 RECREATION RESOURCES.

Recreational boating and fishing opportunities would remain with some increase of use.

3.14 NAVIGATION.

General navigation should improve with removal of material to the –5.5-foot and 4.5-foot elevations. Boaters currently experience delays when wait for high tides to navigate the areas of R1 and R2. Secondary benefits would provide adequate depths for recreational boaters. Due to the height of the existing bridges and existing no wake zones, there should not be an increase of faster or larger vessels using this waterway.

3.15 HISTORIC PROPERTIES.

Remote Sensing and Diver Evaluation investigations have been completed for the Stevenson Creek estuary. No significant historic or cultural resources exist within either the scope of the dredge areas, dewatering site, or permanent material placement site. The resurvey reports were coordinated with the State Historic Preservation Officer (SHPO).

4. ENVIRONMENTAL EFFECTS

4.1 INTRODUCTION.

This section is the scientific and analytic basis for the comparisons of the alternatives. See Table 9 in section 2.0 Alternatives, for summary of direct and indirect impacts. The following includes anticipated changes to the existing environment including direct, indirect, and cumulative effect.

4.2 GENERAL ENVIRONMENTAL EFFECTS.

Dredging proposed for the estuary would remove a concentrated deposit of sediments, primarily muck. Sedimentation has occurred over the years from upstream erosion (lack of maintenance along residential shorelines), wastewater discharges, stormwater runoffs, and naturally decomposing vegetation. Restorative waterway benefits would be realized immediate in terms of increase velocity and circulation. Such actions would improve fish and wildlife values, in addition to, providing improvements in water quality, recreational public interest values, and general navigation.

4.2.1 STEVENSON CREEK ESTUARY.

Stevenson Creek is a 39-acre tidal estuary located on the central west coast of Florida and approximately 60 miles from Tampa. Several barrier islands located to the west and in the Gulf of Mexico protect the site from severe wind and tidal velocities.

Stevenson Creek provides drainage to a watershed of 62,860 acres (9.82 square miles) which includes discharges from an existing wastewater treatment plant. The watershed is divided into five branches and 307 subbasins that range in size from 1 acre to 197 acres with the average subbasin 20.5 acres:

a. Spring Branch (upper and lower branches)
b. Stevenson Creek (upper, middle, and lower)
c. Hammond Branch
d. Jeffords Street Branch
e. Lake Belleview Branch

For purposes of environmental analysis, Stevenson Creek was divided into five environmental zones (see Figure 6, Environmental Benefits Zone Delineation) and two hydrological zones (see Appendix B, Engineering, Hydrodynamic Modeling). **Table 12** also provides a listing of each environmental zone and **Table 13** list each hydrological zone and/or reach.

TABLE 12 ENVIRONMENTAL ZONES AND ACREAGE

Environmental Zones	Aquatic Habitat Acreage	Wetland Acreage
Zone 1		
East of the Douglas Avenue Bridge to Palmetto Street	8.2	5
Zone 2		
West of the Douglas Avenue Bridge to east of the Pinellas Trail Bridge	12.1	1
ZONE 3		
West of the Pinellas Trail Bridge to the North Fort Harrison Bridge	16.6	0
Zone 4		
West of the North Fort Harrison Bridge between the Intracoastal Waterway and Clearwater Harbor	104.9	0
Zone 5		
All of Clearwater Harbor between SR 526 and SR 686	8660.0	0

TABLE 13 HYDROLOGY ZONES/REACHES

Reach 1 Area between North Forth Harrison and Pinellas Trail Bridges
Reach 2 Lower Reach Area 450 feet southeast (upstream) of Pinellas Trail Bridge
Upper Reach Area 490 feet northwest (downstream) of Douglas Ave. Bridge

Source: Corps Hydrodynamic Model Alternative Assessment 2002

4.2.2 TEMPORARY DEWATERING SITE.

This disposal option is an 8 to 9-acre undeveloped parcel located east of the Douglas Avenue Bridge. Past land use appears to have been as a dumping ground for construction material, fill, household waste, and landscape trimmings. The majority of the site is vegetated with exotic and nuisance species such as eartree/treepod (*Enterobobium contortisiliquum)*, lead tree (*Leucaena leucocephala)*, Australian pine (*Casuarina equisetifolia*), Brazilian pepper (*Schinus terebinthifolius*), Caesar weed (*Urena lobata)*, castor bean (*Ricinus communis)*, beggar's tick (*Bidens pilosa*), and other noxious weeds. Remnant native upland vegetation exists on the undeveloped land's eastern boundary adjacent to an auto-salvage yard. Species present in this area include laurel oak (*Quercus laurifolia*), saw palmetto *Serenoa repens*), cat briar (*Smilax bona-nox*), and wild grape (*Vitis sp.*). The shoreline of the parcel is vegetated with black mangroves (*Avicennia germinans*), and red mangroves (*Laguncularia racemosa*). A mangrove swamp is located on the western side of property. This swamp is predominately black mangrove with an open water area in the center (Parson 2001). Note: **Table 14** provides a summary listing of exotics/invasive plant species that require special handling or State permit.

TABLE 14 EXOTIC/INVASIVE PLANT SPECIES REQUIRING SPECIAL HANDLING/PERMIT

SCIENTIFIC NAME	COMMON NAME	REQUIRES SPECIAL HANDLING		SCIENTIFIC NAMES	COMMON NAMES	REQUIRES SPECIAL HANDLING	
		YES	NO			YES	NO
Casuarina Equisetifolia	Australian Pine	X		*Melaleuca quinquenervia*	Melaleuca	X	
Colocasia esculenta	Wild taro		X	*Melia azedarach*	Chinaberry		X
Dioscorea bulbifera	Air-Potato		X	*Panicum repens*	Torpedo grass		X
Eichhornia crassipes	Water-hyacinth	X		*Ricinus communis*	Castor bean		X
Enterolobium Contortisiliquum	Ear pod tree		X	*Sapium sebiferum*	Chinese tallow tree		X
Hibiscus tiliaceus	Mahoe		X	*Schinus terebinthifolius*	Brazilian pepper	X	
Hydrilla verticillata	Hydrilla		X	*Typha*	Cattail		X
Leucaena leucocephala	Lead tree		X	*Urena lobata*	Caesar's weed		X
Ludwigia peruviana	Primrose willow		X	*Wedelia trilobata*	Wedelia		X

Note: Special handling requires obtaining the State DEP permit authorization for the treatment, handling, and disposal of prohibited plants

4.3 VEGETATION.

4.3.1 NO ACTION ALTERNATIVE (STATUS QUO).

This alternative would have no effect on existing wetlands or seagrass beds found within Clearwater Harbor. Sedimentation and ecological decline of the estuary would continue.

4.3.2 4.31 ALTERNATIVE 9 – DREDGE R1 TO –3.5 FT AND R2 TO –2.5 FT NGVD

This alternative has the potential to provide increase habitat and seagrass recruitment under ideal conditions. Removal of the existing muck overburden may provide more optimum substrate and water clarity.

4.3.3 ALTERNATIVE 12 – DREDGE R1 TO –5.5 FT. NGVD AND R2 TO –4.5 FT. NGVD.

This alternative would increase circulation, provide favorable substrate for potential seagrass recruitment, improve water quality, and would add aquatic habitat and foraging values. No adverse impact would result.

Site preparation at the temporary dewatering area would be done in a manner to either avoid or minimize fringing shoreline wetlands. All necessary construction would be a minimum 25-foot buffer from existing wetland.

4.4 THREATENED AND ENDANGERED SPECIES

4.4.1 PROPOSED ACTION, DREDGE R1 AND R2 WITH WETLAND CREATION IN REACH 1

The proposed action would dredge from the east side of the North Fort Harrison to the west side of the Pinellas Trail Bridge (Reach 1), and west side of the Pinellas Bridge to the west side of the Douglas Avenue Bridge. Project components include 3.2 acres of wetland creation, in addition to, removal of exotics from the shorelines and disposal area where possible. Permanent material disposal is scheduled for a 20-acre upland parcel in Hillsborough County.

4.4.2 NO ACTION ALTERNATIVE (STATUS QUO)

Waterway depths do not currently support the manatee access to the estuary. This alternative would continue to limit the manatee's access to high tide occurrences.

4.4.3 ALTERNATIVE 9 – DREDGE R1 TO –3.5 FT. NGVD AND R2 TO –2.5 FT NGVD.

Depths are at zero elevation during lower low tide and submerged resources are not established beyond Clearwater Harbor. This alternative would sufficient depth for the manatee's access to waters of R1. Waterway depth in R2 how ever would continue to obstruct the manatee's access to the thermal and freshwater discharges of the Marshall Street Advance Wastewater Treatment Plant.

4.4.4 ALTERNATIVE 12 – DREDGE R1 TO –5.5 FT NGVD AND R 2 TO –4.5 FT NGVD.

Manatees are very susceptible to cold weather, and it's not unusual for many to die during extremely cold weather. In 1996, at least 17 died due to cold related illnesses. During an exceptionally harsh winter in 1990, 46 manatees succumbed to the bad weather (SeaWorld/Busch Gardens Animal Information Database, 2002). Project depth as proposed would allow the manatee access to the thermal and freshwaters found in R2. Discharge waters from the Marshall Street Plant are between 72 to 75 degrees Fahrenheit. This artificial source of warmwater would eventually provide a stimulus and significant return for the manatee to the Stevenson Creek estuary. It's anticipated that within the next 5 years about 25 manatees could thermo-regulate during winter months in Stevenson Creek.

Adult manatees consume daily about 4% to 9% (32 to 108 lb. or 15-49 kg) of their body weight in aquatic or wet vegetation. Manatees in Florida feed on over 60 species of plants. These include turtle grass, manatee grass, shoal grass, mangrove leaves, various algae, water hyacinth, and water hydrilla (SeaWorld/Busch Gardens Animal Information Database, 2002). Fringing mangroves are found along the easterly bank of North Fort Harrison, and the project proposes to create 3.2 acres of additional mangrove wetland. This would provide the manatee with a secondary food source. The manatee's primary food source (seagrass) exists within a short distance, at the mouth of Stevenson Creek in the adjoining waters of Clearwater Harbor and St. Joseph Sound. Waterway depths as proposed for R1 (-5.5 ft) and R2 (-4.5 ft) with the immediate food sources would provide ideal conditions for the proliferation of manatees in this area.

The Marshall Street Plant is schedule to go offline by 2008. However, the newer facility would be capable of providing the same benefits for manatees in this area. Manatees are known to travel long distance to primary food sources and return to areas where they congregate.

4.5 HARDGROUNDS

4.5.1 PROPOSED ACTION, DREDGE REACH 1 AND REACH 2 WITH WETLAND CREATION IN REACH 1

The proposed action would dredge from the east side of North Fort Harrison to the west side of the Pinellas Trail Bridge (Reach 1), and west of the Pinellas Bridge to the west side of the Douglas Avenue Bridge. Project components include 3.2 acres of wetland creation, in addition to, the removal of about 1 acre of exotics and nuisance species from the shorelines and disposal area where possible. Permanent material disposal would be on uplands in neighboring Broward County.

4.5.2 NO ACTION ALTERNATIVE (STATUS QUO).

A no action alternative could eventually have impact on seagrass meadows found in Charlotte Harbor. In that, material suspension would continue a suspension, re-suspension, and deposition cycle that smother existing seagrasses during tidal actions and storm events.

4.5.3 ALTERNATIVE 9 – DREDGE R1 TO –3.5 FT. NGVD AND DREDGE R2 TO – 2.5 FT NGVD.

Some clam and oyster production occur near the pneumatophores of black mangroves fringing the shoreline within the North Forth Harrison area. No direct impacts are proposed to these areas. However, the sallow and sandy bottom substrate where sparse shellfish production occur would be disturbed.

4.5.4 ALTERNATIVE 12 – DREDGE REACH 1 AND REACH 2 WITH WETLAND CREATION IN REACH 1.

As with Alternative 9, dredging within this area of Stevenson Creek would have some impact on shellfish production. The degree of adverse impact cannot be assessed at this point.

4.6 FISH AND WILDLIFE RESOURCES.

4.6.1 PROPOSED ACTION, DREDGE REACH 1 AND REACH 2 WITH WETLAND CREATION IN REACH 1.

The proposed action would dredge from the east side of North Fort Harrison to the west side of the Pinellas Trail Bridge (Reach 1), and dredge from the west side of the Pinellas Bridge to the west side of the Douglas Avenue Bridge. Project components include 3.2 acres of wetland creation within the NFH area, in addition to, removal of exotics from the shorelines and disposal area where possible. Permanent material disposal would be on uplands.

4.6.2 NO ACTION ALTERNATIVE (STATUS QUO).

A no action alternative would allow the estuary decline to continue which include continue degradation to water quality, fish and wildlife values, recreation, and public interest values.

4.6.3 ALTERNATIVE 9 – DREDGE R1 TO –3.5 FT. NGVD AND R2 TO –2.5 FT.NGVD.

This alternative would provide an increased waterway depth, improve the photic zone, oxygen levels, and tidal flows. Such improvements have the potential to increase habitat complexity, overall fish and wildlife diversity and utilization by estuarine-dependent fish and shrimp species common to this area of the Gulf.

4.6.4 ALTERNATIVE 12 – DREDGE REACH 1 AND REACH 2 THALWEG WITH CREATION OF WETLAND IN REACH 1

This alternative would provide improvements to habitat complexity, fish and wildlife diversity, and increase use by estuarine-dependent fish and shrimp species. Project depths would also provide access for the manatee to the upper and lower reaches of Stevenson Creek and the source of fresh and thermal waters.

4.7 ESSENTIAL FISH HABITAT

4.7.1 PROPOSED ACTION, DREDGE REACH 1 AND REACH 2 WITH WETLAND CREATION IN REACH 1.

The proposed action would dredge from the east side of the North Fort Harrison Bridge to the west side of the Pinellas Trail Bridge (Reach 1), and would dredge from the west side of the Pinellas Bridge to the west side of the Douglas Avenue Bridge (Reach 2). Project components include 3.2 acres of wetland creation and removal of 1.0 acre of exotics from the shorelines and disposal area where possible. Permanent material disposal would be on uplands.

4.7.2 NO ACTION ALTERNATIVE (STATUS QUO).

A no action alternative would have no direct impact on this value, but would allow the continue decline of the estuary without restorative intervention.

4.7.3 ALTERNATIVE 9 – DREDGE R1 TO –3.5 FT NGVD AND R2 TO –2.5 FT. NGVD.

This alternative would impact about 3.6 acres of shallow substrate of existing mudflats in Reach 1 and sand flats within Reach 2. Ship wreckage found in R1 would also be eliminated. The project would have direct impact on EFH (i.e., mud, sand bottom, oyster/clam production areas, and algae) important role as nursery ground, and juvenile habitat area for certain fish species (i.e., mullet, redfish, and gag grouper). Benefits associated with the project includes mangrove creation (3.2 acres) which adds to the aquatic environment by providing habitat diversity, shoreline stabilization, energy to the foodweb, nesting sites for wading and shore birds and shelter for juvenile fish species, in addition to, unobstructed manatee access to R1. Overall, the project has the potential to directly improve 29 acres of EFH and indirectly positively affect over ±1,000 acre of EFH existing with Clearwater Harbor and St Joseph's Sound.

4.7.4 ALTERNATIVE 12 – DREDGE REACH 1 TO –5.5 FT. AND R2 TO –4.5 FT. NGVD.

This alternative adversely impacts areas identified as important EFH in 4.7.3. It is anticipated that over time (within 6 months to 1 year) components of the project would improve the bottom substrate for benthic production, in addition to improving water clarity and quality, salinity reach, and wetland production which are essential components to maintaining EFH.

4.8 HISTORIC PROPERTIES.

No significant historic or pre-historic property would be affected by the project's actions.

4.9 SOCIO-ECONOMIC.

The use of the Wolf Property as a staging area for separation of dredged material is a convenient and cost effective method available to the project. Transportation of material to the City of Clearwater sludge farm 21.5 miles from the project area was the only available long-term option available. Other disposal alternatives included ocean disposal (generally cost prohibitive) and sanitary landfill disposal (cost prohibitive due to tipping fees and distance from project).

4.10 AESTHETICS.

The proposal would not adversely impact this value. The major components of the project are not visible or impacting to area aesthetics. Removal of nuisance and exotic species, however, would be visible and would improve the natural and aesthetic qualities of the area.

4.11 RECREATION.

The main channel or R1 (within the NFH area) would be dredged to –5.5 feet NGVD and the PT and DA area dredged to –4.5 feet. Local boaters would receive boating benefits from this action. Boating activities are currently limited to high tide cycles. General navigation is impossible during periods of low tides. Given the spacing of bridge spans and bridge heights, the increased waterway depths should not realize an increase to the size and speed of vessels using the waterway. Navigation is generally limited to small boats and canoes.

TABLE 15 PROTECTED SPECIES SUMMARY FOR PINELLAS COUNTY

Scientific Name	Common Name	Federal Status	State Status
FISH			
Acipenser oxyrinchus desotoi	Gulf sturgeon	LT	LS
AMPHIBIANS			
Rana capito	gopher frog	N	LS
REPTILES			
Alligator mississippiensis	American alligator	T(S/A)	LS
Caretta caretta	loggerhead	LT	LT
Chelonia mydas	green turtle	LE	LE
Dermochelys coriacea	leatherback	LE	LE
Drymarchon corais couperi	eastern indigo snake	LT	LT
Gopherus polyphemus	gopher tortoise	N	LS
Lepidochelys kempii	Kemp's ridley	LE	LE
Stilosoma extenuatum	short-tailed snake	N	LT
BIRDS			
Ajaia ajaja	roseate spoonbill	N	LS
Aramus guarauna	limpkin	N	LS
Charadrius alexandrinus	snowy plover	N	LT
Charadrius melodus	piping plover	LT	LT
Egretta caerulea	little blue heron	N	LS
Egretta rufescens	reddish egret	N	LS
Egretta thula	snowy egret	N	LS
Egretta tricolor	tricolored heron	N	LS

TABLE 15 PROTECTED SPECIES SUMMARY FOR PINELLAS COUNTY

Eudocimus albus	white ibis	N	LS
Falco peregrinus	peregrine falcon	LE	LE
Falco sparverius paulus	southeastern American kestrel	N	LT
Haematopus palliatus	American oystercatcher	N	LS
Haliaeetus leucocephalus	bald eagle	LT	LT
Mycteria americana	wood stork	LE	LE
Pandion haliaetus	osprey	N	LS
Pelecanus occidentalis	brown pelican	N	LS
Rynchops niger	black skimmer	N	LS
Speotyto cunicularia floridana	Florida burrowing owl	N	LS
Sterna antillarum	least tern	N	LT
MAMMALS			
Podomys floridanus	Florida mouse	N	LS
Sciurus niger shermani	*Sherman's fox squirrel*	N	LS
Trichechus manatus	manatee	LE	LE

Source: Florida Natural Areas Inventory, www.fnai.org/PINE-SUM.HTM, 7/11/01

N = not listed
LS = listed, species of special concern
LT = listed, threatened
LE = listed, endangered

SOURCE: Dial Cordy and Associates, 2002

TABLE 16 WILDLIFE EXPECTED WITHIN THE STEVENSON CREEK WATERSHED

Wildlife Observed (*) or Expected Within the Stevenson Creek Watershed	
Scientific Name	**Common Name**
Birds	
Agelaius phoeniceus	Red-winged blackbird
*Anhinga anhinga**	Anhinga
Ardea herodias	Great blue heron
*Bubulcus ibis**	Cattle egret
Cardinalis cardinalis	Cardinal
*Casmerodius albus**	Great egret
Cathartes aura	Turkey vulture
Colaptes auratus	Northern flicker
Columba livia	Rock dove
Coragyps atratus	Black vulture
Corvus ossifragus	Fish crow
*Cyanocitta cristata**	Blue jay
Dendroica palmarum	Palm warbler
Dumetella carolinensis	Catbird
*Egretta caerula**	Little blue heron
Egretta thula	Snowy egret
*Eudocimus albus**	White ibis
Geothlypis trichas	Common yellowthroat
Melanerpes carolinus	Red-bellied woodpecker
Mimus polyglottus	Mocking bird
Pandion haliaetus	Osprey
Passer domesticus	House sparrow
Parus bicolor	Tufted titmouse
Pelecanus occidentalis	Brown pelican
Phalacrocorax Auritus	Double-crested cormorant
Picoides Pubescens	Downy woodpecker
Plegadis Falcinellus	Glossy ibis
*Quiscalus quiscula**	Common grackle
Sturnus vulgarus	European starling
Strix varia	Barred owl
Thryothorus ludovicianus	Carolina wren
*Zenaida macroura**	Mourning dove

SOURCE: PARSON ENGINEERING

TABLE 16 WILDLIFE EXPECTED WITHIN THE STEVENSON CREEK WATERSHED

Wildlife Observed (*) or Expected Within the Stevenson Creek Watershed	
Scientific Name	**Common Name**
Mammals	
Dasypus novemcinctus	Armadillo
Didelphis virginiana	Opossum
Peromyscus gossypinus	Cotton mouse
Peromyscus polionotus	Oldfield mouse
Procyon lotor	Raccoon
Sciurus carolinensis	Eastern gray squirrel
Sigmodon hispidus	Hispid cotton rat
Sylvilagus floridanus	Eastern cottontail
Reptiles And Amphibians	
Anolis carolinensis	Green anole
Anolis sagrei sagrei	Brown anole
Acris gryllus	Southern cricket frog
Bufo terrestris	Southern toad
Coluber constrictor	Black racer
Diadophis punctatus	Ring necked snake
Hyla gratiosa	Barking tree frog
Hyla squirella	Squirrel tree frog
Osteopilus septentrionalis	Cuban treefrog
Rana sphenocephala	Southern leopard frog
Trachemys scripta elegans	Red-eared turtle
Trachemys scripta scripta	Yellow bellied turtle
Thamnophis sirtalis	Common garter snake
Fish	
Centropanus undecimalus	Snook
Gambusia sp.	Mosquito fish
Lagodon rhomboides	Pinfish
Mugil cephalus	Mullet
Orthopristis chrysoptera	Pigfish
Scizenops ocellatus	Red fish

Source: Field observations (Parsons ES, May 2000), and Florida Natural Areas Inventory, 1996.

TABLE 17 SPECIES OBSERVED IN STEVENSON CREEK PROJECT AREA

<u>VEGETATION</u>

Shoal-grass (*Halodule wrightii*) (west of Fort Harrison Bridge)

<u>Creek banks and flats</u>

Black Mangrove (*Avicennia germinans*)
Red Mangrove (*Rhizophora mangle*)
Brazilian Pepper (*Schinus terebinthifolius*)
Australian Pine (*Casuarina sp.*)
Juncus (*Juncus* sp.)
Saltmarsh Cordgrass (*Spartina alterniflora*)
Saltbush (*Baccharis halimifolia*)
Sea Rocket (*Cakile edentula*)
Spike Grass (*Distichilis spicata*)
Saltwort (*Batis maritima*)
Glasswort (*Salicornia virginica*)

<u>Upland area adjacent to proposed spoil dewatering site</u>

*Australian Pine (*Casurina equisetifolia*)
*Lead Tree (*Leucaena leucocephala*)
Sand Live Oak (*Quercus geminata*)
Water Oak (*Q. nigra*)
Laurel Oak (*Q. laurifolia*)
Sabal Palm (*Sabal palmetto*)
*Earpod (*Enterolobium contortisiliquum*)
*Chinaberry (*Melia azedarach*)
*Chinese Tallow (*Sapium sebiferum*)
Camphor Tree (*Cinnamonum camphora*)
Persimmon (*Diospyros virginiana*)
*Castor Bean (*Ricinus communis*)
Elderberry (*Sambucus canadensis*)
Mulberry (*Morus rubra*)
Palmetto (*Serenoa repens*)
Muscadine (*Vitis rotundifolia*)
*Caesar's Weed (*Urena lobata*)
Spanish Needles (*Bidens pilosa*)
Catbriar (*Smilax sp.*)
Blackberry (*Rubus sp.*)
Virginia Creeper (*Parthenocissus quinquefolia*)
*Air Potato (*Dioscoria bulbifera*)
Bracken Fern (*Pteridium aquilinum*)

*exotic species (Florida Exotic Pest Plant Council, 1999, http://www.fleppc.org/99list.htm)

TABLE 17. SPECIES OBSERVED IN STEVENSON CREEK PROJECT AREA

<u>FISHES</u>
Mullet (*Mugil* sp.) (west of Fort Harrison Bridge)
Snook (*Centropomus undecimalis*)
Redfish (*Sciaenops ocellatus*)
Silversides (*Menidia* sp.)
Pinfish (*Lagodon rhomboides*) or mojarras (fam Gerreidae)

<u>AMPHIBIANS/ REPTILES</u>
unidentified lizard (*Sceloperus* sp.)

<u>BIRDS</u>
White Ibis (*Eudocimus albus*)
Yellow-crowned Night Heron (*Nyctanassa violacea*)
Little Blue Heron (*Egretta caerulea*)
Great Blue Heron (*Ardea herodias*)
unidentified gull species (fam. Laridae)
Royal Tern (*Sterna maxima*)
Reddish egret (*Egretta rufescens*)
Snowy Egret (*Egretta thula*)
Brown Pelican (*Pelicanus occidentalis*)
Anhinga (*Anhinga anhinga*)

<u>MAMMALS</u>
Marsh Rabbit (*Sylvilagus palustris*)

<u>INVERTEBRATES</u>
bivalve, possibly mussel species
bivalve, possibly species of jackknife clam (*Tagelus* sp.)
Eastern Oyster (*Crossostrea virginica*)
Blue Crab (*Callinectes sapidus*)
Fiddler Crab (*Uca* sp.)
holothuroidean echinoderm, possibly *Leptosynapta* sp.,
translucent white, wormlike, 1-2 cm long,
(west of Fort Harrison Bridge)
polychaete sp.? (eggcase found)

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4.12 COASTAL BARRIER RESOURCES.

The project proposes no adverse impacts to these resources. Features of the project would remove a source of sedimentation and would improve water quality that could indirectly and adversely affect these resources. Coastal barrier resources are located offshore of the project site.

4.13 WATER QUALITY

Water quality is a major component of the project. Various contractors' have performed extensive testing over the last 5 years for the City and the Corps. Each report indicates threshold detection of metal, nutrients, and fecal coliform. These levels however do not exceed background or existing regulatory standards. Parson (2001) performed an extensive analysis of the creek watershed, major basins, and sub basins and recommended actions that could be performed to alleviate several sources of contaminants. The City of Clearwater proposes to begin implementing by 2005 a phased watershed management plans for the Stevenson Creek drainage basin.

4.14 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Metal concentrates are considered marginal and are not expected to exceed background levels. HTRW test results can be reviewed in Sub-Appendix X, Other Project Studies. Dredged material disposal proposed for the neighboring Hillsborough County is expected to meet existing regulatory standards.

4.15 AIR QUALITY.

The project would have positive a benefit on this value. Residents have complained that decaying organics (within the creek) odors are unbearable during certain times of the day, periods of low tides. Dredging would remove material that may contribute in some degree to the area's air pollution

4.16 NOISE.

Operation of dredging equipment may add unwelcome decibels to the neighboring community. This impact would be temporary from 6 months to 1 year. No permanent adverse impacts should result.

4.17 IREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES.

The project does not propose any irreversible or irretrievable impacts. There are no seagrasses established in the shallow substrate of the site. Wetland habitat along the shoreline would be avoided to the fullest extent practicable.

4.18 NATURAL OR DEPLETABLE RESOURCES

The project proposes no impact to these resources.

4.19 SCIENTIFIC RESOURCES.

The project proposes no impact to these resources

4.20 NATIVE AMERICANS

The project proposes no impact to Native American resources.

4.21 URBAN QUALITY

The project is an urban tidally-influence waterbody of 39 acres situated in an area of 80 percent residential, commercial, and industrial development. The creek provides surface water drainage for over 6,000 acres. Substantial alterations have occurred within the creek's flood plain and riparian habitats. No adverse impacts should occur to this value.

4.22 SOLID WASTE

Stream bank and shoreline erosion are sources of input up stream within the Hammond Branch Watershed, beyond the purview of this action. Sediments are suspended during tidal actions and major storm events. The City's implementation of a stormwater management plan should address concerns associated with erosion received from Hammond Branch. The project's action associated with this report would remove the accumulation of material currently impeding the creek's ability to support the flow common to estuarine waterbodies. No adverse impact on this value is associated with the proposal.

4.23 DRINKING WATER

The project site is a Class III Waterbody (recreational water) that is also considered "Outstanding Florida Waters." This classification is not related to potable water or any residential wells. No adverse impacts are proposed to any source of potable water.

4.24 CUMULATIVE IMPACTS

The project proposes no adverse cumulative impacts to protected species, water quality or other resources.

4.25 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS.

Dredging of some mudflats within the creek between PT and DA is anticipated, approximately 3.2 acres, in addition to, loss of forested habitat at the dewatering site. These impacts are temporary and should not propose any long-term adverse impacts to fish and wildlife habitat, nesting, resting, or foraging areas. The creation of 3.2 acres of mangrove wetlands, a component of the restoration project would offset the anticipated short-term and temporary impacts.

4.26 LOCAL SHORT-TERM USES AND MAINTENANCE AND/OR /ENHANCEMENT OF LONG-TERM PRODUCTIVITY.

Increase flow and conveyance should be provided, after sediments are removed from the estuary. Benthic levels, fish and wildlife utilization and overall aquatic values should increase. Juvenile and adult species that spend a portion of their life cycle in the estuary would receive increased habitat and cover areas from the planting of mangroves.

4.27 INDIRECT EFFECT

No adverse indirect impacts are anticipated. Beneficial indirect effects are expected, in that, water quality would be improved, flooding potential to surrounding lands would be minimized, sufficient waterway depth would be available for access by manatees and local small boaters.

4.28 COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES

The project complies with this objective. Stevenson Creek estuary needs intervention to restore its self-sustaining functions. Input has been requested from the various Federal, State, and local resource agencies to achieve the desired objectives. The project would include recommendations of the resource agencies, if considered relevant and necessary to the proposed project.

4.29 CONFLICTS AND CONTROVERSY

There are no unresolved issues. Concerns expressed by commenting State and Federal agencies would be addressed with the issuance of this report.

4.30 UNCERTAIN, UNIQUE, OR UNKNOWN RISKS.

The proposal does not contain any uncertain, unique, or unknown risks. The City of Clearwater phased watershed construction would treat stormwater before release into the creek, and other non-point sources of sediment, nutrient, and bacteria.

4.31 PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS

The project does not set a precedent for future actions in this area.

4.32 ENVIRONMENTAL COMMITMENTS

The U.S. Army Corps of Engineers and selected contractors are committed to the avoidance and minimization of adverse environmental impacts, if resource impacts are unavoidable. To ensure turbidity levels are contained, project plans and specs required the use of turbidity controls and regular monitoring of turbidity levels.

4.33 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

4.33.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled, and this Environmental Assessment has been prepared. The project complies with the National Environmental Policy Act.

4.33.2 ENDANGERED SPECIES ACT OF 1973

Consultation with the USFWS and NMFS has been initiated. Final resolution is pending. It is anticipated that at the conclusion of this process the project would comply with this act.

4.33.3 FISH AND WILDLIFE COORDINATION ACT OF 1958

The Fish and Wildlife Coordination Act Report (CAR) prepared in accordance with the Act of 1958, was issued January 2002. Measures were later eliminated from or included into the proposal that affected the CAR presented recommendations and conservation measures. Resolution of these issues is pending with the USFWS.

4.33.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

In accordance with Section 106 of the National Historic Preservation Act and 36 CFR, Part 800, the proposed project would be in full compliance with this act. The Corps conducted cultural resource surveys within the estuary and permanent disposal site. Cultural resources found at these locations didn't require any further coordination. The temporary dewatering site did not require a cultural resource survey. All survey reports were coordinated with the State SHPO. The proposal would have no adverse effect on historic properties listed on or eligible for listing in the National Register of Historic Places.

4.33.5 CLEAN WATER ACT OF 1972

A Section 401 water quality certification would be obtained prior to the project's plans and specs phase. State certification when received would be included in Appendix C. A Section 404(b) (1) evaluation is included in this document.

4.33.6 CLEAN AIR ACT OF 1972

Air quality permits are not required for this project. Coordination is pending with the U.S. Environmental Protection Agency (EPA).

4.33.7 COASTAL ZONE MANAGEMENT ACT OF 1972

A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as Appendix B. The State' s consistency review is pending.

4.33.8 FARMLAND PROTECTION POLICY ACT OF 1981

This act is not applicable. The project proposes no impacts to prime or unique farmland.

4.33.9 WILD AND SCENIC RIVER ACT OF 1968

Stevenson Creek has not received State designation under this act. This act is not applicable.

4.33.10 MARINE MAMMAL PROTECTION ACT OF 1972

The customary safeguards (Standard Manatee Protection Guidelines) would be included in the project's contract specifications, to ensure protection of the endangered manatee. The project would be in compliance with this act.

4.33.11 ESTUARY PROTECTION ACT OF 1968

The project area has not been designated for protection under this act. This act is not applicable.

4.33.12 FEDERAL WATER PROJECT RECREATION ACT.

This act is not applicable. The action proposed under this project would provide environmental restoration under Section 206 of the WRDA of 1996, as amended.

4.33.13 FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

Coordination with the National Marine Fisheries Service (NMFS) is pending. All comments and recommendations, when received, would be reviewed for adoption into the project action, if relevant and necessary under this act.

4.33.14 SUBMERGED LANDS ACT OF 1953

Expansion of the wetland shelf at North Fort Harrison would create 3.2 acres of additional habitat, which requires discharge below the plane of mean low water. Any issues related to this creation would be resolved with the appropriate State agency during the project's water quality certification phase. The proposed action should not adversely impact State submerged lands, and should be in compliance with this act.

4.33.15 COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

The project proposes no adverse alterations or affects to resources designated under this act. Barrier resources located approximately 13,000 feet from the project area are not within the range of impact for this project. The proposed action complies with this act.

4.33.16 RIVERS AND HARBORS ACT OF 1899

The project proposes no obstructions to general navigation. Project components would provide navigable depths and unobstructed use of the waterway. The project is in full compliance with this act.

4.33.17 ANADROMOUS FISH CONSERVATION ACT

The project proposes no adverse impacts to species managed under this act. Completion of coordination with the NMFS is pending.

4.33.18 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

The project would impact approximately 3.6 acres of existing mudflats. These areas are exposed during low tides and are used as resting and foraging grounds by shore, wading and migratory birds (i.e., anhingas, cattle egrets, great egret, American white pelican, and ducks). Lack of sufficient circulation in Reach 2 has created the existing flats. Dredging is necessary to restore circulation and overall environmental quality to the estuary. The proposed action should restore fish and wildlife habitat aquatic values (i.e., improvements to water quality, the photic zone, and benthic substrate). Over time, the estuary's environmental values should increase with benefit of the proposed action, and should provide sustainable physical, chemical, and biological complexity and increase fish and wildlife diversity. The project would comply with these acts.

4.33.19 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The proposed work would not impact these resources.

4.33.20 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT.

The project would impact substrate and habitat that support sustainable fisheries, by providing foraging habitat, nesting, cover, and foraging areas. Existing mudflats support paneid shrimp complex and adverse impacts are unavoidable. The impacts would be temporary and components of the project would create resources which eventually offset project related adverse impacts. Final coordination of project impacts is pending with NMFS.

4.33.21 E.O. 11990, PROTECTION OF WETLANDS

Wetland avoidance is proposed at the dewatering site. However should these impacts be unavoidable, potential impacts could result to about .50 to 1 acre of wetlands. Efforts were made to secure a non-wetland parcel with the necessary disposal capacity. Such property is limited to non-available in this area. The City of Clearwater in this area is 56 percent developed. In other areas of the City, development is at 90 percent. If wetland impacts are determined to be unavoidable (with construction of the temporary dewatering site), resolution would take place during water quality certification or the plans and specs phase. The project would comply with the goals and objectives of this Executive Order.

4.33.22 E.O. 11988, FLOOD PLAIN MANAGEMENT

Stevenson Creek contains a total 39 acres of surface waters. Restoration efforts would include 75 percent of the waterbody or 29 acres. Approximately 32 structures are found within the creek's 100 -year flood plain. The creek's flood plain extends to the Spring Branch at the Northeast and Jeffords Road at the South. Approximately 263 structures found in area below the 100-year flood elevation, experience frequent flooding episodes during normal rain and flood events. The project has been evaluated in accordance with this Executive Order. Secondary components of the project would provide some flood relief for structure prone to flooding during storm events. The project complies with this Act.

4.33.23 E.O. 12898, ENVIRONMENTAL JUSTICE

Minority and low-income communities located within the scope of the project would not experience any disparative adverse impacts. The project would comply with this act.

4.33.24 E.O. 13089, CORAL REEF PROTECTION

The project proposes no impacts to coral reefs.

4.33.25 E.O. 13112, INVASIVE SPECIES

The proposed action provides an opportunity for removal of exotic trees and nuisance species found along the NFH and the temporary dewatering site.
The Federal project is not authorizing, funding, or carrying out actions that might spread or introduce invasive species. All feasible and prudent measures to minimize risk of introducing invasive species would be followed. The contractor would be required to obtain the necessary State permit in accordance with Chapters 62C-20 or 62C-54, F.A.C, as required for the transporting and disposal of prohibited or noxious aquatic plants. Exotics such as Australian pine and Brazilian pepper can be found in the temporary disposal site along the estuary's shoreline. Australian Pine is listed by the State of Florida as a Class I Prohibited Aquatic Plants. Brazilian pepper is listed as a Class I and ecologically damaging species.

The Corps initiated research of the State's Invasive Species Management Plan to determine the recommended removal of the existing exotics. The State recommended method of removal would be required of the contractor and included in the project's plans and specifications. Herbicidal agents that may be applied to eradicate the existing invasive exotic species would be appropriately used with all cuttings transported and disposed of in an approved location. Handling of Brazilian pepper may require a special permit. The contractor would be required to obtain any necessary permit and monitoring of these actions would be performed by the Corps.

5. LIST OF PREPARERS

5.1 PREPARERS

C. L. Brooks, Biologist, Planning Division, U.S. Army Corps of Engineers
Nancy P. Allen, Biologist, Planning Division, U.S. Army Corps of Engineers
Martin Gonzalez, Civil Engineer, Planning Division, U.S. Army Corps of Engineers
Emilio Gonzalez, Civil Engineer, Project & Programs Management Division

5.2 REVIEWERS

Kenneth Dugger, Supervisory Biologist and Chief Reviewer, Planning Division, Corps
Dorothy Boardman (Legal Counsel) Legal Sufficiency Review, Corps
John Pax (Legal Counsel) Legal Review, Corps

6. PUBLIC INVOLVEMENT

6.1 SCOPING LETTER AND/OR DRAFT EA

A scoping letter for the proposed action was issued on May 10, 2003. A copy of the referenced letter can be found in Sub-Appendix E, Pertinent Correspondence. Public meetings and meetings with the City of Clearwater officials in Clearwater have extensively discussed the issues associated with the proposal. The draft EA and preliminary Finding of No Significant Impact (FONSI) will be made available to the public and other interested parties for comment. Comments and written responses will be included in Sub-Appendix E, Pertinent Correspondence.

6.1.1 U.S. GEOLOGICAL SUYRVEY, FLORIDA INTEGRATED SCIENCE CENTER

A letter dated May 14, 2003, was received from the USGS Sirenia Project. It was commented that manatee use of the estuary in its present state was very minimal, conditions are too shallow and freshwater sources are well up stream. Restoring the creek's depth to 6 feet (mean low tide) in R1 would provide an area for manatees to rest and socialize. Dredging Reach 2 would ensure access to the (fresh water) outfall of the existing sewage treatment plant and the associated thermal benefits. It was further stated if manatees are to remain in this region of the state, effort to enhance natural habitat would help ensure the future of the manatee in Florida.

6.1.2 NATIONAL OCEANIC AND ATOMSPHERIC ADMINISTRATION (NOAA) NMFS, PROTECTED RESOURCES DIVISION

By form letter dated June 3, 2003, NMFS found the project would have no effect on listed species or critical habitat protected by the Endangered Species Act under NOAA Fisheries purview.

6.1.3 ENVIRONMENTAL PROTECTION COMMISSION, HILLSBOROUGH COUNTY

By letter dated June 19, 2003, Hillsborough County commented that a wetland delineation would be required prior to the disposal of material in Hillsborough County. General requirements were provided wetland setback requirements for construction with general comments concerning protection of wetlands.

6.1.4 NOAA, NMFS

By letter dated June 23, 2003, NMFS responded that certain habitats within the project area are designated as Essential Fish Habitat (EFH). NMFS recommended that an EFH assessment be submitted for review and comment prior to implementing the Stevenson Creek Estuary project. Four criteria were listed that should be addressed in the EFH assessment. This EA contains the elements of the EFH assessment and is being provided to NMFS to fulfill this requirement (see parts 4.32.20, 4.6.5 and 3.6).

6.1.5 INDIVIDUAL(S) COMMENTS.

By letter dated June 9, 2003, Mr. Joe O. Blackburn Jr. commented anticipation of the project's undertaking and completion. However, concerns were expressed relative to duration of time before maintenance dredging would be required, why the project was ending at Douglas Avenue, was the Marshal Street Water Treatment Plant adding to area odors, and what would be the project's start and completion date

6.2 LIST OF RECIPIENTS.

Copies of the draft EA and FONSI shall be made available to State and local environmental agencies, interest groups, interested individuals, and Federal resources agencies. A complete mailing list to each recipient can be found in Appendix E, Pertinent Correspondence.

6.3 COMMENTS RECEIVED AND RESPONSE

Comments received and responses to the proposed project shall be incorporated into the EA and included in Appendix E, Pertinent Correspondence.

7 REFERENCES

BCI Engineers and Scientist, Inc., 1998. *Sediment Characterization and Removal Feasibility Study*.

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SUB-APPENDIX A - SECTION 404(B) EVALUATION

SECTION 404(b) EVALUATION

STEVENSON CREEK ESTUARY
ENVIRONMENTAL RESTORATION PLAN
CLEARWATER, PINELLAS COUNTY, FLORIDA

I. Project Description.

a. Location. The proposed work is located within the Stevenson Creek estuary between the North Fort Harrison Bridge, Douglas Avenue Bridge, and Pinellas Trail Bridges, in the City of Clearwater, Pinellas County, Florida.

b. General Description.

(1) Stevenson Creek Estuary.
Stevenson Creek encompasses a drainage basin of approximately 6,000 acres in Central Pinellas County, which includes 3,500 acres of, developed land in the western portion of the City of Clearwater. Extensive channelization and creek alterations have taken place and little of the historic flood plains remain in tact. Land uses within the basin are predominantly medium to high-density residential, commercial, and open space (see Table 1). Approximately 90 percent of the watershed has been developed, and the vast majority of the development occurred prior to the implementation of regulatory requirements for flood plain preservation, environmental protection, stormwater treatment and attenuation. Several developments that were constructed within the creek's flood plain have experienced severe flooding. In addition, the creek and its tributaries experience moderate to severe erosion problems due to steep embankments, improper maintenance, highly erodible soils, and inadequate right-of-way (Parsons 2001).

Land changes over the last 100 years have been significant. Review of an aerial photograph dated 1926 showed the creek with a width of about 1,000 feet at North Fort Harrison. Current photographs show the creek with a width of 700 feet, a reduction of about 30 percent. The 1926 aerials show the flood plain intact with associated wetlands. Adjacent land use at this time was either predominately agricultural, under development, or undeveloped. Channelization occurred within Spring Branch and within Stevenson Creek between Drew Street and Druid Road. By 1942, only a few homes were built within the interior land marked for subdivision during the

1920's. However, during the 1950's and 1 960's, the majority of the watershed was built out within the areas designated for medium to high-density developments. During this period, portions of the Stevenson Creek estuary were filled in along its southern banks.

By 1974, over 95 percent of the developable area in the watershed had been developed or set aside as parks and golf courses, and the full length of Stevenson Creek and its tributaries (approximately 29 acres) had been channelized.

Table 1 Existing Basin Land Use Percentages

Land Use Classification	Total Area (Acres)	Percentage of Basin
Commercial	610	9.7
Cropland and Pastureland	5	0.1
Forest	50	0.8
Low Density Residential	56	0.9
Medium Density Residential	3861	61.4
High Density Residential	459	7.3
Industrial	42	0.7
Institutional	182	2.9
Open Land and Range Land	573	9.1
Specialty Farms	10	0.2
Transportation, Communications and Utilities	170	2.7
Water	205	3.3
Wetlands	63	1.0
TOTAL	**6,286**	**100.0**

(Parsons 2001)

Table 2 Land Use Types in the Lower Stevenson Creek Watershed

Land Use	Acreage
Residential	516
Commercial	56
Industrial	20
Institutional	31
Recreational	116
Open Land	11
Agriculture	0
Upland Forests	0
Water Bodies	40
Wetlands	5
Trans./Utilities Communications	27
Total Acreage	**821**

Soils are hydric with moderate to high infiltration rates. Maximum infiltration rates for soils can vary from 10 inches to 3 inches per hour when dry to 0.4 to 0.10 inch per hour when fully saturated (Parsons 2001)

(2) <u>Temporary Disposal Site, Wolfe Property</u>.

The temporary dewatering site identified as the Wolf Property, contains approximately 8 acres which includes 4 acres of mixed hardwood, wetland and uplands. The remaining acreage is a brackish marsh comprised of black mangroves (*Avicennia germinans*) and red mangroves (*Laguncularia racemosa*) established along the western shoreline. Saltmarsh and openwater are found waterward of the mangroves. Sand fill berms, approximately 15 feet in elevation are found to the east. A hardwood oak hammock with exotics is found on the eastern portion of the site. This area also contains saw palmetto (*Serenoa repens*), cat briar (*Smilax bona-nox*), and wild grape (*Vitis sp.*). The nuisance and exotic species consist of ear tree (*Enterolobium contortisiliquum*), lead tree (*Leucaena leucocephala*), Caesar weed (*Urena lobata*), castor bean (*Ricinus communis*) beggar's tick (*Biden pilosa*), Australian pine (*Casuarina equisetifolia*), Brazilian pepper (*Schinus terebinthifolius*), and unidentified noxious weeds. East of the berms is located a 4-acre parcel which support an auto-salvage yard. This site has since been purchased by the City of Clearwater and cleared of vegetation.

(3) <u>Permanent Disposal Site, Former Sludge Farm</u>.

Approximately 20 acres within a 400-acre parcel have been identified for permanent placement of dried muck from the dewatering process. This area is located about 20 miles from Stevenson Creek within Hillsborough County, about 1 mile south of Highway 582 (Lake Fern/Tarpon Springs Road) and 6 miles from the

City of Tarpon Springs, Pinellas County, Florida (Figure 3). No jurisdictional wetlands exist within the parcel identified for placement of dredged material. The disposal area is about 50 feet from the tree line associated with the wetlands (Dial Cordy 2002). Past use of the area has been by the City of Clearwater as a depository for municipal sludge. This action concluded about 10 years earlier. The primary use of the area is currently as pasture for cattle and horses. The surrounding area is agricultural/rural and is presently experiencing developmental pressures. Soils underlying the disposal area are Zolof fine sand, Myakka fine sands and Pomello fine sands. The soils range from poorly drained to moderately well drained. The Zolfo series sands comprise the majority of the substrate under the disposal area. Where sludge was deposited, native soils are found only inches below the surface (Dial Cordy). For a more detail report of the permanent disposal site, see Sub-Appendix E , Study Reports, Dial Cordy 2002.

c. Authority and Purpose.
Project authorization is received under Section 206 of Water Resources Development Act of 1996, as amended, for aquatic ecosystems' restoration and protection.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. The proposed material is clean sand to be secured from existing sandflats and sand separated from dredged material.

(2) Quantity of Material. A total volume of 31,800 cubic yards of clean sand is proposed to create two mangrove wetlands (1.5 acre and 1.7 acres) at elevation 1.0-foot NGVD in R1 at the southeast near NFH and at the southwest near Pinellas Trail.

(3) Source of Material. The material proposed for discharge would be obtained from R1 and R2. Approximately 55,000 cubic yards of sand exists in R1 at NFH and 64,725 cubic yards exists in R2.

e. Description of the proposed Discharge Site.

(1) Location. The 1.5 acre creation site is located near North Fort Harrison along the southeastern shoreline. The 1.7 acre creation site is located near Pinellas Trail. Both locations are within Reach 1.

(2) **Size**. The area proposed to receive the discharged material was also selected for the wetland creation (1.5 ac. and 1.7 ac.) in Reach 1 at North Fort Harrison and Pinellas Trail.

(3) **Type of Site**. The fill area is estuarine habitat with openwater and intertidal areas.

(4) **Type of Habitat**. Mudflats and sand are the predominant habitats.

(5) **Timing and Duration of Discharge**. The construction starting date and length of time needed to complete the work has yet to be determined.

f. **Description of Disposal Method**. Pipeline would discharge the material to the desired wetland creation sites and temporary dewatering site.

II. Factual Determinations

a. **Physical Substrate Determinations**. The discharge of dredged material can result in varying degrees of change to the complex physical, chemical, and biological characteristics of bottom substrate. Discharges that alter substrate elevations or contours can also affect changes to water circulation, depth, current pattern, water fluctuation, and increase waterway temperatures. The proposed discharge could also impacts bottom-dwelling organisms by smothering immobile forms or forcing mobile forms to migrate. These impacts would be temporary.

Discharge associated with creation of the wetlands proposes no adverse long-term or permanent changes to the estuary. Some impact is anticipated to benthos established along the shoreline. Such impacts would be temporary, with a full recovery of benthic organisms anticipated within 6 months to a year.

(1) **Substrate Elevation and Slope**. The height of the wetland shelf is proposed at 1.0 feet NGVD.

(2) **Sediment Type**. High solid content sands with low organics comprise the discharge material. (BCI 1998).

(3) **Dredge/Fill Material Movement**. Planting of mangroves on the discharged material would provide the necessary stabilization.

(4) Physical Effects on Benthos. Temporary impacts would occur to benthic organisms within the areas to receive the discharged material. The material would be similar to the existing bottom substrate.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Water Column Effects. Temporary impacts would occur but no adverse long-term impacts should result.

(2) Current Patterns and Circulation. Current tidal patterns are east into estuary and northwest to Clearwater Harbor. The project proposes no obstructions to current flow, location, structure, or dynamics which could adversely effect the aquatic environment.

(3) Normal Water Level Fluctuations and Salinity Gradients. Water fluctuation levels in the estuary are dependent upon tidal ebb/flow and rainfall. The proposed discharge would not change existing water levels or decrease the salinity gradients. Extensive hydrodynamic modeling was conducted over a 14-day tidal cycle at high and lower-low water tide elevations to ensure sufficient circulation would be achieved in the estuary to sustain biological, physical, and chemical recovery.

c. Suspended Particulate/Turbidity Determinations. Dredging within the estuary has the potential to suspend particulates that have entered the waterbody from runoff, flooding, vegetative and planktonic breakdown. The duration particulates remain suspended should be relatively short. It is anticipated the suspension of such particulates should settle rapidly and not adversely impact light penetration to the estuary, primary productivity, temperatures, or oxygen levels. Construction generated turbidity would be monitored to ensure existing water quality standards are not degraded. Dredging projections anticipate 6 days of dredging over 548 days at 10 hours per day.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. Turbidity associated with hydraulic pipeline dredging is more at the point of dredging. Only temporary impact would occur during material discharge and the hydrocyclone process. Approximately 42 percent sand separation and 56 percent fines would be extracted from the dredged material. Suspended particulates and turbidity would be controlled with turbidity curtains or other appropriate control devices.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Impacts would be temporary during discharge. However, improvements would be realized in this area by removing existing muck and improving the photic zone.

(b) Dissolved Oxygen. Temporary impacts would result during discharge of material. No permanent impact would result. Oxygen levels would increase with removal of the accumulated waterway sediments.

(c) Toxic Metals, Organics, and Pathogens. Sand proposed for discharge within the estuary would be free of known contaminants or pollutants.

(d) **Aesthetics.** Project related impacts are proposed below the level of mean low water, with exception of the mangrove wetland creation. No adverse impacts should occur to area aesthetics.

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. Minimum impact from suspended turbidity is anticipated. All impacts would be temporary during discharge with some effect on primary productivity. No adverse long-term impacts should occur.

(b) Suspension/Filter Feeders. The proposed discharge would have a temporary adverse impacts on these resources. However, positive permanent benefits should result from increased water clarity, light penetration, and habitat creation.

(c) Sight Feeders. During discharge, all motile species would relocate. No long-term adverse impact would result.

d. Contaminant Determinations. Sand material proposed to create the wetland areas would be free of contaminants.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. The discharge of material as proposed would have no long-term adverse impacts. Macro and micro-organism proliferation of the area should occur over time.

(2) **Effects on Benthos**. No long-term impacts should result. Significant positive impacts should result with the proposed muck removal and light penetration to the bottom substrate.

(3) **Effects on Nekton**. Nekton species are capable of direct locomotion and possess the capacity of moving out of the impact area. Some adverse impact would result from the proposed discharge, in loss of habitat and coverage of less motile species. Adverse impacts are anticipated to be minimal and temporary in both the terrestrial and openwater areas. Project components would include improved water quality and removal of non-productive sediments, resulting in increased production by nektons and similar organisms.

(4) **Effects on the Aquatic Food Web**. Removal of the unproductive overburden of silt/muck that covers the bottom substrate of the creek would have positive benefits on this value. Impacts associated with the proposed activity would be temporary and presents no long-term adverse impacts. Positive benefits should be added to this value with the increased establishment of mangrove wetlands.

(5) **Effects on Special Aquatic Sites**.

(a) **Hardgrounds and Coral Reef Communities**. The project area and vicinity do not support coral reef communities. Oysters observed within the area of mangroves along the east shoreline of North Fort Harrison may experience some temporary decline or impact from direct material discharge. It's expected the population should increase within a relative short duration, approximately 12 to 24 months.

(b) **Sanctuaries and Refuges**. There are no known sanctuaries or refugia that would be impacted by the project.

(c) **Wetlands**. The proposed discharge of material would not adversely impact any existing wetland, but would provide 3.2 acres of additional wetland habitat.

(d) **Mud Flats**. The project's dredging actions would have direct adverse impact on these resources by eliminating about 3.2 acres established in Reach 2. However, the proposed discharge of material would have no direct or indirect impact on these resources.

(e) <u>Vegetated Shallows</u>. Vegetated shallows within the project area are located along the western shoreline of the temporary dewatering site. No impacts are proposed to these resources from project activities.

(f) <u>Riffle and Pool Complexes</u>. The discharge of material associated with wetlands creation within the North Fort Harrison area (Reach 1) would have no adverse impacts on these resources. The proposed dredging would eliminate such areas.

(6) <u>Endangered and Threatened Species</u>. Signs are posted between North Fort Harrison and Pinellas Trail warning boaters of the manatee presence. Manatee precautionary guidelines would be used to ensure protection of the species. There has been no observance of the manatee use of this area in recent history. There are no other known federally listed species found within the project immediate boundaries. The project has the potential to support utilization of the creek by the threatened West Indian manatee. Project depth would make the creek accessible to the manatee year round. The 70 to 75 degree waters associated with the wastewater treatment plant could be accessed by the manatee during winter months. Winter distribution and warm-water manatee aggregation can be found from power plant beginning from Crystal River to the Port of Islands in Collier County Florida (FWS, Florida Manatee Recovery Plan, 2001)..

(7) <u>Other Wildlife</u>. A short-term interruption to wildlife may occur during construction. However, the planned discharge proposes no adverse impacts. Eventually, the project would provide aquatic benefits in the form of habitat, foraging, nesting, and resting areas.

(8) <u>Actions to Minimize Impacts</u>. All practicable measures to minimize the project's adverse impacts have been con sidered. Permanent disposal of dredged material would take place on uplands.

f. <u>Proposed Disposal Site Determinations</u>.

(1) <u>Mixing Zone Determination</u>. The receiving zone would be composed of the same material as the discharge area. No adverse impacts should result.

(2) <u>Determination of Compliance with Applicable Water Quality Standards</u>. Minimum turbidity is associated with hydraulic dredging. A variance would be required from the State DEP to exceed existing water quality standards. The project site waters are classified as Class III, recreational waters, but are considered Outstanding Florida Waters, along with the adjoining waters of Clearwater Harbor and St. Joseph Bay.

(3) <u>Potential Effects on Human Use Characteristics</u>.

(a) <u>Municipal and Private Water Supplies</u>. No aspect of the project proposes adverse cumulative or secondary impacts to municipal or private water supplies. Dredged material would be placed permanently on uplands that do not contain private wells or any direct drainage to waters of the State.

(b) <u>Recreational and Commercial Fisheries</u>. Juvenile fish species that spend a portion of their life cycle in estuaries would eventually migrate out of the project area toward the Gulf and open sea. Such species support the commercial fishing industry. The discharge of fill material proposes no adverse impact on this value. Secondary beneficial components of the project would improve water quality, increased photic light penetration, increased benthic production and provide fish and wildlife species with increased foraging opportunities.

(c) <u>Water Related Recreation</u>. Positive components would be realized to this value. Waterway depth currently is zero feet at mean low lower water. Lowering the waterway to -5.5 feet NGVD would provide adequate depth for small to medium draft vessels. Expansion of the mangrove wetland would restore public recreation use, increasing fishing opportunities and other water related activities.

(d) <u>Aesthetics</u>. Area aesthetics would be improved with the removal of exotic vegetation along the shoreline and at the disposal areas.

(e) <u>Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves</u>. The project proposes no adverse impacts to these values.

g. <u>Determination of Cumulative Effects on the Aquatic Ecosystem</u>. The Project proposes no adverse effect to the aquatic ecosystem. Cumulative impacts associated with the project would be beneficial. Fish and wildlife utilization of the waterway and adjacent areas should increase. Oyster production should increase with the expansion of mangrove habitat.

h. Determination of Secondary Effects on the Aquatic Ecosystem. Increasing the photic level and removing existing silt should provide conditions ideal for seagrass recruitment southwest of North Fort Harrison Bridge.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

c. After consideration of disposal site dilution and dispersion, the discharge of fill materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. Weltand creation would not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended. If the project is successful in achieving the identified goals, the manatee return to this area would be realized. The mangrove would be a secondary foraging source for the manatee.

e. The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, recreational, aesthetic, and economic values would not occur.

f. On the basis of existing guidelines, the site proposed for permanent discharge of dredged material is specified as complying with the requirements of these guidelines.

SUB-APPENDIX B - COASTAL ZONE MANAGEMENT CONSISTENCY

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM FEDERAL CONSISTENCY EVALUATION PROCEDURES

STEVENSON CREEK ESTUARY ENVIRONMENTAL RESTORATION PLAN CLEARWATER, PINELLAS COUNTY, FLORIDA

1. Chapter 161, Beach and Shore Preservation. The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

Response: The project proposes no adverse impacts to the existing shoreline. Shoreline construction seaward of mean high water would include only the creation of a mangrove shelf which buffers coastal development from erosional winds and provides a stabilizing substrate from erosion, in addition to, other public interest benefits. The proposed project would comply with the strategic vision of the State of Florida as mentioned in the State and Regional Planning Chapters.

2. Chapters 163(part II), 186, and 187, County, Municipal, State and Regional Planning. These chapters establish the Local Comprehensive Plans, the Strategic Regional Policy Plans, and the State Comprehensive Plan (SCP). The SCP sets goals that articulate a strategic vision of the State's future. Its purpose is to define in a broad sense, goals, and policies that provide decision-makers directions for the future and provide long-range guidance for an orderly social, economic and physical growth.

Response: The proposed project has been coordinated with various Federal, State and local agencies during the planning process. Further coordination would be accomplished with the issuance of the draft EA. The project is expected to meet the primary goal of the State Comprehensive Plan through preservation and protection of the shorefront development and infrastructure.

3. Chapter 252, Disaster Preparation, Response and Mitigation. This chapter creates a State Emergency Management Agency, with the authority to provide for the common defense; to protect the public peace, health and safety; and to preserve the lives and property of the people of Florida.

Response: The project involves restoring a diminishing ecosystem and proposes no action that would interfere with the State's ability to provide preparations, responses, reductions, or recoveries from emergencies or disasters. Secondary benefits associated with the project are navigation improvements and flood waters abatement. Therefore, this project would be consistent with the efforts of the Division of Emergency Management.

4. Chapter 253, State Lands. This chapter governs the management of submerged state lands and resources within state lands. This includes archeological and historical resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; submerged lands; spoil islands; and artificial reefs.

Response: A permanent location for dredged material is necessary and adequate acreage is not available to the local sponsor. Land acquired for disposal purposes would not impact resources as identified under this Chapter. The project further proposes no adverse impacts to seagrass established within Clearwater Harbor. The historic resources that may be located within the main channel of North Fort Harrison would be avoided to the fullest extent practicable. If impacts were unavoidable, these resources would be mitigated. The area has been subjected to a systematic and thorough survey to ascertain cultural significance. The project comply with the intent of this chapter.

5. Chapters 253, 259, 260, and 375, Land Acquisition. This chapter authorizes the state to acquire land to protect environmentally sensitive areas.

Response: The proposed project does not require the acquisition of public land as outlined in the referenced chapters. Land acquisition associated with the planned activity would provide the needed temporary and permanent disposal capacity. All attempts have been undertaken to ensure environmental sensitive lands are protected to the fullest extent practicable. Therefore, this chapter does not apply.

6. Chapter 258, State Parks and Aquatic Preserves. This chapter authorizes the state to manage state parks and preserves. Consistency with this statute would include consideration of projects that would directly or indirectly adversely impact park property, natural resources, park programs, management or operations.

Response: The proposed project area does not contain any state parks or aquatic preserves within the immediate area. St. Joseph Sound a recognized State aquatic preserve is located within minutes from the project site. No adverse impacts would result to this resource. The project is consistent with this chapter.

7. Chapter 267, Historic Preservation. This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.

Response: Coordination with the State Historic Preservation Officer (SHPO). Historic Property has been conducted. Resources at the project site and disposal sites propose no adverse impact to any properties eligible for listing in the *National Register of Historic places.*

8. Chapter 288, Economic Development and Tourism. This chapter directs the state to provide guidance and promotion of beneficial development through encouraging economic diversification and promoting tourism.

Response: The project would provide secondary benefits to recreational users by providing increased boating and fishing opportunities. This action would be compatible with tourism for this area and therefore, is consistent with the goals of this chapter.

9. Chapters 334 and 339, Transportation. This chapter authorizes the planning and development of a safe balanced and efficient transportation system.

Response: No form of public transportation would be impacted by the project.

10. Chapter 370, Saltwater Living Resources. This chapter directs the state to preserve, manage and protect the marine, crustacean, shell and anadromous fishery resources in state waters; to protect and enhance the marine and estuarine environment; to regulate fishermen and vessels of the state engaged in the taking of such resources within or without state waters; to issue licenses for the taking and processing products of fisheries; to secure and maintain statistical records of the catch of each such species; and, to conduct scientific, economic, and other studies and research.

Response: Impacts associated with the creation of 3.2 acres of mangrove wetland would be temporary to non-motile infaunal or benthos. These organisms are highly fecund and adaptive to periodic burial by sand in the intertidal zone. Levels should return to pre-construction conditions within 6 months to one year. Based on the overall impacts, benefits that would be provided by the proposed activity are consistent with the goals of this chapter.

11. Chapter 372, Living Land and Freshwater Resources. This chapter establishes the Game and Freshwater Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

Response: The project proposes no adverse impacts to land or freshwater resources.

12. Chapter 373, Water Resources. This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.

Response: This project would not adversely affect water resources as described by this chapter.

13. Chapter 376, Pollutant Spill Prevention and Control. This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

Response: The contract specifications will prohibit the contractor from dumping oil, fuel, or hazardous wastes in the work area and will require that the contractor adopt safe and sanitary measures for the disposal of solid wastes. A spill prevention plan would be required. Test results for pollutants and hazardous wastes indicate levels of metals are such that no special handling would be required.

14. Chapter 377, Oil and Gas Exploration and Production. This chapter authorizes the regulation of all phases of exploration, drilling, and production of oil, gas, and other petroleum products.

Response: This project does not involve any type of exploration or production activities.

15. Chapter 380, Environmental Land and Water Management. This chapter establishes criteria and procedures to assure that local land development decisions consider the regional impact nature of proposed large-scale development. This chapter also deals with the Area of Critical State Concern program and the Coastal Infrastructure Policy.

Response: The proposed action will have no direct adverse or beneficial effects on large-scaled development. The drainage basin of the creek would receive benefits, in that; some relief from flood events should result. This chapter however does not apply to the proposed action.

16. Chapters 381 (selected subsections on on-site sewage treatment and disposal systems) and 388 (Mosquito/Arthropod Control). Chapter 388 provides for a comprehensive approach for abatement or suppression of mosquitoes and other pest arthropods within the state.

Response: Measures would be in place to ensure surface waters do not contribute to propagation of mosquitoes or other pest arthropods. Adequate drainage facilities would be planned into the temporary and permanent disposal areas. Therefore, the project would be consistent with the goals of this chapter.

17. Chapter 403, Environmental Control. This chapter authorizes the regulation of pollution of the air and waters of the state by the Florida Department of Environmental Regulation (now a part of the Florida Department of Environmental Protection).

Response: Environmental protection measures will be implemented to ensure that no lasting adverse effects on water quality, air quality, or other environmental resources occur. Water Quality Certification would be sought from the State prior to construction. The project would comply with the intent of this chapter.

18. Chapter 582, Soil and Water Conservation. This chapter establishes policy for the conservation of the state soil and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop, and utilize soil and water resources both onsite or in adjoining properties affected by the project. Particular attention will be given to projects on or near agricultural lands.

Response: The proposed project is not located near or on agricultural lands. This chapter does not apply.

SUB-APPENDIX C - CUMULATIVE EFFECTS ASSESSMENT

CUMULATIVE EFFECTS ASSESSMENT

STEVENSON CREEK ESTUARY
ENVIRONMENTAL RESTORATION PLAN
CLEARWATER, PINELLAS COUNTY, FLORIDA

This Appendix C documents the technical data, definitions, and methods for assessing the cumulative impacts. The definitions and methods are taken largely from the Council on Environmental Quality (CEQ) publication "Considering Cumulative Effects Under the National Environmental Policy Act" 1997. The following describes the methods, rationale, and results of the Cumulative Effects Assessment for the proposed action and alternatives in terms of the 11 steps identified by CEQ.

1. Significant Cumulative Effects Issues and the Assessment Goals.
The cumulative impacts of the proposal were assessed in an Environmental Benefits analysis prepared by Dial Cordy and Associates 2002 (see Appendix E, Study Reports). Existing wetlands values at the dewatering site were quantified using an Estuarine Wetland Rapid Assessment Procedures (E-WRAP). Aquatic habitat value of the estuary was also quantified to determine environmental benefits and long-term impact.

Existing roadways, ditches, canals, levees, or other anthropogenic impacts have eliminated wetland flood plain and altered hydrology. Wetlands at the temporary disposal site would experience some unavoidable impacts. Attempts were made to avoid adverse impacts to the fullest extent practicable. Positive impacts would result from the project. Water-dependent species (i.e., fish, wading and migratory birds) utilization of the area should increase. Wetland habitat would increase, providing cover, food, nesting, and roosting areas. Desirable groundcover would increase, providing refugia for macroinvertebrates, fishes, reptiles, amphibians, and small mammals, in addition to, food sources for certain mammals, waterfowl or wading birds. The project proposes no adverse cumulative impacts. Long-term environmental benefits would be received with creation of 3.2 acres of mangrove habitat.

2. Geographic Scope.
Stevenson Creek contain 39 acres of which 29 acres are proposed for restoration. Dredging of the creek would occur east of the NFH Bridge to west of the PT Bridge. Some existing mudflats would be eliminated between the DA Bridge and PT Bridge. The project, however, would create 3.2 acres of mangrove habitat which has the potential to yield approximately from 27.92 to 66.69 habitat units.

3. Time Frame.
Removal of 111,000 cubic yards of sand and muck from the lower reach of Stevenson Creek (Reach 1) and 86,500 cubic yard from the upper reach (Reach 2), with creation of 3.2 acres of mangrove habitat areas would allow the estuary to achieve a self-sustaining level of environmental recovery within 12 to 24 months. This projection is based on the usual re-establishment of benthic organisms within 6 months to 1 year of construction activity and mangroves adaptation and reproductive strategies within 8 to 13 months (Odum 1982).

4. Other Actions Affecting the Resources, Ecosystems, and Human Communities.
The Stevenson Creek estuary continues to have substantial non-point source discharges from upland stormwater runoff and aging septic tanks. The City of Clearwater has begun to take action to address these issues. Specifically, features that provide conveyance enhancements, treatments, and attenuation of floodwaters are to be in place for Spring Branch by April 30, 2005. Approximately $4million will be used to acquire property for construction of features that allow 27 existing direct stormwater discharge structures to be taken offline. Such construction would be successful in removing upstream sedimentation and pollutants before reaching the estuary.

BCI Engineers and Scientists, Inc., on behalf of the City of Clearwater provided a feasibility level report on sediments within Stevenson Creek (August 1998). In summary, the Stevenson Creek Sediment Characterization and Removal Feasibility Study, chemical analysis found that sediments contained a level of copper that exceeded Class 3 marine water quality standards (WQS). Petroleum hydrocarbons, oil and grease were also detected. Toxicity Characteristic Leaching Procedure (TCLP) define analysis for priority pollutants metals, pesticides, herbicides, and potential metal toxicity. TCLP results were below criteria levels set forth in 40 CFR 261.24, and did not qualify as hazardous. After being subjected to elutriate procedures, copper, lead, silver, zinc exceeded Class 3 marine WQS. However, additional sampling and testing would be required to substaniate consistency of concentration. There may also exist sources of input from contaminants such as Polynuclear Aromatic Hydrocarbons, in addition to metals such as aluminum, arsenic, iron, and manganese. High solid content sand with low organic content dominated the area east of Pinellas Trail with low solids and high organic sediments west of Pinellas Trail.

Sediment analysis and elutriate testing performed by the Corps yielded results comparable to BCI's findings with exception of organic concentrations. Both reports are included in Sub-Appendix E, Project Study Reports. Removal of the existing sediments would benefit the benthic community and improve water quality.

5. Response of Resources to Change and Stress.
Stevenson Creek is a presently a low to minimally functioning estuary with some production of blue and fiddler crabs, shellfish (oyster and clam), fringing mangroves. Utilization by Wading, shore, and migratory birds, are known to forage the areas of the creek when the sandflats are exposed during low tides. Circulation patterns are currently obstructed from NFH to DA by sandflats, bottom sediments, substantial organic material, and overlying muck. Dredging the creek to increase conveyance, circulation, and velocity would increase utilization by nursery and juvenile fishery species, and would increase the production of existing mangroves. Mangroves have a series of remarkable adaptation which enable them to flourish in an environment characterized by high temperatures, widely fluctuating salinities, and shifting, anaerobic substrates (Odum 1982). Undertaking the proposed restoration activity would add positive components to the cumulative productivity of the estuary and utilization by water-dependent species. Secondary components would increase recreational use and public interest values.

6. Stresses Effecting the Resources and Thresholds.
The City of Clearwater contracted with Parson Engineering Science, Inc. (Parsons) to develop a phased water management plan for Stevenson Creek, to improve the physical, chemical, and biological integrity of surface water discharging to Stevenson Creek, and to lessen floodwaters damage to surrounding development. This report can be viewed in its entirety at the U.S. Army Corps of Engineers, Jacksonville District Office.

Parson's water management plan attempts to develop a holistic and comprehensive approach to improving the Stevenson Creek watershed physical, chemical, and biological integrity of surface water in a three-part process. Components of the plan included identifying the watershed's natural boundaries (incorporating all the land areas that contribute stormwater runoff to a particular surface water body), applying the latest scientific methods to identify problems (includes watershed rehabilitation, scientific discipline and expertise), and coordinating improvements within social, political, and economic constraints (developing a team approach using local state, and federal agencies).

The Stevenson Creek floodplain has been substantially altered and adversely impacted by channelization and development. The resulting effects have been flooding to surrounding development, moderate to severe erosion to the creek and it's tribu taries due to steep embankment, improper maintenance, highly erodible soils, and inadequate right-of-way. The City of Clearwater in an attempt to control flooding events has constructed two phases of a three-phase flood control project. The first two phases of the project consist of the creek's main channel segments between Betty Lane and Jeffords Street (Parsons 2001). The third phase would include the segment upstream of Jeffords. Parson has also identified stream bank and streambed erosion as a major source of solids in the Stevenson Creek Watershed, in addition to, metals (aluminum, lead, and zinc), nutrients (nitrogen and phosphorus), and bacteria (animal and human fecal contaminations).

Parson recommends improvements within the watershed to address flood protection, water quality, and erosion sedimentation problems. This recommendation also includes maintenance of infrastructure throughout the watershed, exotic plant eradication, and wetland planting. The recommendation also includes the elimination of a common practice of dumping yard waste into creeks, ditches, swales, and storm sewers. Illegal dumping has contributed to the accumulation of highly organic sediments in the estuary.

Spring Branch a tributary to Stevenson Creek contributes a significant source of sediments, nutrients, and freshwater into the creek. Any substantial and lasting restoration efforts would need to consider improvements to the waters of Spring Branch. This would be in addition to, the eventual clean up and elimination of freshwater inputs, pollutants, contaminants, and sedimentation from the sources identified in the Parson's report. Without these efforts, adverse cumulative impacts would result to the estuary with eventual decline in fish and wildlife values, public interest uses, recreational components, and aesthetic appeal. The City of Clearwater would need to continue implementation of its watershed management plan, with inclusion of offline and online treatment facilities to include wetland creation. The City of Clearwater proposes action as previously identified to address problems associated with the Spring Branch discharge. Action proposed to commence in April 2005 would significantly reduce sediment loading in the creek, and would improve water quality.

7. Baseline Condition.

Stevenson Creek is classified according to the Fish and Wildlife Service *Classification of Wetlands and Deepwater Habitats of the United States*, December 1979, as an estuarine system with an intertidal subsystem. The water regime is regularly flooded with a mixohaline water chemistry. According to the Florida Department of Environmental Protection (FDEP) 1993 Surface Water Quality Standards Chapter 17-302.520(3)(e), Stevenson creek is classified as a marine system. Fresh water is defined by the FDEP as those "above the zone in which tidal actions influence the salinity of the water and where the concentration of chloride ions is normally less than 1500 milligrams per liter (mg/L)." The chloride ions concentration in Stevenson Creek at the Pinellas Trail Bridge is 3570 mg/L, indicative of saline (marine) waters (BCI 1998). From 1991 to 1998 salinity levels at the Douglas Avenue Bridge east of Pinellas Trail averaged from 15.49 parts per thousand (ppt) to 14.55 ppt. Spring Branch the major northeast tributary salinity levels varied from 26.10 ppt to 15.19 ppt during the period of 1991 to 1998.

Approximately 90 percent of the Stevenson Creek watershed is developed. However, only 56 percent of the land within the lower basin is developed (from North Fort Harrison to Douglas Avenue.) as identified in Table 1.

Table 1 Land Use Types in the Lower Stevenson Creek Watershed

Land Use	Acreage
Residential	516
Commercial	56
Industrial	20
Institutional	31
Recreational	116
Open Land	11
Agriculture	0
Upland Forests	0
Water Bodies	40
Wetlands	5
Trans./Utilities Communications	27
Total Acreage	**821**

Source: Parson 2001

Table 2 Mangroves Gross Primary Production (GPP) at Different Salinities (Hicks and Burns 1975)

Mangrove Type	Average Surface Salinity (ppt)	GPP gC/M2/day
Red	7.8	8.0
Red	21.1	3.9
Red	26.6	1.6
Black	7.8	2.3
Black	21.1	5.7
Black	26.6	7.5
White	21.1	2.2
White	26.6	4.8

8. Cause and Effect Relationships.
The estuary's decline is attributable to sedimentation, habitat alteration, stream channelization, discharge of untreated urban stormwater runoffs, erosion of stream banks, inputs of metals and nutrients, depleted oxygen levels, and bacteria (leaking sewers and septic tanks). The resulting effect is a continuing decline in habitat, fish and wildlife use, and water quality values. Measures to be implemented in April 2005 by the City should have positive benefits on addressing and eliminating some if not all of the identified problems.

9. Magnitude and Significance
With exception of existing sand and mudflats, the project proposes no adverse impacts to the aquatic environment. Completion of the project would add values to the estuary which support increase utilization and production by sport fishing species such as snook and red drum.

10. Mitigation of Significant Cumulative Effects.
Mitigation is not required to offset or compensate project impacts. The project would restore a declining and degraded estuary by removing unproductive muck, contaminated sediments, and nutrients accumulated over the bottom substrate of the creek. This action would increase photosynthesis by raising the photic light penetration needed for successful colonization of benthos and submerged resources.

11. Monitoring and Management.
The City of Clearwater would accomplish all monitoring and management of created wetlands, in addition to, any required remedial actions.

SUB-APPENDIX D- FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
6620 Southpoint Drive South
Suite 310
Jacksonville, Florida 32216-0958

IN REPLY REFER TO:
FWS/R4/ES-JAFL

January 10, 2002

Ms. Catherine Brooks
US Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Ms. Brooks:

In accordance with an FY 2001 funding agreement with the U.S. Army Corps of Engineers' Jacksonville District, the U.S. Fish and Wildlife Service (Service) is submitting the enclosed final Fish and Wildlife Coordination Act Section 2(b) Report with reference to the Stevenson Creek Restoration Project, Pinellas County, Florida. Included in the final report is the required section 7 consultation for the Endangered Species Act.

If you have a question about this report, please contact either Don Palmer at (904) 232-2580, ext. 115 or Bryan Pridgeon at (727) 570-5398, ext. 13.

Sincerely,

Don Palmer

For Peter M. Benjamin
Assistant Field Supervisor

Enclosure

cc with enclosure:
J. Beever/GFC/Punta Gorda

S: palmer\stevensonltr\acm\01.10.02

Jan 10, 2002

STEVENSON CREEK SECTION 206 ENVIRONMENTAL RESTORATION PROJECT

DRAFT ~~FINAL~~ REPORT

10 Jan 02

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, in cooperation with the City of Clearwater, has proposed restoration activities for the tidally influenced part of Stevenson Creek, a small creek flowing into Clearwater Harbor (Pinellas County, Florida). The restoration is proposed under Section 206 of Water Resources Development Act of 1996. In response to the Preliminary Restoration Plan (PRP), this report was prepared under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the Endangered Species Act of 1973, as amended.

Previous studies, reports, data, and field visits indicate that the area is both in need of restoration and that the success of restoration activities is likely, especially if coupled with local basin and watershed management plans. The creek has been heavily impacted by human activities. Filling portions of the creek for residential development, recreational areas, and roadways/bridges has resulted in hydraulic conditions that promote the accretion of mucky bottom substrates in certain areas, and the deposition of coarser materials in other areas. Muck and silt substrates have resulted in the loss of much of the biological value of the most downstream portion of the creek. Fortunately, some viable habitats still exist within and adjacent the principal project area (Douglas Avenue Bridge down to the Fort Harrison Bridge of Edgewater Avenue).

According to restoration plans, efforts to improve habitat structure and function will comprise dredging activities, the installation of emergent and submerged vegetation, and the control of exotic plant species. The U.S. Fish and Wildlife Service recommends several additional measures to complement proposed restoration activities in order to maximize current habitat resources, enhance the estuarine ecosystem, and encourage public interest in restoration. Among these measures are the transfer of selected sediments to Submerged Aquatic Vegetation/mangrove planting areas, the preservation of an important wetland system, the management of an avifauna feeding area, and the construction of recreational/educational facilities.

FINAL
FISH AND WILDLIFE COORDINATION ACT REPORT
FOR THE
STEVENSON CREEK
SECTION 206 ENVIRONMENTAL RESTORATION PROJECT

Prepared for
Jacksonville District
US Army Corps of Engineers
400 West Bay Street
Jacksonville, Florida 32202

and

US Fish and Wildlife Service
9549 Koger Boulevard, Suite 111
St. Petersburg, Florida 33702

by
Dial Cordy and Associates Inc.
490 Osceola Avenue
Jacksonville Beach, Florida 32250

11 September 2001

1.0 IDENTIFICATION OF PURPOSE, SCOPE AND AUTHORITY

The purpose of the Stevenson Creek restoration project is to improve the quality of the Stevenson Creek estuary environment, providing wildlife habitat and satisfying the public interest (ACOE, 2000). Restoration is proposed under Section 206 of Water Resources Development Act of 1996. The Section 206 restoration activities, focusing on the lower reaches of Stevenson Creek, will be incorporated into the Estuary Restoration Project and Stevenson Creek Watershed Management Plan, both sponsored by the City of Clearwater, Florida.

This Fish and Wildlife Coordination Act Report (CAR) evaluates the impact of the proposed restoration project on fish and wildlife resources. The CAR is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the Endangered Species Act of 1973, as amended.

2.0 PRIOR STUDIES AND REPORTS

The U.S. Army Corps of Engineers (ACOE) briefly described plans for the Stevenson Creek project in the Preliminary Restoration Plan (ACOE, 2000). This CAR is written in response to the project as described in that document (detailed below in *Description of Project Evaluated by the Service* section). The Preliminary Restoration Plan (PRP) discusses project history, goals, rationale, and projected benefits and costs.

Because of its relevance to dredging in the project area, the PRP cites a preliminary sediment characterization study (BCI, 1998) that was conducted to determine the physical and chemical properties of creek water, sediments, and elutriate water. Sediment analyses indicated that one semi-volatile constituent, benzo (a) pyrene, was detected at a concentration equal to the Florida Department of Environmental Protection's (DEP) residential clean-up threshold goal, and that both oil and grease were detected. Water analyses (of a sample taken from just upstream of the Douglas Avenue Bridge) indicated that copper concentration was higher than allowable for Class III Water Quality Standards (WQS). Finally, analyses of elutriate water demonstrated that copper, lead, silver, and zinc concentrations were all higher than allowable levels for Class III WQS. Further investigations of metals, oil, and grease in sediments were recommended to determine the prevalence of these substances in creek sediments.

To further investigate sediments that may be dredged from the creek, and to guide in the determination of a suitable de-watering site for sediments, the Jacksonville District ACOE coordinated additional sampling and analyses of creek sediments. The resulting data (PPB Environmental Laboratories, 2000) are especially crucial because one possible disposition site is an auto salvage yard listed by the U.S. Environmental Protection Agency (EPA) and the DEP as one of 220 Targeted Brownfields Assessment Program regulatory sites in Clearwater (Ballogg, pers. com.). Therefore, sediments placed on the site, following clean-up of the salvage yard, must meet various criteria, including those established by the DEP for residential areas.

Radiometric data obtained from cores taken at the creek's approximate centerline within the project area were analyzed to determine the rate of buildup of sediments. Analyses indicated that muck (fine particulate matter) was deposited over the last 35 years. This rate was described as a "very rapid accumulation" (Holmes, 2001).

The Final Draft Report of the Stevenson Creek Watershed Management Plan (Parsons, 2001) presents the overall goals for the watershed and gives detailed background data and information regarding the methods for implementation. The management plan places the PRP into a broader context, but provides few data specific to the project area.

The Pinellas County Department of Environmental Management (DEM) currently collects data both within and adjacent to the estuary. For example, DEM maintains databases for manatee (*Trichechus manatus)* sightings in the creek and harbor, and for several seagrass sampling sites in Clearwater Harbor near the creek. In addition, DEM has sampled and analyzed water samples obtained at the southeast edge of the project area, and in Spring Branch, a tributary to the north of the project site.

Dial Cordy and Associates Inc. (DC&A) recently (June, 2001) conducted a survey of the project area's natural resources, protected species, and critical habitats, and collected information that may be useful for determining the likely impacts of restoration activities, including dredging. Much of the information below is based on that field study.

3.0 DESCRIPTION OF PROJECT AREA AND CURRENT CONDITIONS

3.1 General Information

The restoration plan involves the section of Stevenson Creek that flows through Township 29 S, Range 15 E, Section 3, in Pinellas County, Florida (Figure 1). The project area of approximately 29 acres is entirely within the City of Clearwater. Tributaries of the creek include Spring Branch, a few unnamed creeks, and several ditches and piped drainageways. The approximate average widths of the open water areas between the Fort Harrison Bridge (Edgewater Drive/Alternate U.S. Hwy 19) and the Pinellas Trail Bridge (former CSX railroad), and between the Pinellas Trail Bridge and the Douglas Avenue Bridge are approximately 375 feet (maximum = ca. 750 feet), and approximately 300 feet, respectively. Channel width upstream of the project area narrows considerably (18-30 feet). Major features adjacent to this reach include the Marshall Street Advanced Wastewater Treatment Facility, an auto salvage/disposal yard, and a wetland community dominated by mangroves and rushes. With a few exceptions, properties adjacent to the project area are residential.

Figure 1

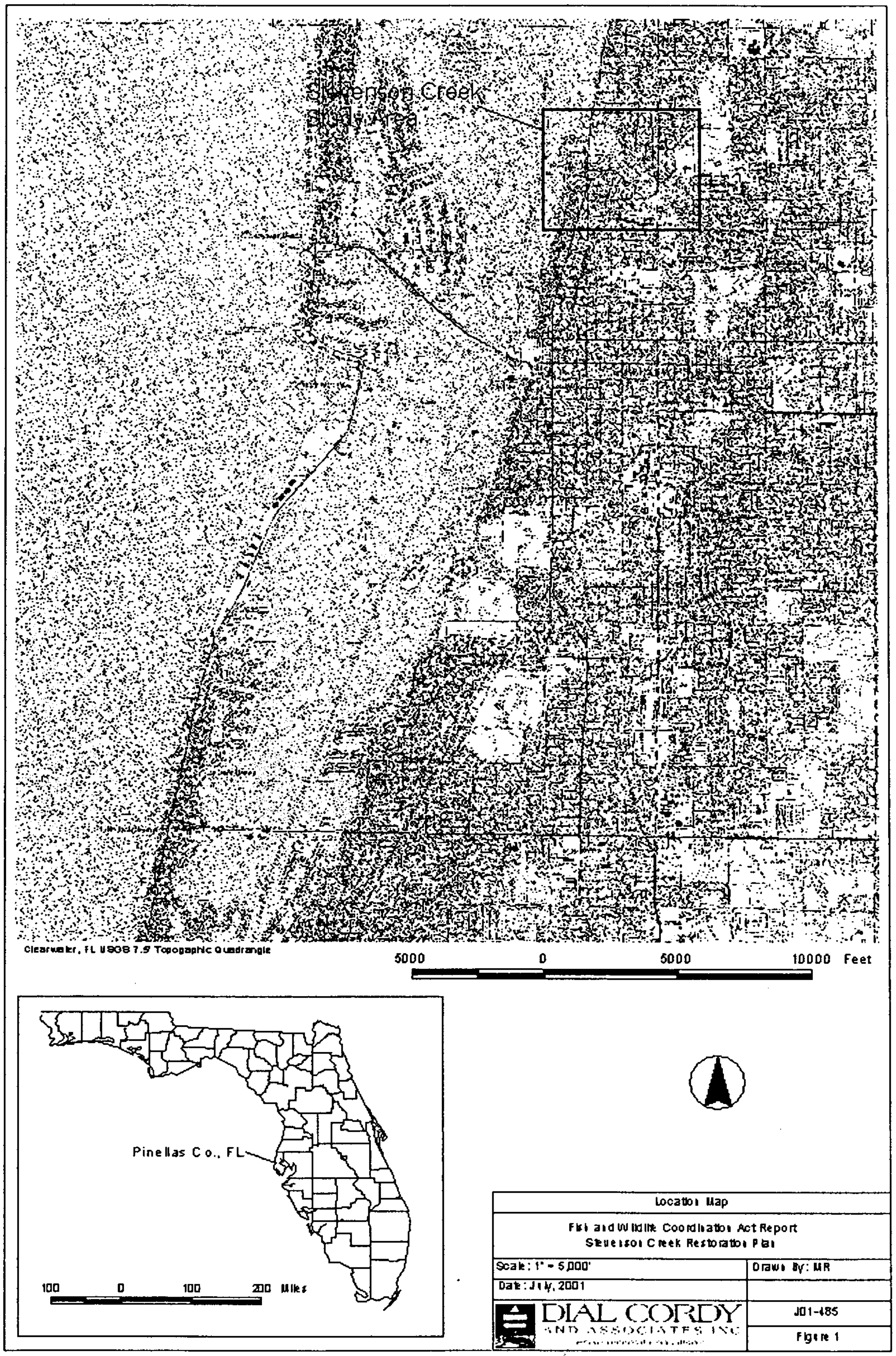

Figure 1 Location Map

3.2 Hydrology and Water Quality

Hydrology and water chemistry in the Stevenson Creek project area are heavily influenced by tides. Stream-channel bottom elevations at the Fort Harrison Bridge, Pinellas Trail Bridge, and Douglas Avenue Bridge are approximately -4.0 feet -3.0, and -3.0 NVGD, respectively (Parsons, 2001), and average salinities at the Douglas Avenue Bridge and in Spring Branch at Overbrook Street range between 11 and 18 ppt, and between 15 and 27 ppt, respectively (Pinellas County Department of Environmental Regulation, in Appendix I, Parsons, 2001). Historic and/or recent water quality problems in the area include low dissolved oxygen levels, high turbidity, and high coliform bacterial counts (PBS&J, 1996). Although some water quality data have been collected at the Douglas Avenue Bridge and in Spring Branch, no data collected after 1990 were found for the Stevenson Creek project-area.

3.3 Fish, Wildlife, and Habitat Resources

Fish and wildlife resources in the project area are typical of a small, Gulf Coast estuary system surrounded by residential development. No pristine areas are available for habitat use. However, shoreline (mangrove-covered areas) and in-stream habitats support communities comprising a wide variety of species (Table 1). Notable habitats available to fish and/or wildlife include creek waters, mudflats that become exposed during low tides, riparian areas adjacent to uplands, wetlands associated with the creek, and surrounding uplands. Although no submerged aquatic vegetation (SAV) was observed during field surveys between the Douglas and Harrison Bridges, there are substantial SAV (*Halodule wrightii*) resources in Clearwater Harbor in close proximity to the small channel extending from the Harrison Bridge to the Intracoastal Waterway channel (Figure 2).

The estuary does support substantial populations of birds, fishes, and other organisms (crabs, clams, etc.). Recent observations indicate that the estuary is important for certain sport fishes such as snook (*Centropomus undecimalis*) and red drum (*Sciaenops ocellatus*), as well as avifauna that utilize mudflats for feeding and/or shoreline vegetation for roosting. The wetland areas adjacent to Douglas Avenue are especially important habitats for birds, juvenile and prey fishes, and various invertebrates. Pinellas County data for 1992-1999 demonstrate use of the estuary by manatees (Figure 2). However, no other federally protected species are known to occur in the creek. Although oysters (*Crossostrea virginica)* were noted in a few isolated areas within project boundaries, they are generally restricted to areas close to the shoreline and associated with black mangrove pneumatophores. Florida Marine Research Institute data from 1992-1997 show no occurrences of sea turtle strandings in the area.

Table 1 Species Observed 26-27 June 2001 at Stevenson Creek

FISHES
Mullet (*Mugil* sp.) (west of Fort Harrison Bridge)
Snook (*Centropomus undecimalis*)
Redfish (*Sciaenops ocellatus*)
Silversides (*Menidia* sp.)
Pinfish (*Lagodon rhomboides*) or mojarras (fam Gerreidae)

AMPHIBIANS/ REPTILES
unidentified lizard (*Sceloperus* sp.)

BIRDS
White Ibis (*Eudocimus albus*)
Yellow-crowned Night Heron (*Nyctanassa violacea*)
Little Blue Heron (*Egretta caerulea*)
Great Blue Heron (*Ardea herodias*)
unidentified gull species (fam. Laridae)
Royal Tern (*Sterna maxima*)
Reddish egret (*Egretta rufescens*)
Snowy Egret (*Egretta thula*)
Brown Pelican (*Pelicanus occidentalis*)
Anhinga (*Anhinga anhinga*)

MAMMALS
Marsh Rabbit (*Sylvilagus palustris*)

INVERTEBRATES
bivalve, possibly mussel species
bivalve, possibly species of jackknife clam (*Tagelus* sp.)
Eastern Oyster (*Crossostrea virginica*)
Blue Crab (*Callinectes sapidus*)
Fiddler Crab (*Uca* sp.)
holothuroidean echinoderm, possibly *Leptosynapta* sp.,
translucent white, wormlike, 1-2 cm long,
(west of Fort Harrison Bridge)
polychaete sp.? (eggcase found)

Table 1, continued.

VEGETATION
Shoal-grass (*Halodule wrightii*) (west of Fort Harrison Bridge)

<u>Creek banks and flats</u>
Black Mangrove (*Avicennia germinans*)
Red Mangrove (*Rhizophora mangle*)
Brazilian Pepper (*Schinus terebinthifolius*)
Australian Pine (*Casuarina sp.*)
Juncus (*Juncus* sp.)
Saltmarsh Cordgrass (*Spartina alterniflora*)
Saltbush (*Baccharis halimifolia*)
Sea Rocket (*Cakile edentula*)
Spike Grass (*Distichilis spicata*)
Saltwort (*Batis maritima*)
Glasswort (*Salicornia virginica*)

<u>Upland area adjacent to proposed spoil dewatering site</u>
*Australian Pine (*Casurina equisetifolia*)
*Lead Tree (*Leucaena leucocephala*)
Sand Live Oak (*Quercus geminata*)
Water Oak (*Q. nigra*)
Laurel Oak (*Q. laurifolia*)
Sabal Palm (*Sabal palmetto*)
*Earpod (*Enterolobium contortisiliquum*)
*Chinaberry (*Melia azedarach*)
*Chinese Tallow (*Sapium sebiferum*)
Camphor Tree (*Cinnamonum camphora*)
Persimmon (*Diospyros virginiana*)
*Castor Bean (*Ricinus communis*)
Elderberry (*Sambucus canadensis*)
Mulberry (*Morus rubra*)
Palmetto (*Serenoa repens*)
Muscadine (*Vitis rotundifolia*)
*Caesar's Weed (*Urena lobata*)
Spanish Needles (*Bidens pilosa*)
Catbriar (*Smilax sp.*)
Blackberry (*Rubus sp.*)
Virginia Creeper (*Parthenocissus quinquefolia*)
*Air Potato (*Dioscoria bulbifera*)
Bracken Fern (*Pteridium aquilinum*)

*exotic species (Florida Exotic Pest Plant Council, 1999, http://www.fleppc.org/99list.htm)

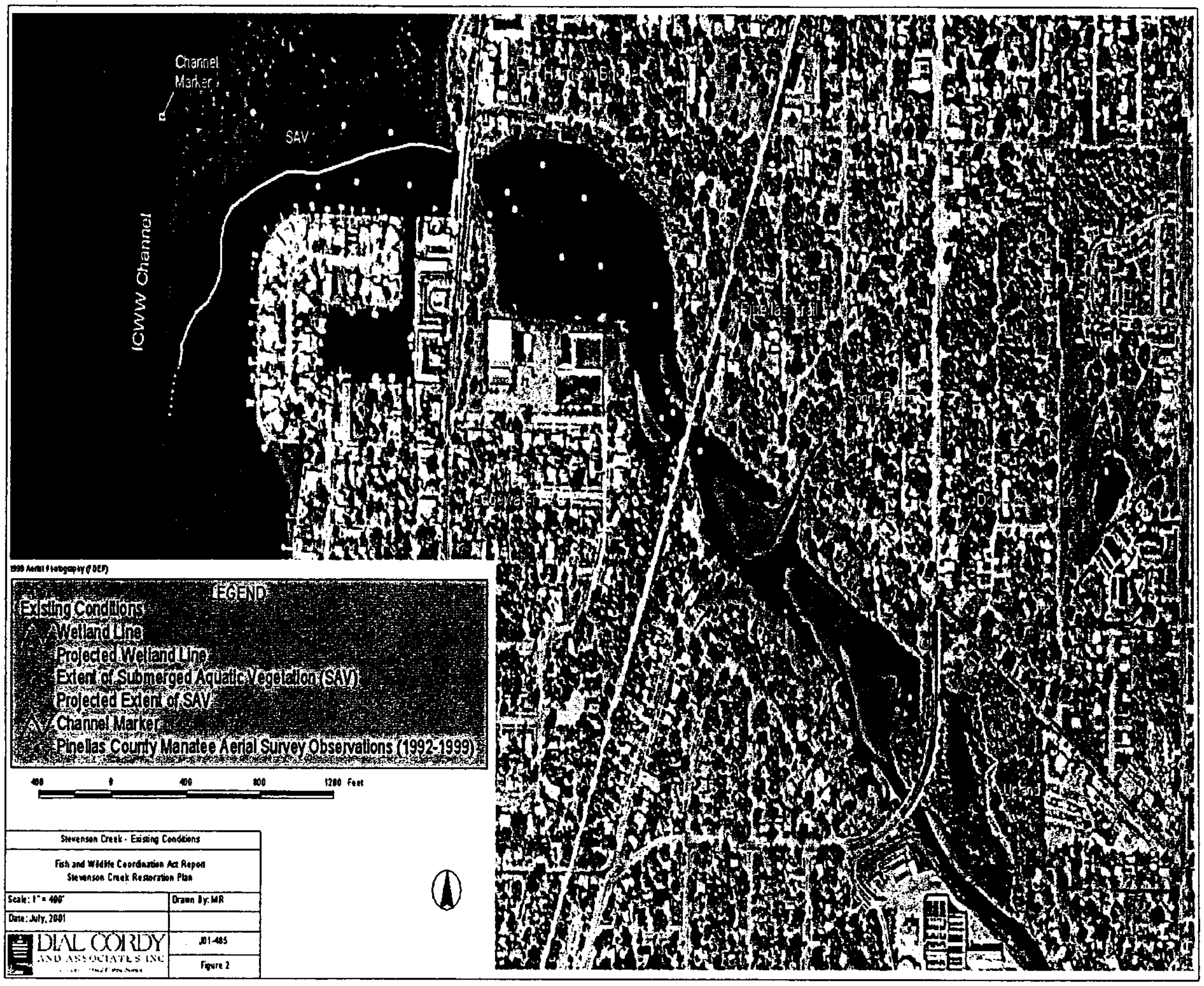

Figure 2 Stevenson Creek - Existing Conditions

3.4 Exotic Species

Observed exotic species associated with the creek were limited to plants, particularly Brazilian pepper (*Schinus terebinthifolius*) and Australian pine (*Casuarina sp.*). Although mentioned as possibly problematic (ACOE, 2000), cattail (*Typha* sp.), torpedo grass (*Panicum repens*) melaleuca (*Melaleuca quinquenervia),* and seaside maho (*Thespesia populnea)* were not observed within the primary project area during the June 2001 reconnaissance. Various exotic species (Table 1) were observed in the upland area between the proposed sediment de-watering site and the mangrove/juncus marsh adjacent to Douglas Avenue.

4.0 FISH AND WILDLIFE SERVICE PLANNING OBJECTIVES AND EVALUATION METHODOLOGY

The Service's planning objectives are intended to determine how the proposed restoration activities will affect the area's fish and wildlife resources, including species protected by state and/or federal statute and critical habitats. Consideration is given to both temporary and possible long-term effects.

Evaluation methods included the use of reports, unpublished and published data, and fieldwork. The site was observed during both high and low tides, and both open water and riparian areas were investigated. Care was taken to examine sediment quality, bathymetry, vegetation, and site surroundings in order to estimate project effects on fish and wildlife. On-site observations resulted in a species list (Table 1) for both flora and fauna.

5.0 DESCRIPTION OF PROJECT EVALUATED BY THE SERVICE

The primary component of the Section 206 restoration is the removal of certain sediments in the creek in order to increase water quality and tidal flow, benefit the benthic community, and stimulate the regeneration of seagrasses (ACOE, 2000). The most widespread dredging activity will entail muck removal from the creek between the Fort Harrison Bridge and the Pinellas Trail Bridge. Additional, limited dredging is proposed for the area between Pinellas Trail and the Douglas Avenue Bridge. Conversations with ACOE and City of Clearwater personnel indicate that some minor dredging may also be proposed in the future for the reach of the creek extending upstream from the Douglas Avenue Bridge (adjacent to the Marshall Street Advanced Treatment Facility), and proposed for the channel west of the Fort Harrison Bridge. However, these activities are not explicitly described in the PRP. Overall, ACOE proposes the removal of approximately 80,000 cubic yards of muck from the project area, and an additional 10,000 cubic yards of sand from the area adjacent to the Fort Harrison Bridge. Plans also call for the removal of an acre of exotic vegetation, the installation of 10-12 acres of SAV, and planting emergent vegetation along approximately 2,500 linear feet of shoreline.

6.0 ANTICIPATED CONDITIONS WITHOUT PROJECT

6.1 Hydrology, Water Quality, and Sediments

Without the implementation of this Section 206 project, water quality within the project area of Stevenson Creek would likely continue to decline, albeit at a slower rate than it has in the last 30-40 years. This is due to the fact that little new clearing or construction is likely to occur in the watershed, and because hydrologic, hydraulic, and pollution control improvements are scheduled for most of the Stevenson Creek watershed. Without the project, the further deposition of silt may increase to problematic proportions, the already thick layer of muck on the historic creekbed.

6.2 Fish, Wildlife, and Habitat Resources

Without the proposed project, the habitat within the project area will continue to deviate from its original condition as a well-flushed estuarine creek. With additional sedimentation, water depth will decrease. This may allow for the development of vegetation within the creek channel. In fact, mangrove seedlings have already been observed in the middle of the channel. Although vegetation encroachment may not necessarily be detrimental for certain species, the structure and function of the estuary will change considerably. Certainly, decreased water depth would limit use by manatees and larger sportfishes. It is possible that, given enough time, the estuary may become a tidal marsh. This outcome would have negative consequences for the majority of the current species assemblage, as well as the citizens of Clearwater, who depend on Stevenson Creek to function as a conduit for stormwater and treated water discharge to Clearwater Harbor.

Between Pinellas Trail and the Douglas Avenue Bridge, several sandy areas become exposed during low tides. These areas provide significant foraging areas for various birds. Without selective dredging, sediment quality in the foraging areas may decline and thereby limit food resources (e.g. mollusks, crustaceans, and polychaetes) utilized by wading birds and certain fishes.

Project plans include conducting activities to limit and control the spread of exotic species in the project area. Without maintenance-control of exotic species such as Brazilian pepper and Australian pine, native vegetation would likely decline relative to these more invasive species. Species that depend exclusively on native vegetation for food, refuge, or roosting would decline as well. (On-site observations indicated that mangroves, not Brazilian pepper, were preferred by certain wading birds for roosting.)

7.0 ANTICIPATED POST-PROJECT CONDITIONS

Project implementation will result in both temporary impacts and permanent changes in the creek. Temporary impacts may include turbidity in the project area and adjacent areas, the deposition of suspended materials outside of the project area, and damage to riparian vegetation. Permanent changes to the project area and its fish and wildlife resources will depend on the extent and pattern of dredging, and the extent of vegetation installation. The following assessment of projected permanent changes to the project area is based on the PRP, and rests on the assumptions that (1) the majority of fine substrate (muck) is removed from the Pinellas Trail to Harrison Bridge segment, (2) sand substrate is removed from only areas surrounding the Harrison Bridge, and (3) that dredging between Pinellas Trail and Douglas

Avenue is restricted to one channel that does not significantly impact avifauna foraging areas. Although activities to improve the proposed plan are suggested in following sections, these are not evaluated in this section.

7.1 Habitat Resources

Important habitats in the project area include wetlands and narrow shoreline areas dominated by mangroves, grasses, sedges, or rushes, and sandy creek substrates that are used by birds as feeding grounds. They are also used by many living marine resources for various life stages and are designated as Essential Fish Habitat (EFH) by the National Marine Fisheries Service. In addition, the "open water column"and "unvegetated sand/mud substrates" are also designated as EFH. Proposed activities described in the PRP will likely have a positive effect on these habitats. Removal of silt substrates would improve water quality by decreasing turbidity and increasing the penetration of light to the creekbed. In shallow areas, this may stimulate the growth of SAV, or increase the likelihood of success of SAV installation. (Mid-channel areas will be deeper than they currently are due to dredging, which will uncover the natural bottom contour.) Presence of SAV will increase habitat diversity and complexity in the creek. Planting mangroves will expand existing mangrove areas, and planting rushes and cordgrass will create new emergent marsh and riparian habitats. Removal of exotic plants will help ensure that existing, native vegetation and newly planted vegetation remain the primary components of communities associated with the creek.

7.2 Fish and Wildlife

In general, most species currently occupying the project area will benefit from restoration activities. Water quality improvements may not only directly benefit populations of certain fishes, but they may also contribute to the success and spread of various invertebrates, such as oysters, crabs, and shrimps. Other benefits of improved water and sediment quality may result in additional food resources for fish and wildlife populations. For example, particular bivalve species that are consumed by wading birds require sandy substrates for survival. Therefore, reduction of silt may result in additional prey for such birds. Benthic infaunal species diversity would also increase. Sandy substrates and increased water clarity may contribute to the success of SAV, which is known to increase habitat value for many invertebrate and vertebrate species.

7.3 Endangered and Threatened Species

Fish and wildlife species that are protected by federal and/or state law and that are known to occur in Pinellas County are listed in Table 2. Several of these species may benefit from the restoration project. Of particular note is the manatee, which has been observed frequently by local residents. If the project is successful, especially with relevence to SAV plantings, manatees will enjoy additional resources. Other species protected by state and/or federal law, such as egrets, herons, and storks are also expected to benefit from the project, both from increases in food resources and roosting (and possibly, rookery) sites. Neither these species, nor sea turtles, will be negatively impacted by project activities.

8.0 EVALUATION OF PROPOSED PROJECT

Few, if any, negative temporary or permanent impacts appear to be associated with the project. However, benefits from the restoration, i.e., increased fish and wildlife diversity and/or population sizes, may not be realized until a few years after completion of the project. Certainly, though, two projected outcomes of the current plan are highly unlikely. First, it is unlikely that 12 acres of SAV will result from the project within the creek, and, second, it is hypothetical, at best, to assert that an additional 600 acres of SAV will be recruited in St. Joseph Sound, simply due to dredging, as was proposed in the PRP.

The urban setting surrounding the project area and complex water quality control issues may continue to challenge the recovery of the Stevenson Creek estuary. Improvements in water management proposed for the watershed (Parsons, 2001) may hasten the estuary's recovery. However, certain projects within that plan should be re-evaluated in consideration of their impact on natural resources. One structural improvement that would significantly improve the likelihood of success of restoration is the construction/installation of culverts that would create flow under roads associated with bridges. These areas constrict flow and cause the precipitation of suspended materials in peripheral areas, which in turn further constrict the channel. Though these concerns may be beyond the scope of this Section 206 program, other steps can be taken to increase the likelihood of restoration success and maximize the efficiency of activities.

Table 2 Protected Species Summary for Pinellas County

Scientific Name	Common Name	Federal Status	State Status
FISH			
Acipenser oxyrinchus desotoi	Gulf sturgeon	LT	LS
AMPHIBIANS			
Rana capito	gopher frog	N	LS
REPTILES			
Alligator mississippiensis	American alligator	T(S/A)	LS
Caretta caretta	loggerhead	LT	LT
Chelonia mydas	green turtle	LE	LE
Dermochelys coriacea	leatherback	LE	LE
Drymarchon corais couperi	eastern indigo snake	LT	LT
Gopherus polyphemus	gopher tortoise	N	LS
Lepidochelys kempii	Kemp's ridley	LE	LE
Stilosoma extenuatum	short-tailed snake	N	LT
BIRDS			
Ajaia ajaja	roseate spoonbill	N	LS
Aramus guarauna	limpkin	N	LS
Charadrius alexandrinus	snowy plover	N	LT
Charadrius melodus	piping plover	LT	LT
Egretta caerulea	little blue heron	N	LS
Egretta rufescens	reddish egret	N	LS
Egretta thula	snowy egret	N	LS
Egretta tricolor	tricolored heron	N	LS

Eudocimus albus	white ibis	N	LS
Falco peregrinus	peregrine falcon	LE	LE
Falco sparverius paulus	southeastern American kestrel	N	LT
Haematopus palliatus	American oystercatcher	N	LS
Haliaeetus leucocephalus	bald eagle	LT	LT
Mycteria americana	wood stork	LE	LE
Pandion haliaetus	osprey	N	LS
Pelecanus occidentalis	brown pelican	N	LS
Rynchops niger	black skimmer	N	LS
Speotyto cunicularia floridana	Florida burrowing owl	N	LS
Sterna antillarum	least tern	N	LT
MAMMALS			
Podomys floridanus	Florida mouse	N	LS
Sciurus niger shermani	*Sherman's fox squirrel*	N	LS
Trichechus manatus	manatee	LE	LE

Source: Florida Natural Areas Inventory, www.fnai.org/PINE-SUM.HTM, 7/11/01

N = not listed
LS = listed, species of special concern
LT = listed, threatened
LE = listed, endangered

9.0 RECOMMENDATIONS AND CONSERVATION MEASURES

9.1 Dredging and Manipulation of Sediments

Although removal of muck/silt substrates from the creek is likely to have an overall positive effect on habitat value, the Service recommends that coarser sediments (sand or muddy sand) remain in the project area (either in their current location, or transferred to an adjacent location, as indicated below). These sediments have considerable value, both for establishing/maintaining tidally exposed, non-vegetated areas useful to birds for foraging, and for use as substrate for installation of emergent vegetation and SAV. With the transfer of these sandy substrates, planners can achieve both navigation and habitat benefits within the project area. Also, manipulating the distribution of coarser substrates will help ensure that flow within channels remains at a velocity that inhibits the precipitation of fine particles within the creek, and thereby maintains lower turbidity and higher sediment quality throughout the estuary.

Candidate sand-removal sites include the area around the Fort Harrison Bridge (ca. 10,000 cu., as stated in the PRP) and the area near the juncture of Stevenson Creek and Spring Branch (Figure 3). The principle area that would benefit from the consequent deposition of these sands (following the removal of muck from that section of the creek) is the nearshore and offshore areas north of the City of Clearwater shuffleboard and lawn bowling parks on Calumet Street. This will increase the viability of vegetation installation.

Selective dredging and deposition of sandy material just downstream of the Douglas Avenue Bridge would serve several purposes. Currently, adjacent to the bridge, a small mudflat becomes exposed during low tides (Figure 2). The flat is used as a foraging area for several species of birds. This foraging area could be expanded to the north and northwest using sediments from the development/dredging of a channel through the south/southwest side of the flat (Figure 3). The channel may facilitate drainage of the watershed, maintain adequate tidal flow through the estuary, and stabilize important existing and created habitats. Dredging and redistribution of sediments at this site should be carried out in a manner that will not contribute to the overall diminution of wading/shore-bird habitat.

9.2 Vegetation

The resoration plan proposes control of invasive plants and installation of native emergent and submerged vegetation conducive to fish and wildlife resources. In addition, the Stevenson Creek Watershed Management Plan (Parsons, 2001) identified shoreline erosion as a significant concern. The Service agrees that these issues should be addressed to ensure the long-term viability of restoration efforts.

Recent on-site observations revealed a need for some Brazilian pepper control efforts in riparian areas. Current coverage of this invasive has not yet reached unmanageable proportions. Another area of concern is a stand of Australian pine on the creek's south shore, between Douglas Avenue and Pinellas Trail. These trees, and most of the Brazilian pepper observed during reconnaissance fall within private property boundaries. The coordination of any control efforts should obviously involve the area's neighborhood association, and personal contact with affected residents. A public meeting could be used to provide rationale for dredging and vegetation installation, and to obtain useful feedback from local residents.

In order to enhance riparian habitat and stabilize shorelines, emergent vegetation and mangroves should be planted where feasible. Following muck removal, coarser substrates from other areas of the estuary should be deposited along designated shorelines (e.g., south shore just east of the Fort Harrison Bridge; see Figure 3) to properly grade sediments for the installation of mangroves (*Avicennia germinans* and *Rhizophora mangle*). Other shoreline

Figure 3 Stevenson Creek - Restoration Recommendation

areas would benefit from planting emergent vegetation such as *Spartina alterniflora* and *Juncus roemerianus*. Spacing of beds should not encroach landowners' access to the waterway (Figure 3). Overall, plantings may involve up to 3570 linear feet of shoreline.

The use of coarser, sandier sediments will also be conducive to benthos and the establishment of SAV. Offshore from the primary mangrove planting area, these sediments may elevate the bottom from post-dredging depths of 6-8 feet to 3-6 feet (BCI, 1998), increasing the percent of incident light reaching the bottom. Because of limited sediments available for substrate improvement in this area, the area suitable for SAV may comprise only about 2.75 acres (Figure 3). It is unlikely that improvements in water quality and clarity from only dredging will result in the recruitment of SAV in the deeper channel areas. However, if improved water quality is achieved following other restoration activities and watershed management programs, plantings in deeper areas of the creek may prove successful. Installation of SAV can play a critical role in the restoration of an estuarine system, and must be carefully conducted in order to reap maximal benefits. For example, installation should occur following site monitoring (see below) and allowing newly deposited sediments to compact/settle.

Prior to the installation of SAV in Stevenson Creek, several factors must be taken into consideration. First, the realistic goal of 2.5-3.0 acres of coverage must be accepted. Due to physical, hydrologic, and bathymetric constraints, achieving the target coverage of 10-12 acres is unlikely. Any funds that were to be spent on a more widespread installation should instead be reserved for pre- and post-planting monitoring and replanting. As much as 50% of installed plants should be expected to fail (Fonseca et al, 1998). Replanting will be required. Second, planting sites must be carefully examined prior to installation of vegetation. Areas proposed to receive SAV should be scrutinized to determine if they have the proper sediment thickness and consistency, protection from erosion, and nutrient (both in the water column and substrate) and light requirements to support beds (Fonseca et al, 1998). To assist biologists in determining conditions that will provide an environment conducive to SAV, nearby areas can be used as reference beds (Clearwater Harbor areas adjacent to the Fort Harrison Bridge). These shoal-grass (*H. wrightii*) beds, which have been subject to monitoring in recent years, may provide substantial information useful for guiding project biologists. That species is recommended for installation due to its wide salinity and temperature tolerance, and its high spreading rate (Fonseca et al, 1998). However, as much as 25% surface light may be required for successful transplantation of shoal-grass (Fonseca et al, 1998). If, due to project constraints, engineers are unable to establish/create a suitable substrate at preferred, light-penetrating depths (after dredging, filling/contouring) for the growth of shoal-grass, a species that can better utilize greater depths (i.e., less light) may be used (e.g., *Halophila engelmanii*). If economically feasible, a polyculture of shoal-grass (in shallower areas) and star-grass (*H. engelmanii*) on slopes and in deeper areas may be advisable. If environmental requirements are met, it may be possible to use star-grass to appreciably increase the coverage of SAV (across deeper channel areas) beyond the 2.5-3.0 target acreage.

9.3 Mitigation of Temporary Impacts

Temporary impacts from project activities such as turbidity and deposition of suspended materials outside of the project area may be controlled by installing temporary structures that prohibit transport of suspended materials outside of project boundaries. Damage to riparian vegetation during dredging operations can be minimized by simply maintaining a sufficient, fixed distance from plants, including their roots, proproots, and pneumatophores. Wetlands adjacent to any areas where dredging will occur (especially southeast of the Douglas Avenue Bridge, if applicable) should be protected from materials suspended during dredge operations. Likewise, if SAV beds in Clearwater Harbor (Figure 2) could be affected by suspended materials, these should be sheltered from dredge operations.

9.4 Other Recommendations

Recreational use of the creek may be encouraged/planned in such a way as to increase the value of the project area to residents and visitors. One excellent opportunity for increased public appreciation of the area would be to create a small canoe/kayak access point adjacent to the Fort Harrison Bridge (Figure 3) on/adjacent to the City of Clearwater property (Lawn Bowling and Shuffleboard Clubs). Currently, the candidate site consists of an unimproved parking area and a sloped trail that leads to a break in mangroves at the shore. The trail and opening serves as an unimproved ramp for small boats (e.g., jonboats). It appears that a considerable amount of runoff/surface soils are lost from the parking area. If the area were graded and covered with gravel, and its boundaries were reinforced, runoff would decrease considerably. During mangrove planting in the area, the public access point could be improved. A handicapped-accessible boardwalk/ramp would join the parking area to the access point. The access area could comprise a small, unpaved clearing through the riparian vegetation and a dock or small fishing pier. Signage in the area might include manatee information, a history/design of the Stevenson Creek restoration, and Adopt-A-Creek information.

The second recreational access point to the creek could be a small boardwalk/overlook from Pinellas Trail, an established recreational pathway including a bridge bisecting the project area. The area surrounding the bridge is planned for vegetation installation, so the view from the overlook would improve over time. Signage of any or all of the above topics may again be included at the overlook or on Pinellas Trail.

The placement of recreational access points is of utmost importance. While the PRP notes the eventual creation of a public park on the proposed dewatering site (currently the auto salvage yard), the Watershed Management Plan suggests that the site be used as a stormwater treatment facility (Figure 3). Because the wetlands surrounding and adjacent to the Douglas Avenue Bridge adjacent to the site are some of the most valuable resources in the entire watershed, they will require considerable protection from human impacts. For that reason, and because a significant stormwater treatment facility should appreciably improve water quality in the lower Stevenson Creek basin, we recommend that funds and efforts for recreation are directed toward the two projects recommended above.

The City and ACOE should recognize the Douglas Avenue wetlands as important habitat, and undertake reasonable protective measures. For example, restricting the construction of any permanent structures on or immediately adjacent to the wetlands would decrease direct and secondary impacts to this habitat. Fencing off the wetlands and associated upland habitats would help limit human impacts to the area. Also, the encouragement of participation of residents to include that stretch of Douglas Avenue in an adopt-a-roadway program is advised. Similarly, inclusion of the creek in an adopt-a-creek program would complement those efforts, and ensure the greatest possible benefits to fish and wildlife, as well as the neighborhood's residents. Finally, especially because of its proximity to the wetlands, the upland area between the wetlands and the proposed dewatering site should be subjected to exotic species eradication efforts.

In order to protect and maximize restoration investments, appropriate signage of various areas is recommended. For example, signs warning of the presence of manatees in the creek would be advised, as would signs marking SAV restoration/planting areas. It may also be useful to establish markers demonstrating the deepest portions of the creek, and to post reflective markers at the margins of the proposed, modified tidally exposed area near Douglas Avenue.

Finally, the installation of pollution/sedimentation controls upstream, and throughout the watershed, is recommended, generally as described in Parsons (2001). Although outside the project area, and generally small in scope, these water management systems may have a significant cumulative effect on the estuary and its biological community.

10.0 SUMMARY OF SERVICE POSITION

Activities described in the Stevenson Creek PRP have the potential to play a pivotal role in the recovery of the small, tidal creek estuary. Dredge operation, if conducted as recommended, will not adversely affect fish and wildlife resources, but will likely aid in habitat restoration. Certain sediments, when dredged from one area and deposited in another, can be used to improve sediment quality (particularly for use as SAV/emergent vegetation substrate) and hydraulic characteristics of the creek. The installation of native vegetation, including SAV, will complement dredging/recontouring, contributing to the development of additional habitat, increased water quality, and shoreline stabilization. Efforts to control exotic species are advised while the scope of such activities is still relatively cost-effective. Communication with private property holders on the creek, and the inclusion of recreational opportunities (as outlined) would likely increase stakeholder interest and project success.

11.0 Literature Cited

Ballogg, Miles. City of Clearwater Economic Development Team. Personal communication (10 July 2001).

BCI Engineers & Scientists. 1998. Stevenson Creek- City of Clearwater- Sediment characterization and removal feasibility study (Prepared August 1998 for City of Clearwater). Lakeland, Florida.

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Holmes, Charles W. 2001. Radiometric data on selected cores from Stevenson Creek, Clearwater Florida (Letter dated 27 April 2001). US Geological Survey. St. Petersburg, Florida.

Parsons Engineering Science. 2001. Preliminary Stevenson Creek Watershed Management Plan Draft Final Report (Prepared June 2001 for City of Clearwater). Tampa, Florida.

Post, Buckley, Schuh, & Jernigan, Inc. 1996. Stevenson Creek Watershed- Water quality technical report (Prepared October 1996 for City of Clearwater). Tampa, Florida.

PPB Environmental Laboratories, Inc. 2000. Final Report for Stevenson Creek- Clearwater, Florida (Prepared October 2000 for US Army Corps of Engineers). Gainesville, Florida.

U.S. Army Corps of Engineers. 2000. Stevenson Creek Estuary Preliminary Restoration Plan (October 2000). Jacksonville, Florida.

SUB-APPENDIX E - PERTINENT CORRESPONDENCE

DIVISIONS OF FLORIDA DEPARTMENT OF STATE
Office of the Secretary
Office of International Relations
Division of Elections
Division of Corporations
Division of Cultural Affairs
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Department of Revenue
Department of Law Enforcement
Department of Highway Safety and Motor Vehicles
Department of Veterans' Affairs

FLORIDA DEPARTMENT OF STATE

Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES

October 23, 2002

Mr. James C. Duck
Jacksonville District US Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Re: DHR No. 2002-09756 / Date Received by DHR: October 8, 2002
Historic Assessment and Remote Sensing Survey of the Stevenson Creek Estuary, Pinellas County, Florida (Final Report)

Dear Mr. Duck:

Our office has received and reviewed the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966* (Public Law 89-665), as amended in 1992, and *36 C.F.R., Part 800: Protection of Historic Properties*. The State Historic Preservation Officer is to advise and assist federal agencies when identifying historic properties listed or eligible for listing in the *National Register of Historic Places*, assessing effects upon them, and considering alternatives to avoid or minimize adverse effects.

The draft version of the referenced report was reviewed by this office on April 24, 2002 (DHR No. 2002-03854). Results of the survey indicated that five targets not associated with visible debris or structures (SC-1 – SC-5) were identified. Two of these targets (SC-4, SC-5) produced signatures characteristic of submerged cultural resources. We maintain our concurrence with the determination of Mid-Atlantic Technology and Environmental Research, Inc. that these targets should be avoided by project activities. If avoidance is not feasible, targets SC-4 and SC-5 should be investigated by an underwater archaeologist. Please note that at the time of our initial review, this office did not consider the draft report sufficient in accordance with Chapter 1A-46, *Florida Administrative Code*, due to the absence of the following information:

- Pertinent environmental and paleoenvironmental data

This information is also absent from the final report. In the future, this office will not concur with the findings of draft reports that are not complete and sufficient. The complete language of Chapter 1A-46 is available online at http://dhr.dos.state.fl.us/bhp/compliance.

If you have any questions concerning our comments, please contact Mary Beth Fitts, Historic Sites Specialist, at mbfitts@mail.dos.state.fl.us or (850) 245-6333. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Frederick P. Gaske, Deputy SHPO
Janet Snyder Matthews, Ph.D., Director, and
State Historic Preservation Officer

Xc: Mr. Wes Hall, Mid-Atlantic Technology and Environmental Research, Inc.

DIVISIONS OF FLORIDA DEPARTMENT OF STATE
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Department of Highway Safety and Motor Vehicles
Department of Veterans' Affairs

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. James C. Duck
Jacksonville District US Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

December 5, 2002

Re: DHR No. 2002-11047 / Date Received by DHR: November 19, 2002
Cultural Resources Survey of the Stevenson Creek Disposal Area, Hillsborough County, Florida (New South Associates 2002) - Draft Report

Dear Mr. Duck:

Our office has received the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966* (Public Law 89-665), as amended in 1992, and *36 C.F.R., Part 800: Protection of Historic Properties*. The State Historic Preservation Officer is to advise and assist federal agencies when identifying historic properties listed or eligible for listing in the *National Register of Historic Places*, assessing effects upon them, and considering alternatives to avoid or minimize adverse effects.

We have reviewed the submitted report and determined it is complete in accordance with Chapter 1A-46, *Florida Administrative Code*. However, in order to be considered sufficient based on the criteria specified in Chapter 1A-46, the final report must contain the following:

- Pertinent historical data from records such as plat maps, tract books, and subdivision maps
- Pertinent information from informants
- Procedures to deal with unexpected discoveries including the discovery of human remains
- Curation location of project records

If you have any questions concerning our comments, please contact Mary Beth Fitts, Historic Sites Specialist, at mbfitts@mail.dos.state.fl.us or (850) 245-6333. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Frederick P. Gaske, Deputy SHPO

Janet Snyder Matthews, Ph.D., Director, and
State Historic Preservation Officer

Xc: Mr. Charles Cantley, New South Associates

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☐ **Archaeological Research** (850) 245-6444 • FAX: 245-6436
☒ **Historic Preservation** (850) 245-6333 • FAX: 245-6437
☐ **Historical Museums** (850) 245-6400 • FAX: 245-6433
☐ **Palm Beach Regional Office** (561) 279-1475 • FAX: 279-1476
☐ **St. Augustine Regional Office** (904) 825-5045 • FAX: 825-5044
☐ **Tampa Regional Office** (813) 272-3843 • FAX: 272-2340

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Florida Integrated Science Center
Sirenia Project
412 N.E. 16th Avenue, Room 250
Gainesville, Florida 32601-3701
Phone: (352) 372-2571 x17 **e-mail: Robert_Bonde@usgs.gov** Fax: (352) 374-8080

14 May 2003

U.S. Army Corps of Engineers
c/o: Emilio Gonzales
Antilles & North Florida Branch (DP-I)
Project Management Division
700 San Marco Blvd.
Jacksonville, Florida 32207

Dear Emilio,

Thank you for the tour of the proposed dredging site at Stevenson Creek, Clearwater, Florida yesterday. It is a very beautiful area and any effort to enhance the substrate and habitat will be beneficial to the entire ecosystem. The usage of this area by manatees in its present state is probably minimal. Most manatees that pass this area will be transients that are moving through the area from either the south or the north using the adjacent Intracoastal Waterway. Manatees that do pass similar sites in other parts of the state will often seek safe harbor or try and access local fresh water runoff. However, this site presently is too shallow to accommodate manatees in its present state and any effort to restore the Creek to historic levels by removing sludge will be beneficial to manatees hoping to gain access to this area. Additionally, there is a fresh water source well up stream, as well as a sewage treatment plant the presently discharges fresh water. Access to either of these sites would be beneficial to manatees as well.

Restoring the depth to about 6 feet (mean low tide) in the Reach 1 from the mouth to Pinellas Trail Bridge will afford an area for manatees to rest and socialize. Any enhancement of natural vegetation within Reach 1 will also help to attract manatees to this area. Dredging water depth to about 3 feet (mean low tide) in Reach 2 from Pinellas Trail Bridge to Douglas Avenue Bridge will ensure access to the outfall of the existing sewage treatment plant discharge just southeast of the Douglas Avenue Bridge. This area will be used by manatees to access the fresh water discharged from that source, as well as appreciate any thermal benefit.

Typical manatee behavior often entails use of similar areas during the day when boating activity is greatest on the adjacent seagrass flats. Their adaptive behavior allows for usage patterns that require the manatees to go out onto the shallow flats at night to feed on the seagrasses when boat traffic is reduced. This diurnal pattern is common in many parts of urbanized manatee habitats throughout Florida and would probably be readily adapted by local manatees that choose to use this site.

The thermal benefit of this site to the manatee's overwintering strategy for this area is not known. Temperatures at the sewage outfall are within minimum limits necessary to ensure winter survival, but this benefit may be lost in dilution with the cooler adjacent ambient water. I will add some temperature collecting units into the system prior to this upcoming winter season and calibrate the potential benefit of this site to meet manatee thermoregulatory needs.

I think that the concept of using this project to help develop habitat for manatees is wise. Manatees in northern Florida are presently being subjected to deregulation pressures of the power industry. The direct effect of that reduction in operation of previously reliable sites might mean that future artificial warm water sites are not available to meet their basic temperature needs. If this is the case, and manatees are to remain in this region of the state, then any effort to enhance natural habitat areas like this one will be helpful in insuring the future of manatees in Florida.

Sincerely,

Robert K. Bonde

Robert K. Bonde
Biologist

cc – J. Valade, FWS

1) What is the long term plan to ensure the dredging stays open?

2) Is the Marshal St. Water Treatment Facility Discharge adding to our problems?

3) Why is the proposed work ending at Douglas, leaving a bottleneck from Douglas east to Betty Lane?

4) ~~When is~~ What are your projected start and completion dates?

Responses to any questions would be appreciated greatly.

Joel O. Blackburn Jr.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702
(727) 570-5317; FAX 570-5300

June 23, 2003 F/SER43:MS/DD

James C. Duck, Chief
U.S. Army Corps of Engineers
Planning Division, Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

The National Marine Fisheries Service (NOAA Fisheries) has reviewed your letter dated May 19, 2003, regarding the Corps of Engineers' request for information on issues to be addressed in an ecosystem restoration study of the Stevenson Creek Estuary located in Clearwater, Pinellas County, Florida. A 29-acre area of the Stevenson Creek Estuary has been chosen as a pilot project for the Environmental Protection Agency's Brownfield Assessment Program, which empowers local stakeholders to assess, clean up and restore previously commercially-utilized areas for sustainable uses which would improve the local community.

The proposed restoration of the Stevenson Creek estuary would be achieved through the dredging of estuary bottom to a depth of -5.5 feet the area between the North Fort Harrison Bridge to the Pinellas Trail Bridge, and the dredging of estuary bottom to a depth of -2.5 or -3.5 feet from the Pinellas Trail Bridge to the Douglas Avenue Bridge. Restoration activities also would include the creation of 3.2 acres of mangrove wetland habitat within unvegetated intertidal areas, the management of stormwater discharges into the estuary, and the removal of nuisance plant species along the estuary's banks. Hydraulic dredging is proposed with disposal and dewatering of dredged material in an upland area in Pinellas County.

Certain aquatic habitats within the project area are designated as Essential Fish Habitat (EFH) as identified in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico. Specific categories of EFH in the project area include estuarine emergent wetlands, estuarine water column, and mud substrates. The generic amendment was prepared by the Gulf of Mexico Fishery Management Council as required by the 1996 amendment to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Federal and state agencies which permit, fund, or undertake activities which may adversely impact EFH must undertake an EFH Consultation with NOAA Fisheries.

Through coordination with you and your staff, NOAA Fisheries determined in 1999 that the Jacksonville District's project planning process can be used to satisfy the consultation requirements of the MSFCMA. Consistent with our interagency EFH agreement, NOAA Fisheries recommends that an EFH Assessment be prepared and provided for our review and comment prior to implementing the Stevenson Creek Estuary project. The assessment, which may be incorporated in a National Environmental Policy Act document prepared for this project, should include the following:

1) A description of the proposed action, including quantification of the impacts of project implementation on intertidal and subtidal species;

2) An analysis of the impacts of habitat alteration on EFH and dependent fishery resources;

3) A discussion of measures proposed or considered to avoid, minimize, and offset adverse impacts to marine fishery resources; and

4) A statement of your agency's conclusions with respect to the proposed action as it would affect EFH.

Related comments, questions or correspondence should be directed to Mark Sramek in our office in St. Petersburg, Florida. He may be contacted at (727) 570-5311 or at the letterhead address above.

Sincerely,

Rickey N Ruebsamen for

Frederick C. Sutter III
Deputy Regional Administrator

cc:
F/SER4
F/SER43

Department of Environmental Protection

Jeb Bush
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

David B. Struhs
Secretary

July 18, 2003

Mr. James C. Duck, Chief
Planning Division, Jacksonville District
U. S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

RE: Department of the Army – Jacksonville District Corps of Engineers – Scoping Notice for the Stevenson Creek Estuary Ecosystem Restoration Study – Brownfield Assessment Program Pilot Project – Clearwater, Pinellas County, Florida
SAI # FL200305212211

Dear Mr. Duck:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 95-359, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated a review of the referenced scoping notice for the proposed Brownfield Assessment Program Pilot Project.

Department (DEP) staff has expressed concern that the project may cause or contribute to existing soil, sediment, and groundwater pollution on the proposed dredged material dewatering and disposal sites. The Corps of Engineers' plan should ensure that dredged material is adequately evaluated for the presence of pollutants that may leach from the material or present a direct exposure concern should they be used as fill material. Dredged material dewatering and disposal plans should address the potential for adverse impacts to existing contamination at the Wolfe Property and ensure that landfill disposal is accomplished in accordance with the landfill's permit. Please note that construction of the project will also require water quality certification in the form of an Environmental Resource Permit (ERP) from the Southwest District office in Tampa. For additional information, please see the enclosed DEP comments.

The Department of State (DOS) notes that there are three recorded prehistoric burial mound sites located near the project area - with possible additional unrecorded archaeological sites along Stevenson Creek. As historic properties may be impacted by the proposed activities, the DOS recommends that a survey of the uplands adjacent to Stevenson Creek be conducted and forwarded to complete the DOS' review process. Please see the enclosed DOS comments for further details.

Pinellas County Environmental Management Department staff supports the need for improvements to the Stevenson Creek Estuary and recommends that the plan include the

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establishment of unvegetated foraging areas for birds and avoidance of impacts to existing seagrass beds and unvegetated sand flats within or near the project area. Though the County Planning Department finds the proposal consistent with the natural resources goals, objectives and policies of the Pinellas County Comprehensive Plan, staff requests additional information on the proposal to dispose of dredged material in a local sanitary landfill. Please see the attached Pinellas County comments for further information.

The Southwest Florida Water Management District (SWFWMD) recommends that the proposed work be reviewed for consistency with the Surface Water Improvement and Management (SWIM) plan for Tampa Bay. The proposed activities should be conducted to minimize adverse impacts to soils/groundwater, surface water quality, and threatened and endangered species in the vicinity of the project. Please see the attached SWFWMD comments.

Based on the information contained in the scoping notice and enclosed comments, the state has determined that, at this stage, the allocation of federal funds for the above-referenced project is consistent with the Florida Coastal Management Program (FCMP). The applicant must, however, address the concerns identified by DEP, DOS, Pinellas County, and SWFWMD staff as described in the attached comments. All subsequent environmental documents must be reviewed to determine the project's continued consistency with the FCMP. The state's continued concurrence with the project will be based, in part, on the adequate resolution of issues identified during this and subsequent reviews.

Thank you for the opportunity to review this project. If you have any questions regarding this letter, please contact Ms. Lauren P. Milligan at (850) 245-2161.

Sincerely,

Sally B. Mann

Sally B. Mann, Director
Office of Intergovernmental Programs

SBM/lm

Enclosures

cc: Brenda Arnold, DEP, Southwest District
Linda Frohock, DEP, Division of Waste Management
Sarah Jalving, DOS
Angela Hurley, TBRPC
Rand Frahm, SWFWMD

Florida State Clearinghouse

Memorandum

Florida Department of Environmental Protection

TO:	Brenda Arnold, DRI/Environmental Specialist
THROUGH:	William Kutash, P.G., Waste Programs Administrator
FROM:	David Gerard, P.E., Brownfields Southwest District Coordinator
DATE:	July 17, 2003
SUBJECT:	Review of USACOE May 19, 2003 Scoping Notice for the Stevenson Creek Estuary Ecosystem Restoration Study. Florida Brownfields Area BF529701000 Clearwater, Pinellas County

---

I have reviewed the subject notice as the Southwest District's Brownfields Program Coordinator and as a representative of the Waste Cleanup section. The notice correctly identifies the project site as being located within a large portion of Clearwater that has been designated as a brownfields area. Florida "Brownfield Areas" are designated as such pursuant to s. 376.80, Florida Statutes. The same area is also an EPA regional brownfields pilot. See the attached memo dated June 11, 2003, from Roger Register, the Department's Brownfields Liaison, for discussion of the brownfields designation as it relates to the proposed project.

From the perspective of the Waste Cleanup section, the District would be concerned with the potential of the project to cause pollution on the sites that are being considered for dewatering purposes and for disposal of the dredgings. The USACOE's plan should ensure that dredgings are adequately evaluated for the presence of pollutants which might leach from the material or present a direct exposure concern should they be used as fill material. The proposed dewatering site, the Wolfe Property, and adjacent property may already contain soil, sediment, and groundwater contamination; as such, project plans should address the potential for the dewatering activity to adversely impact the existing contamination. The plan should also consider that the Department has an active case on a property adjacent to the Wolfe site, where contamination issues at an old salvage yard are being investigated. The plan should ensure that disposal of the dredgings in a landfill would be done in accordance with the landfill's permit.

cc: Mike Gonsalves, Waste Cleanup Supervisor
Bob Sellers, ES II, Waste Cleanup

Florida Department of
Environmental Protection

Memorandum

To: Lauren P. Milligan, Environmental Consultant
Office of Legislative and Governmental Affairs

From: Roger B. Register, Brownfields Liaison
Bureau of Waste Cleanup

Project: USACOE – Scoping Notice for the Stevenson Creek Estuary Ecosystem Restoration Study – Brownfield Assessment Program Pilot Project – Clearwater, Pinellas County

SAI#: FL03-2211

Date: June 11, 2003

Per your request, I am forwarding comments from the Division of Waste Management's Bureau of Waste Cleanup (BWC) regarding consistency review of this project. The BWC is responsible for implementing certain portions of the Brownfields Redevelopment Act (ss. 376.77-.85, Florida Statutes (F.S.)), Chapter 62-785, Florida Administrative Code (F.A.C.), the *Brownfields Cleanup Criteria* rule, and addresses cleanup of non-petroleum contaminated sites in general. You requested that we identify any potential concerns and include possible permit requirements, applicable statutes and rules, proprietary issues, and a contact person. I offer the following comments regarding the Brownfields Redevelopment Program and its impacts, if any, on the referenced plan for the Stevenson Creek Estuary Assessment project proposed by the U.S. Army Corps of Engineers (Corps).

Brownfields Legislation

The Florida Legislature established the Florida Brownfields Redevelopment Program that created a designation process by which one or more "brownfield sites" can be designated a State of Florida "brownfield area" by local government resolution. Such a designation carries with it certain rights and responsibilities. Once the "brownfield area" has been designated, an entity (Person Responsible for Brownfield Site Rehabilitation) may then enter into a Brownfield Site Rehabilitation Agreement (BSRA) with the DEP or its delegated local pollution control program. Cleanup activities will be conducted pursuant to statutory and rule authority that adopts Risk-Based Corrective Action (RBCA) principles for brownfield sites. The use of RBCA may include application of site-specific alternative cleanup target levels and the use of institutional and/or engineering controls to prevent exposure to contaminants.

Upon successful completion of the terms of the BSRA, the person responsible obtains certain liability protections and may be eligible for a variety of economic incentives including $2,500 Brownfields Redevelopment Bonus Refunds for any qualified target industry businesses for each new Florida job created in a brownfield. In addition, there is a 35% tax credit for costs incurred to perform site rehabilitation. The tax credit may be applied to Florida corporate income tax or intangible personnel property tax and is eligible for a one-time transfer to another entity. A local government may use this tax credit, if it incurs eligible costs for site rehabilitation including site assessment, applies for a tax certificate and then transfers the tax certificate (credit) to an entity with an eligible tax liability.

Stevenson Creek Estuary Restoration Project

The Corps, Jacksonville District, requests assistance in gathering information that may directly or indirectly impact the proposed aquatic ecosystem restoration and protection project planned for the Stevenson Creek Estuary. The Brownfields Redevelopment Program does not have any direct regulatory impacts to the hydraulic dredging or disposal of dredged materials onto uplands based on the submitted data. The proposed aquatic ecosystem restoration and protection project does not require execution of a BSRA or oversight by the Brownfields Redevelopment Program. However, other program areas within and outside the FDEP should be notified of this project and given an opportunity to comment. The program areas include the Submerged Land and Environmental Resources Program (SLER), the Southwest District office and the Southwest Florida Water Management District.

An indirect impact that the Corps should be aware of is that consultation is required with the Southwest District staff for proper handling and disposal of dredged materials. Due to the recommended permanent disposal options proposed for two different locations within Hillsborough County, the Southwest District should be contacted and given an opportunity to comment on this proposed project and its intent to dispose of the dredged materials in uplands or a sanitary landfill. Also, Chapter 62-777, F.A.C., *Contaminant Cleanup Target Levels* rule should be reviewed for possible goals to determine whether dredged materials pose a threat to public health and the environment.

The Florida's Brownfields Redevelopment Program provides regulatory and financial incentives to encourage the private and public sectors in the redevelopment of brownfields. The Stevenson Creek Estuary Assessment project does fall within a state-designated Brownfields area. The overall project is consistent with the department's efforts to encourage the redevelopment or reuse of identified brownfields sites within local communities and provides additional leveraging of limited state and federal funds. This project does afford an opportunity for a sustainable environmental recovery of the estuary that may have been adversely impacted by brownfield sites within the designated Brownfield area and provide a tool in improving the overall environmental health of the local community along the Stevenson Creek Estuary.

For more information on the FDEP's implementation of relevant portions of the Brownfields Redevelopment Act, contact Roger B. Register, Brownfields Liaison at (850) 245.8934 or David Gerard, P.E. with the Southwest District Office at (813) 744.6100 ext. 420.

FLORIDA DEPARTMENT OF STATE
Glenda E. Hood
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Ms. Lauren Milligan
Florida State Clearinghouse Coordinator
Florida Department of Environmental Protection
3900 Commonwealth Boulevard, Mail Station 47
Tallahassee, Florida 32399-3000

June 13, 2003

Re: DHR No. 2003-4484 / Received by DHR: May 23, 2003 6-16-03
SAI No.: FL200305212211
Project Name: Stevenson Creek Estuary Ecosystem Restoration
Pinellas County, Florida

Dear Ms. Milligan:

Our office received and reviewed the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966* (Public Law 89-665), as amended in 1992, and *36 C.F.R., Part 800: Protection of Historic Properties*. The State Historic Preservation Officer is to advise and assist federal agencies when identifying historic properties (listed or eligible for listing, in the *National Register of Historic Places*), assessing the project's effects, and considering alternatives to avoid or reduce the project's effect on such properties.

A review of the Florida Master Site File and our records indicates that there are three recorded archaeological sites (8PI10, 8PI62, and 8PI140) located near the area of potential effect for this project (see enclosed map). Sites 8PI10, 8PI62, and 8PI140 are all recorded as prehistoric burial mounds. In addition, available environmental data for the area support the possibility for unrecorded archaeological sites occurring in the uplands bordering Stevenson Creek. It is, therefore, the opinion of this office that there is a reasonable probability of some proposed project activities impacting historic properties since the area has never been subjected to a systematic, professional survey to locate such properties.

Since potentially significant archaeological and historic sites may be present, it is our recommendation the uplands adjacent to Stevenson Creek be subjected to a systematic, professional archaeological and historical survey. The purpose of this survey will be to locate and assess the significance of historic properties present. The resultant survey report shall conform to the specifications set forth in Chapter 1A-46, *Florida Administrative Code*, and will need to be forwarded to this office in order to complete the process of reviewing the impact of this proposed project on historic properties.

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JUN 20 2003
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☐ Palm Beach Regional Office (561) 279-1475 • FAX: 279-1476
☐ St. Augustine Regional Office (904) 825-5045 • FAX: 825-5044
☐ Tampa Regional Office (813) 272-3843 • FAX: 272-2340

The results of the investigations will determine if significant historic properties would be disturbed by this project. In addition, if significant remains are located, the data described in the report and the consultant's conclusions will assist this office in determining measures that must be taken to avoid, minimize, or mitigate adverse impacts to historic properties listed, or eligible for listing in the *National Register of Historic Places*, or otherwise of historical or architectural significance.

Because this letter and its contents are a matter of public record, consultants who have knowledge of our recommendations may contact the applicant. This should in no way be interpreted as an endorsement by this agency. The *Registry of Professional Archaeologist* (RPA) is the national certifying organization for archaeologists. A listing of archaeologists who are RPA members living or working in Florida can be accessed at http://dhr.dos.state.fl.us/bhp/compliance. In addition, the complete RPA Directory of Certified Professional Archaeologists is available at www.rpanet.org. Otherwise, upon request, we will forward our RPA list to the applicant.

If you have any questions concerning our comments, please contact Samantha Earnest, Historic Sites Specialist, at searnest@dos.state.fl.us or (850) 245-6333. Your interest in protecting Florida's historic properties is appreciated.

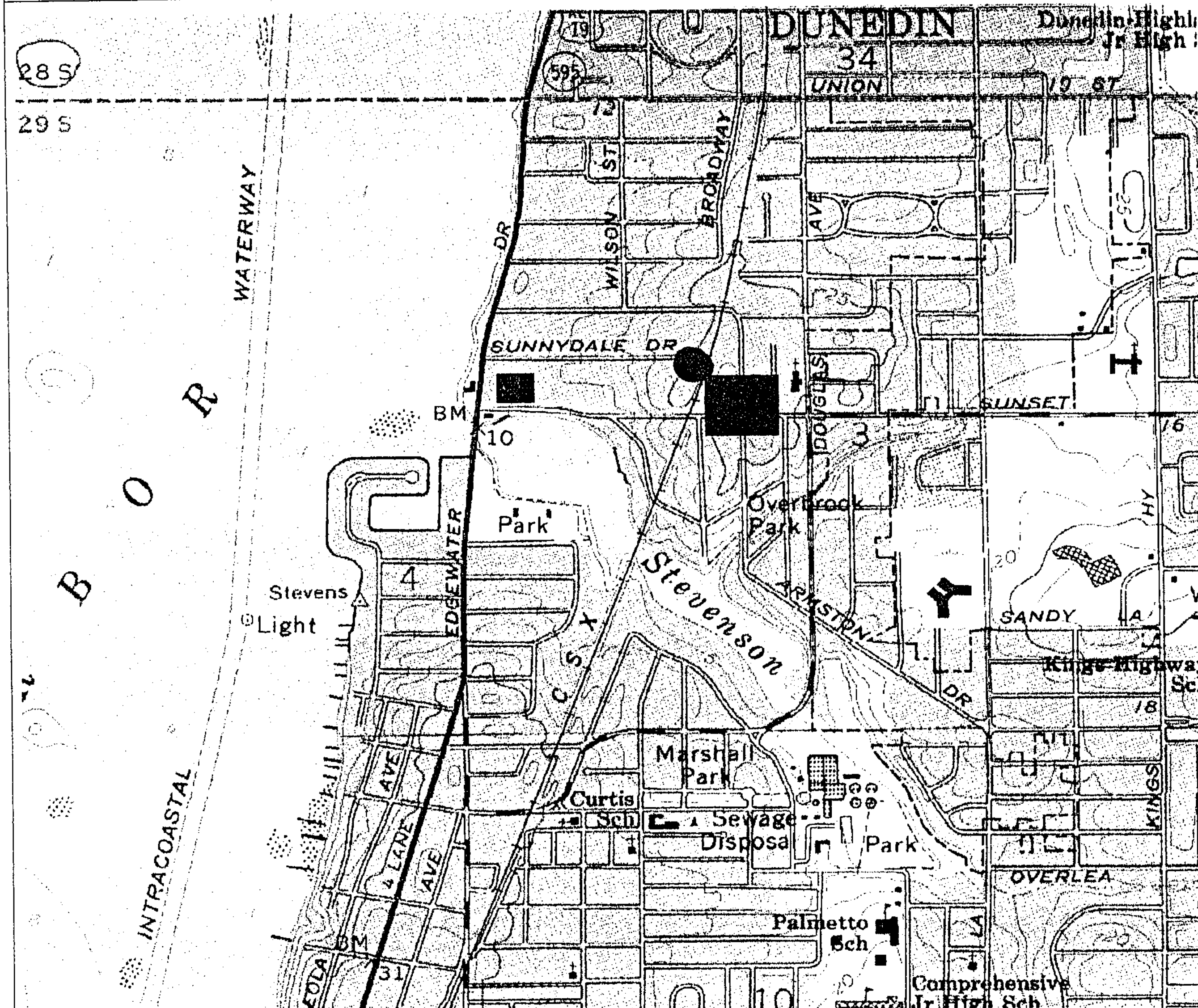
Sincerely,

Frederick P. Gaske, Deputy SHPO

Janet Snyder Matthews, Ph.D., Director, and
State Historic Preservation Officer

Enclosure

Compliance Review Section
DHR No. 2003-4484
SAI No. FL200305212211
Stevenson Creek Estuary Ecosystem Restoration



0 1320 2640 3960 5280 Feet

Map Legend

Archaeological Sites

USGS 7.5' Topographic Map
Clearwater

WARNING! The locations of the archaeological site, historic structures, unmarked human burials, cemeteries, and other cultural features depicted on this map are for resource managment and law enforcement purposes. It is a felony to excavate, or to remove, deface, destroy, or othewise alter any archaeological site or specimen located uponany state owned and controlled lands, without the permission of the Division of Historical Resources (see Section 267.13, Florida Statutes). State law protects human burial sites on all lands regardless of ownership. It is a felony to knowingly and willfully disturb, destroy, remove, vandalize or damage marked or unmarked human burial sites or to remove grave goods or other objects placed at grave sites (see Sections 872.02 and 872.05, Florida Statutes).

Florida Department of State
Division of Historical Resources
Bureau of Historic Preservation
Compliance Review Section

500 South Bronough Street
Tallahassee, Florida 32399-0250
(850) 245-6333

RECEIVED
MAY 27 2003

FLORIDA STATE CLEARINGHOUSE
LOCAL GOVERNMENT COORDINATION
ROUTING SHEET

SAI#: FL200305212211 **DATE: 5/21/2003**

COMMENTS DUE TO RPC: 6/20/2003

AREA OF PROPOSED ACTIVITY: 99.997 COUNTY: PINELLAS CITY: CLEARWATER

☐ FEDERAL ASSISTANCE ☑ DIRECT FEDERAL ACTIVITY ☐ FEDERAL LICENSE OR PERMIT ☐ OCS

PROJECT DESCRIPTION
DEPARTMENT OF THE ARMY - JACKSONVILLE DISTRICT CORPS OF ENGINEERS - SCOPING NOTICE FOR THE STEVENSON CREEK ESTUARY ECOSYSTEM RESTORATION STUDY - BROWNFIELD ASSESSMENT PROGRAM PILOT PROJECT - CLEARWATER, PINELLAS COUNTY, FLORIDA.

ROUTING:	**RPC**	**Local Governments**
	___ TAMPA BAY RPC	X PINELLAS

IF YOU HAVE NO COMMENTS, PLEASE CHECK HERE AND RETURN FORM TO RPC:___

ALL CONCERNS OR COMMENTS REGARDING THE ATTACHED PROJECT SHOULD BE SENT IN WRITING BY THE DUE DATE TO THE REGIONAL PLANNING COUNCIL SHOWN BELOW. PLEASE REFER TO THE SAI # IN ALL CORRESPONDENCE:

Comments from Pinellas County Planning Department Attached

ANGELA HURLEY
9455 KOGER BOULEVARD, SUITE 219
ST. PETERSBURG, FL 337022491

IMPORTANT: PLEASE DO NOT SEND COMMENTS DIRECTLY TO THE CLEARINGHOUSE!

IF YOU HAVE QUESTIONS REGARDING THE ATTACHED PROJECT OR THE INTERGOVERNMENTAL COORDINATION PROCESS, PLEASE CONTACT THE STATE CLEARINGHOUSE. IF YOU HAVE QUESTIONS REGARDING THE FEDERAL CONSISTENCY REVIEW PROCESS, PLEASE CONTACT THE FLORIDA COASTAL MANAGEMENT PROGRAM. THE TELEPHONE NUMBER FOR BOTH PROGRAMS IS (850) 245-2161.

BOARD OF COUNTY COMMISSIONERS

PINELLAS COUNTY, FLORIDA

315 COURT STREET
CLEARWATER, FLORIDA 33756

COMMISSIONERS:

KAREN WILLIAMS SEEL - CHAIRMAN
SUSAN LATVALA - VICE CHAIRMAN
CALVIN D. HARRIS
JOHN MORRONI
ROBERT B. STEWART
BARBARA SHEEN TODD
KENNETH T. WELCH

June 23, 2003

VIA FACSIMILE: (727) 570-5118

Ms. Angela Hurley
Tampa Bay Regional Planning Council
9455 Koger Boulevard
Suite 219
St. Petersburg, Florida 33702-2491

Subject: SAI# FL200305212211 – Department of the Army – Jacksonville District Corps of Engineers – Scoping Notice for the Stevenson Creek Estuary Ecosystem Restoration Study – Brownfield Assessment Program Pilot Project - City of Clearwater, Pinellas County, Florida

Dear Ms. Hurley:

Pinellas County is in receipt of the referenced project and has reviewed the provided information.

The Pinellas County Environmental Management Department supports the need for improvements to the Stevenson Creek Estuary. Removal of nutrient-laden sediments and improved circulation should enhance water quality in the long-term. However, the Department does have concerns that in order for the entire plan, when implemented, to be environmentally sound, it needs to provide or leave some shallow unvegetated foraging areas for birds, and avoid adverse or damaging impacts to existing submerged aquatic vegetation habitats within or near the project area. For example, if adverse turbidity is generated from the dredging, nearby and downstream seagrass beds and/or productive unvegetated sand flats could be impacted. It is also unclear if the causes of the existing deposited sediments that have built up over the years will be remedied; if not, then it will likely be necessary to repeat this expensive and potentially invasive restoration activity again in the future.

DEPARTMENT OF PLANNING
LOCATION: 600 Cleveland Street, Suite 750, Clearwater, Florida 33755
TELEPHONE: (727) 464-8200 FAX: (727) 464-8201

PLEASE ADDRESS REPLY TO: 315 Court Street
Clearwater, FL 33756

The Pinellas County Planning Department reviewed the project and finds that the project description references "*...disposal at a sanitary landfill located in Pinellas County...*" but does not clearly define which sanitary landfill or its location. At this time, Pinellas County Utilities staff is not aware of the project. If the intent is to dispose of the materials at a Pinellas County facility, this needs to be clear, and the Department requests receiving additional materials regarding this for further review.

The Pinellas County Planning Department does, however, find that the project is consistent with the following goal, objective and policies of the Pinellas County Comprehensive Plan, as long as the concerns raised in this letter are adequately addressed:

NATURAL, HISTORIC, AND CULTURAL RESOURCES ELEMENT – Natural Systems and Living Resources

3. GOAL: TO CONSERVE, PROTECT, RESTORE AND APPROPRIATELY MANAGE THE NATURAL SYSTEMS AND LIVING RESOURCES OF PINELLAS COUNTY TO ENSURE THE HIGHEST ENVIRONMENTAL QUALITY POSSIBLE.

3.1.2. Policy: Pinellas County shall continue to follow an active program of preservation, conservation and/or restoration of functioning native terrestrial, estuarine, aquatic, and marine vegetative communities.

3.3. Objective: Pinellas County shall protect, and conserve living marine resources within the coastal planning area by preserving where appropriate, or restoring where possible marine and estuarine habitats, including coastal wetlands and tidal streams.

3.3.2. Policy: Pinellas County shall continue to enforce its erosion control regulations to reduce sedimentation and turbidity in coastal habitats (particularly seagrass beds) resulting from upland development activities.

Should you have any questions regarding the comments above, please contact me at (727) 464-8200. Thank you for the opportunity to review this project.

Sincerely,

Brian K. Smith, Director
Pinellas County Planning Department

F:\USERS\CENDOCS\BCC\AHurley-Stevenson Creek EstuaryBKS62303.gg.doc

Southwest Florida
Water Management District

2379 Broad Street, Brooksville, Florida 34604-6899
(352) 796-7211 or 1-800-423-1476 (FL only)
SUNCOM 628-4150 TDD only 1-800-231-6103 (FL only)
On the Internet at: WaterMatters.org

An Equal Opportunity Employer

Tampa Service Office
7601 Highway 301 North
Tampa, Florida 33637-6759
(813) 985-7481 or
1-800-836-0797 (FL only)
SUNCOM 578-2070

Bartow Service Office
170 Century Boulevard
Bartow, Florida 33830-7700
(863) 534-1448 or
1-800-492-7862 (FL only)
SUNCOM 572-6200

Sarasota Service Office
6750 Fruitville Road
Sarasota, Florida 34240-9711
(941) 377-3722 or
1-800-320-3503 (FL only)
SUNCOM 531-6900

Lecanto Service Office
3600 West Sovereign Path
Suite 226
Lecanto, Florida 34461-8070
(352) 527-8131
SUNCOM 667-3271

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Pasco
Judith C. Whitehead
Hernando

David L. Moore
Executive Director
Gene A. Heath
Assistant Executive Director
William S. Bilenky
General Counsel

June 6, 2003

Ms. Lauren Milligan
Florida State Clearinghouse
Florida Department of Environmentally Protection
3900 Commonwealth Boulevard, Mail Station 47
Tallahassee, Florida 32399-3000

Subject: Department of the Army – Jacksonville District Corps of Engineers – Scoping Notice for the Stevenson Creek Estuary Ecosystem Restoration Study – Brownfield Assessment Program Pilot Project – Clearwater, Pinellas County, Florida

SAI#: FL 200305212211

Dear Ms. Milligan:

The staff of the Southwest Florida Water Management District (District) has conducted a consistency evaluation for the project referenced above. Consistency findings are divided into four categories and are based solely on the information provided in the subject application.

FINDING	CATEGORY
	Consistent/No Comment
X	Consistent/Comments Attached
	Inconsistent/Comments Attached
	Consistency Cannot be Determined Without an Environmental Assessment Report/Comments Attached

This review does not constitute permit approval under Chapter 373, Florida Statutes, or any rules promulgated thereunder, nor does it stand in lieu of normal permitting procedures in accordance with Florida Statutes and District rules.

If you have any questions or if I can be of further assistance, please contact me in the District's Planning Department at extension 4423.

Sincerely,

Jason M. Mickel
Basin Planner

Attachment
cc: Patricia Dooris, SWFWMD (w/ attachment)
Manny Lopez, SWFWMD (w/ attachment)
Richard Mayer, SWFWMD (w/ attachment)
Gordon McClung, SWFWMD (w/ attachment)

:EIVED
1 1 2003
OIP/OLGA

SWFWMD COMMENTS ON FLORIDA STATE CLEARINGHOUSE
DOCUMENT NUMBER FL200305212211

The District's Planning Department, and Environmental and Engineering Sections have reviewed Florida State Clearinghouse Document, FL200305212211 - Department of the Army – Jacksonville District Corps of Engineers – Scoping Notice for the Stevenson Creek Estuary Ecosystem Restoration Study – Brownfield Assessment Program Pilot Project – Clearwater, Pinellas County, Florida. Overall, the District supports the Stevenson Creek Estuary Ecosystem Restoration Study but has provided the following suggestion and recommendations for consideration:

- Proposed work should be reviewed within the context of Surface Water Improvement and Management (SWIM) activities for Tampa Bay.

- Restoration of shoreline habitats should be coordinated and consistent with SWIM targets and goals (design and type).

- Stormwater management and proposed improvements should compliment SWIM and the Tampa Bay Estuary Program goals (nutrient loads).

- Dredging activities should be conducted in a fashion that minimizes adverse water quality conditions to Tampa Bay.

- "Brownfield" conditions should warrant special consideration, whereas minimizing the release of contaminants into the environment is part of the overall project scope. Preliminary sediment testing for Contaminants of Concern and other potential toxic/hazardous waste should be conducted and remediation plans should be developed as needed.

- Dewatering sites for dredged material should be managed to prevent off-site drainage into Tampa Bay or adjacent land habitats.

- Dredged sediment disposal sites and dewatering sites (uplands) should be surveyed for endangered species, threatened species, and other species categorized in some way by the respective jurisdictional agencies as meriting special protection or consideration (e.g., gopher tortoise).

COUNTY: PINELLAS

DATE:	5/21/2003
COMMENTS DUE DATE:	6/20/2003
CLEARANCE DUE DATE:	7/20/2003
SAI#:	**FL200305212211**

MESSAGE:

STATE AGENCIES	WATER MNGMNT. DISTRICTS	OPB POLICY UNIT	RPCS & LOC GOVS
COMMUNITY AFFAIRS	SOUTHWEST FLORIDA WMD	ENVIRONMENTAL POLICY UNIT	
ENVIRONMENTAL PROTECTION			
FISH and WILDLIFE COMMISSION			
STATE			
X TRANSPORTATION			

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evaluation and is categorized as one of the following:

- _ **Federal Assistance to State or Local Government (15 CFR 930, Subpart F).** **Agencies are required to evaluate the consistency of the activity.**
- X **Direct Federal Activity (15 CFR 930, Subpart C). Federal Agencies are required to furnish a consistency determination for the State's concurrence or objection.**
- _ **Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.**
- _ **Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.**

Project Description:

DEPARTMENT OF THE ARMY - JACKSONVILLE DISTRICT CORPS OF ENGINEERS - SCOPING NOTICE FOR THE STEVENSON CREEK ESTUARY ECOSYSTEM RESTORATION STUDY - BROWNFIELD ASSESSMENT PROGRAM PILOT PROJECT - CLEARWATER, PINELLAS COUNTY, FLORIDA.

To: Florida State Clearinghouse

AGENCY CONTACT AND COORDINATOR (SCH)
3900 COMMONWEALTH BOULEVARD MS-47
TALLAHASSEE, FLORIDA 32399-3000
TELEPHONE: (850) 245-2161
FAX: (850) 245-2190

EO. 12372/NEPA

- [X] No Comment
- [ ] Comment Attached
- [ ] Not Applicable

Federal Consistency

- [X] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

From:

Division/Bureau: FDOT D7 Modal Planning + Dev.
Reviewer: Robin Rhinesmith
Date: 6/16/03

Project Information

Project:	FL200305212211
Due Date:	JUNE 20, 2003
Description:	DEPARTMENT OF THE ARMY - JACKSONVILLE DISTRICT CORPS OF ENGINEERS - SCOPING NOTICE FOR THE STEVENSON CREEK ESTUARY ECOSYSTEM RESTORATION STUDY - BROWNFIELD ASSESSMENT PROGRAM PILOT PROJECT - CLEARWATER, PINELLAS COUNTY, FLORIDA.
Keywords:	ACOE-STEVENSON CREEK RESTORATION-BROWNFIELD SITE-CLEARWATER, PINELLAS
Program:	99.997

Agency Comments:

TAMPA BAY RPC - TAMPA BAY REGIONAL PLANNING COUNCIL

Please see the comments forwarded by Pinellas County in their letter dated 6/23/03.

PINELLAS - PINELLAS COUNTY

The Pinellas County Environmental Management Department supports the need for improvements to the Stevenson Creek Estuary. Removal of nutrient-laden sediments and improved circulation should enhance water quality in the long-term. However, the Department does have concerns that in order for the entire plan, when implemented, to be environmentally sound, it needs to provide or leave some shallow unvegetated foraging ares for birds, and avoid adverse or damaging impacts to existing submerged aquatic vegetation habitat within or near the project area. The Pinellas County Planning Department reviewed the project and finds that the project description references to "..disposal at a sanitary landfill located in Pinellas County.." but does not clearly define which sanitary landfill or its location. At this time, Pinellas County Utilities staff is not aware of the project. If the intent is to dispose of the materials at Pinellas County facility, this needs to be clear, and the Department requests receiving additional materials regarding this for further review. The Pinellas County Planning Department does, however, find that the project is consistent with the goals, objectives and policies of the Pinellas County Comprehensive Plan, as long as the concerns raised in this letter are adequately addressed.

ENVIRONMENTAL POLICY UNIT - OFFICE OF POLICY AND BUDGET, ENVIRONMENTAL POLICY UNIT

COMMUNITY AFFAIRS - FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS

Released Without Comment

FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

STATE - FLORIDA DEPARTMENT OF STATE

A review of the Florida Master Site File and our records indicates that there are three recorded archaeological sites (8PI10), 8PI62, and 8PI140) are all recorded as prehistoric burial mounds. In addition, available environmental data for the area support the possibility for unrecorded archaeological sites occuring in the uplands bordering Stevenson Creek. It is therefore the opinion of this Office that there is reasonable probability of some proposed project activites impacting historic properties since the area has never been subjected to a systematic, professional survey to locate such properties.

TRANSPORTATION - FLORIDA DEPARTMENT OF TRANSPORTATION

NC/Consistent

ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Department staff has expressed concern that the project may cause pollution on the sites that are being considered for dewatering purposes and for disposal of the dredged material. The USACOE's plan should ensure that dredged material is adequately evaluated for the presence of pollutants which might leach from the material or present a direct exposure concern should they be used as fill material. The proposed dewatering site, the Wolfe Property, and adjacent property may already contain soil, sediment, and groundwater contamination; as such, project plans should address the potential for the dewatering activity to adversely impact the existing contamination. The plan should also consider that the Department has an active case on a property adjacent to the Wolfe site, where contamination issues at an old salvage yard are being investigated. The plan should ensure that disposal of the dredged material in a landfill would be accomplished in accordance with the landfill's permit. Please note that construction of the project will also require water quality certification in the form of an Environmental Resource Permit (ERP) from the Southwest District office in Tampa.

SOUTHWEST FLORIDA WMD - SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

consistent/comments attached

SUB- APPENDIX F - PROJECT STUDY REPORTS

Stevenson Creek Sediment Characterization and Removal Feasibility Study

Prepared for:

City of Clearwater, Florida

Prepared by:

BCI Engineers & Scientists, Inc.

BCI File 979674

August 1998

EXECUTIVE SUMMARY

The City of Clearwater, Pinellas County, engaged BCI Engineers & Scientists, Inc. (BCI) to provide engineering services for a **preliminary** characterization, beneficial use, and removal feasibility study of sediments from Stevenson Creek. The project area is approximately 29 acres between North Fort Harrison Avenue Bridge and Douglas Avenue Bridge. Specific work tasks undertaken and reported include:

- Determination of Creek Sediment and Water Chemical and Physical Characteristics
- Determination of Creek Bathymetry and Muck Sediment Volume Estimate
- Investigation of Potential Sediment Use Options
- Development of Potential Sediment Disposal Options and Costs

Chemical Characterization

Chemical characterizations performed on Stevenson Creek sediments and surface water included analysis for priority pollutant metals, pesticides, herbicides and potential metal toxicity, as defined by the Toxicity Characteristic Leaching Procedure (TCLP). Existing site information was provided by the City (**Appendix A**) and was used to select the test parameters, as dictated by the project cost. Sediment samples were also subjected to elutriate testing procedures and analyzed for the aforementioned parameters. The analyses and existing information revealed the following:

Sediments

- All metals except antimony and thallium were detected.
- Sediments do not qualify as hazardous material based on the metal concentrations detected in the TCLP leachate produced.
- No pesticides or herbicides were detected above regulatory levels.
- No volatile constituents were detected.
- One semi-volatile constituent (Benzo (a) pyrene) was detected at a concentration of 0.1 mg/kg, a value equal to the Florida Department of Environmental Protection's selected soil clean-up goal for residential areas.
- Petroleum hydrocarbons including oil and grease, both detected over 60 mg/kg, may be a concern and will need to be investigated further.

Water

- Barium, copper and zinc were detected in the surface water. Only copper was above the Florida Class III Water Quality Standards (WQS) for marine waters.
- No pesticides or herbicides were detected in the surface water sample.
- Four volatile constituents and one semi-volatile constituent were detected in the surface water sample at levels below marine WQS.
- No petroleum hydrocarbons or oil and grease were detected in the creek water.

Elutriate

- Arsenic, barium, chromium, copper, lead, nickel, selenium, silver and zinc were all detected in the elutriate water. Concentrations of copper, lead, silver and zinc exceeded the Florida Class III WQS for marine waters in the elutriate water. However, further sampling and testing will be needed to substantiate if these concentrations are consistently above regulatory limits. Concentrations of arsenic, barium, chromium, nickel and selenium in the elutriate water were below marine Class III WQS.

Physical Characterization

Physical characterization of Stevenson Creek sediments revealed two distinct classifications of sediments. High solids content sands of low organic content were the dominant sediment type east of the Pinellas Trail and in the numerous sandbars. Low solids content, organic sediments (muck) were present over the remainder of the creek west of the Pinellas Trail and are of primary focus for this removal feasibility study. The average physical characteristics of the organic sediments are listed below:

Average Physical Characteristics
Organic Sediments

Physical Characteristic	Average
Solids Content	39%
Organic Content	13%
Percent Passing No. 200 Mesh Sieve	57%
Specific Gravity	2.3
Plasticity Index	95

Sediment Volume Estimates

Calculations based on creek bathymetry, probing and sample analysis determined that Stevenson Creek currently contains an approximate volume of 80,000 cubic yards (c.y.) of organic (muck) sediments concentrated mostly between the Pinellas Trail and North Fort Harrison bridges. If there is a desire to improve navigation at low tide, removal of one foot of sand from the entire 29-acre project area would require removal of 47,000 c.y. of additional sand sediments. Only small, isolated areas of muck were identified east of the Pinellas Trail Bridge.

Stevenson Creek Sediment Volume Totals

Organic Sediments	Sand Sediments	Total
80,000 c.y.	47,000 c.y.	127,000 c.y.

Conclusions

- Chemical analyses of the creek water indicate that only copper exceeds the Class III marine WQS.

- All TCLP results fall well below criteria set forth in 40 CFR 261.24 and do not qualify the sediments as being hazardous.

- After subjected to an elutriate procedure, copper, lead, silver and zinc exceeded the Class III marine WQS. However, this needs to be further substantiated with additional sampling and testing. Although no standards exist for sediment disposal on land, a comparison of Stevenson Creek results with U.S. Environmental Protection Agency (USEPA) 503 regulations for sewage sludge disposal on land indicates the sediments are well below regulatory limits and should not pose any land disposal concerns. Petroleum hydrocarbons along with oil and grease may also be a concern.

- Physical testing of Stevenson Creek sediments reveals two distinct classifications of sediments. High solids content sands of low organic content were the dominant sediment type east of the Pinellas Trail and in the numerous sandbars. Low solids content, organic sediments (muck) were present over the remainder of the creek west of the Pinellas Trail and are of primary focus for this removal feasibility study.

- Approximately 80,000 c.y. of organic sediments are proposed for removal from Stevenson Creek. However, an additional one foot of sandy sediments from the sand bars and from under the muck sediments, totaling 47,000 c.y., could be removed to aid in navigation at low tide.

- The cost to hydraulically dredge the organic sediments from Stevenson Creek is estimated to approximately $7/c.y. However, this would be contingent upon availability of between five to 10 acres of land for temporary dewatering or final disposal in close proximity to the creek. It is estimated that the total project cost, including permitting, engineering, design, construction, implementation, monitoring and testing could range between $940,000 and $1,950,000.

- Based on the concentration of metals and nutrients found in the elutriate water, and petroleum hydrocarbons and oil and grease in the sediments, removal of the 80,000 c.y. of organic-bearing sediments between Douglas Avenue and North Fort Harrison Avenue bridges should enhance water quality in Stevenson creek. Although no specific benthic surveys were conducted, removal of these sediments should benefit the benthic community, improve water quality and assist with the regeneration of seagrasses in areas adjacent to the creek. Two projects, Crane creek (dredging completed this past Spring) and Turkey creek (to begin in December of 1998), in the Indian River Lagoon on the east coast of Florida, were designed with similar water quality and benthic environment improvement goals.

Stevenson Creek Estuary Restoration Project

Introduction:

The Stevenson Creek estuary is approximately 45 acres of mangrove forest, needle rush marsh and mud flats located north of downtown Clearwater in the North Greenwood neighborhood. It is the only estuarine ecosystem located within the jurisdictional boundaries of the City of Clearwater, and therefore offers unique opportunities for both wildlife utilization and recreational activities by area residents.

Existing Conditions

During the last 50 years, the estuary has been significantly impacted by encroachment, eliminating approximately 40 acres of tidal wetlands. Citizens are deeply concerned about the health of the estuary, the wildlife that lives in it, and most importantly, the safety of those who enjoy this natural resource.

Area which has been impacted

Project Scope & Costs:

The City of Clearwater has embarked on an multifaceted plan to restore and rehabilitate this threatened natural system. The scope of the effort includes:

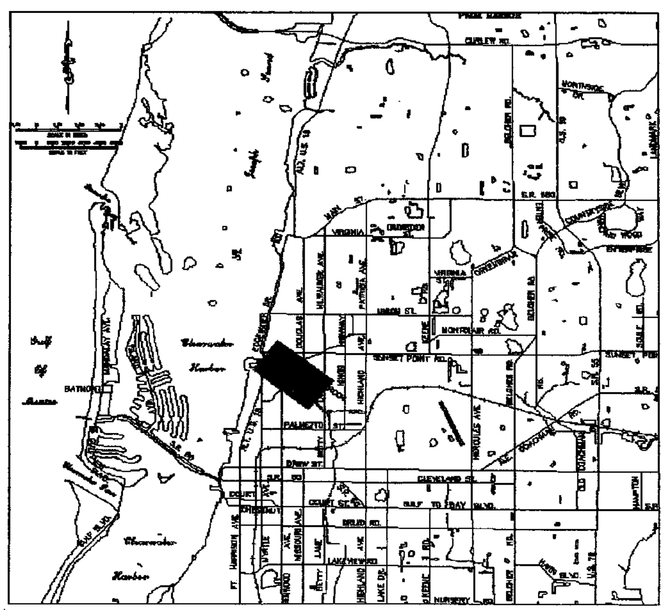
1. Removal of exotic and invasive plants ($50,000)
2. Sponsorship of an annual community clean-up day ($2,500)
3. Improving the existing stormwater drainage system to decrease direct discharge of pollutants ($275,000)
4. Purchase and improvement of the remaining tidal marsh area ($750,000)
5. Perform restoration dredging within portions of the estuary ($6,000,000)

Total Costs: $7,077,500

The most ambitious of these efforts by far is the restoration dredging project. The project proposes to remove excessive accumulations of organic debris and pollutants from the estuary and back fill these areas with clean sand material. The cumulative effect of these projects will be to restore much of the original beauty and function of this resource, reduce odor problems and ensure the safety of wildlife and residents for decades to come.

Project Schedule:

Begin Design: **1998**



Project Location

Final Report

Bacterial Source Tracking Using Antibiotic Resistance Analysis of Fecal Coliforms

Stevenson Creek, Clearwater, Florida

June – December, 2000

Valerie J. Harwood and John E. Whitlock
University of South Florida
Department of Biology
(vharwood@chuma1.cas.usf.edu)

March 20, 2001

Introduction

Various bacteria are found in the digestive tracts and feces of wild and domestic animals and humans. Some of these bacteria including fecal coliforms and fecal streptococci are used as indicators of fecal contamination when present in natural waters. Unfortunately, the mere presence of these indicator bacteria is not informative as to the source of fecal pollution, an important factor for risk-assessment and remediation. Consequently, several methods collectively known as bacterial source tracking (BST) methods have been developed to "fingerprint" fecal indicator bacteria in order to determine their host or source (e.g. human, dog, wild animal) and may be based on either the genetic make-up of the bacteria, or on physiological characteristics such as resistance to various antibiotics. Using antibiotic resistance analysis (ARA), it is possible to assess the source of indicator organisms based on a much larger subset of the bacterial population than is currently possible using genetic methods. ARA was used to determine the source of fecal contamination in this study essentially as described in Harwood et. al 2000.

In any BST method, a database of fingerprints, or patterns, of bacteria isolated from the feces of known source animals (e.g. humans, dogs, wild animals) must first be constructed and tested for its predictive accuracy. This database is called the calibration data set. Discriminant analysis, a multivariate statistical test, is used to analyze the data. The ability of the database to accurately predict the source of indicator organisms is assessed using isolates from known sources as "unknown" or test isolates. The database can also be self-crossed, that is, the database isolates are used as both the calibration data set and the test data set.

The database used in this study consists of 3309 fecal coliform isolates from six sources, humans (domestic wastewater), dogs, cattle, chickens, pigs and wild animals (mainly raccoons and birds). The average rate of correct classification (ARCC) is a measure of the predictive accuracy of the database, and is obtained by self-crossing the database, adding the number of correctly classified isolates in all source categories, and dividing by the total number of isolates. The ARCC of this data set is 57.2% when 6 source categories are used in the analysis. The chance of an isolate falling into one of 6 categories by chance if categorization were random is 16.7%, therefore the antibiotic resistance patterns of fecal coliforms have substantial predictive capacity with respect to bacterial sources (Harwood *et al.,* 2000).

In any database, some percent of isolates from other sources will misclassify as human isolates. The rate of misclassification of isolates into the human category can be used to develop a cut-off point for significant levels of human isolates. In this database, about 20% of wild animal isolates are misclassified as human, and wild animal isolates have the highest rate of misclassification as human of all sources. The conservative rate of 25% is used as the cut-off point for identification of a significant percentage of isolates from human sources in any sample.

Stevenson Creek

This study was initiated in order to identify the dominant source(s) of fecal contamination to Stevenson Creek in Clearwater, Florida. Five sites were chosen to represent areas where routine monitoring has shown high levels of fecal coliforms. Two of the sites were located at the composite samplers previously installed for the project (Comp1 and Comp2). Comp1 is located at the golf course on the main branch of Stevenson Creek; Comp 2 is located on Spring Branch off King Highway. Sites previously designated for monitoring efforts were sampled: STC1 at Spring Branch, STC2 at Hammond's Branch and STC5 at Evergreen.

Sampling dates were June 27, July 25, August 22, September 19, October 23, November 13, and December 27, 2000. Isolation of fecal coliforms was poor from November with samples yielding only an estimate of population density and no information as to source of contamination. Consequently, additional samples were collected in December.

Results

The dominant sources of fecal coliform isolates obtained from the five sites over the course of this study were wild animal, dog and human. The overall trend was for wild animal isolates to comprise the majority of fecal coliforms obtained when colony forming units (CFU) counts exceeded the acceptable limit of 200CFU/100ml. STC1 and STC2 sampled on 6/27/00 were the only observations where exceedingly high CFU counts co-occurred with a majority of human isolates. On 8/22/00 at STC1, the majority of isolates were dog and the CFU count was 300/100ml. Samples from the month of September yielded a majority of human isolates from all sites while densities of coliforms were low, ranging from 7-26 CFU/100ml. The above results suggest that source most frequently contributing to excessive fecal coliform counts was wild animals followed by human and dog isolates.

Some statistically significant relationships were apparent between the CFU counts and classification of isolates. The percentages of isolates from specific sources were compared to CFU/100ml using a regression analysis. There was a significant, inverse relationship between the percentage human isolates and the CFU count for Comp2, i.e. as the CFU count went down over the study period, the percentage of human isolates went up , $P=0.019$, $r^2= 0.87$ (Fig. 9). While this relationship was not observed for the other four sites examined individually, it was observed when data from all sites were pooled, $P=0.001$, $r^2=0.34$ (Fig 11). This indicates enough of an overall trend among the sites to maintain a significant inverse relationship between CFU and percent human. Likewise, when the percentage of wild isolates was compared to CFU counts in a similar test, a significant direct relationship was observed at STC 1, $P<0.001$, $r^2= 0.96$. The CFU count decreased along with the percent of wild isolates, Fig 10. Again, a significant relationship was not observed for any of the other four sites when examined individually. However, when the five sites were pooled the regression was significant, $P<0.001$, $r^2=0.60$ (Fig. 12). These results support the notion that wild animals are the predominant contributors to fecal contamination marked by elevated fecal coliform levels.

The relative importance of specific wild animals as contributors to high fecal coliform numbers is difficult to assess with confidence but is likely related to factors such as population size and density and their utilization of the territory adjacent to the sample sites. During the course of the study, birds were the most frequently observed wild vertebrates. Great white egrets, snowy egrets, little blue herons, and anhingas were frequently present in low densities during sample collection i.e one or two individuals. Waterfowl such as gallinules, coots and ducks, were observed in slightly higher densities (three or four individuals), but not as frequently. The largest aggregates of wild animals observed during the study period were flocks of migratory birds such as European starlings and boat-tailed grackles. These birds, however, were observed during the late fall months when fecal coliform densities were low. Gulls common to the coastal areas such as the black-headed gull and herring gull were not observed frequently near the sampling sites.

While human input may not be the major cause of elevated fecal coliform levels for most of the samples analyzed for this study, the domination of small populations by human isolates suggests that human sources contribute to low-level background contamination. This occurs when FC populations are low, near the transition to dry season and perhaps few isolates are washed into surface waters from draining storm water. Lowering water tables may also draw wastewater from small, otherwise innocuous leaks. Overall, there was little evidence of acute human fecal contamination on a large scale across the five site examined. However, there may be considerable human source influencing STC1 and STC2, which is detectable despite the presence of fecal coliforms from other sources. These sites were impacted by human fecal sources with the highest frequency and magnitude of the five sites. They were more frequently over 25% human and exhibited a higher mean % human than the other sites. The most pronounced human contamination of STC1 and 2 occurred in June where 56.7% and 47.7% of isolates examined were human. The density of human isolates at STC1 and STC2 may be approximated from the fecal coliform density using the percent classified as humans. This yields 11400 'human'CFU/100ml for STC1 and 2400 'human'CFU/100ml for STC 2, both of which exceed the limit of 200CFU/ml. Consequently, unlike any other sampling event in this study, the human input for these two sites in June were high enough to cause violation considering only human isolates.

References

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Table 1. Density of fecal coliforms from the five sites as determined by membrane filtration

Site	Colony Forming Units/100ml						
	June	July	August	September	October	November	December
STC 1	20000	13000	300	26	35	1	6
STC 2	5000	2200	68	7	1	1	70
STC 5	1600	6400	115	7	1	1	24
Comp 1	12000	18000	110	9	6	30	17
Comp 2	20000	12000	0	16	960	10	120
Mean	11720	10320	118.6	13	200.6	8.6	47.4

Table 2. Percent wild isolates at Stevenson Creek sites, June – December

Site	June	July	August	Sept	Oct	Nov	Dec	Mean
Comp1	100.0	62.7	76.2	0	34.1	NA	0	45.5
Comp2	100.0	62.1	30.5	0	63.4	NA	0	42.7
STC1	43.3	42.1	21.7	3.1	0	NA	0	18.9
STC2	40.9	43.2	10.5	16.7	NA	NA	0	22.3
STC5	80.6	67.7	46.7	6.3	NA	NA	0	40.3

Table 3. Percent human isolates at Stevenson Creek sites, June – December

Site	June	July	August	Sept	Oct	Nov	Dec	Mean	# > 25%
Comp1	0	3.7	4.8	62.5	20.5	NA	75	27.8	2
Comp2	0	6.9	25.4	93.3	15.9	NA	90.5	38.7	3
STC1	56.7	31.6	13.3	90.6	12.5	NA	71.4	46.0	4
STC2	47.7	16.2	10.5	83.3	NA	NA	75	46.5	3
STC5	0	22.6	10	75	NA	NA	82.5	38.0	2

Table 4. Percent dog isolates at Stevenson Creek sites, June – December

Site	June	July	August	Sept	Oct	Nov	Dec	Mean
Comp1	0	0	19.1	37.5	36.4	NA	25	19.6
Comp2	0	0	42.4	6.7	2.3	NA	9.5	10.15
STC1	0	18.4	65.0	3.1	87.5	NA	28.6	33.7
STC2	0	18.9	79.0	0	NA	NA	25	24.6
STC5	0	6.5	43.3	18.8	NA	NA	17.5	17.2

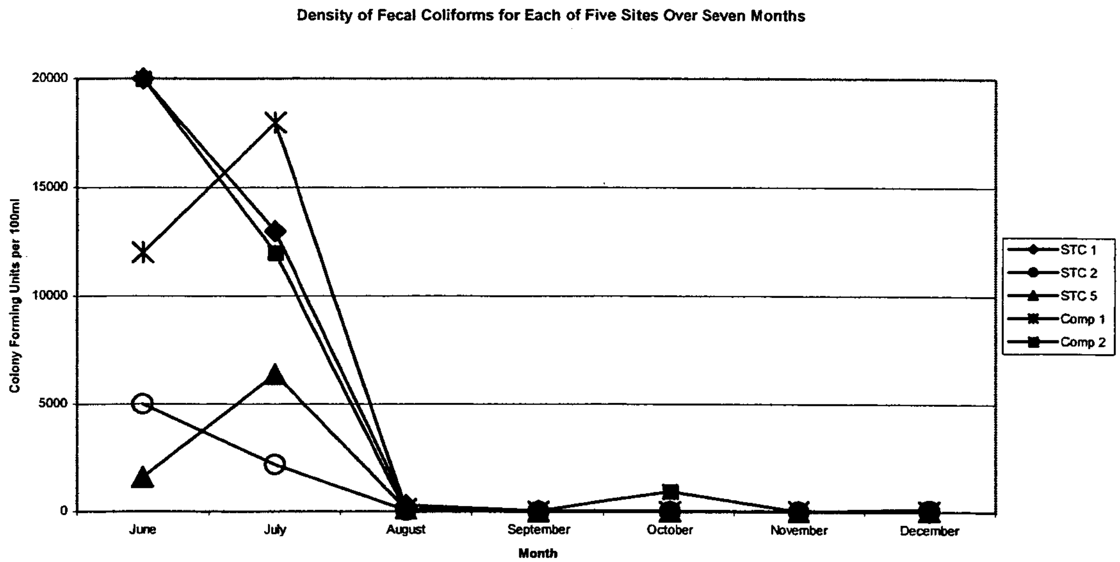

Figure 1. CFU/100ml from the five sites over seven months.

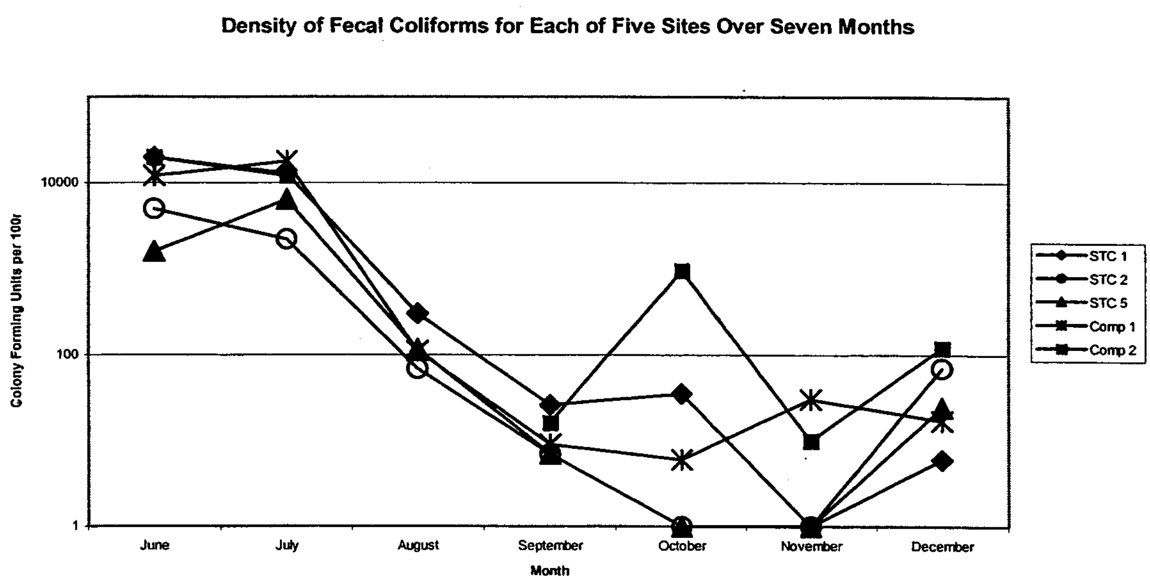

Figure 2. CFU/100ml from the five sites over seven months, graphed on a log scale.

Categorization of Isolates from Each of Five Sites on 6/27/00

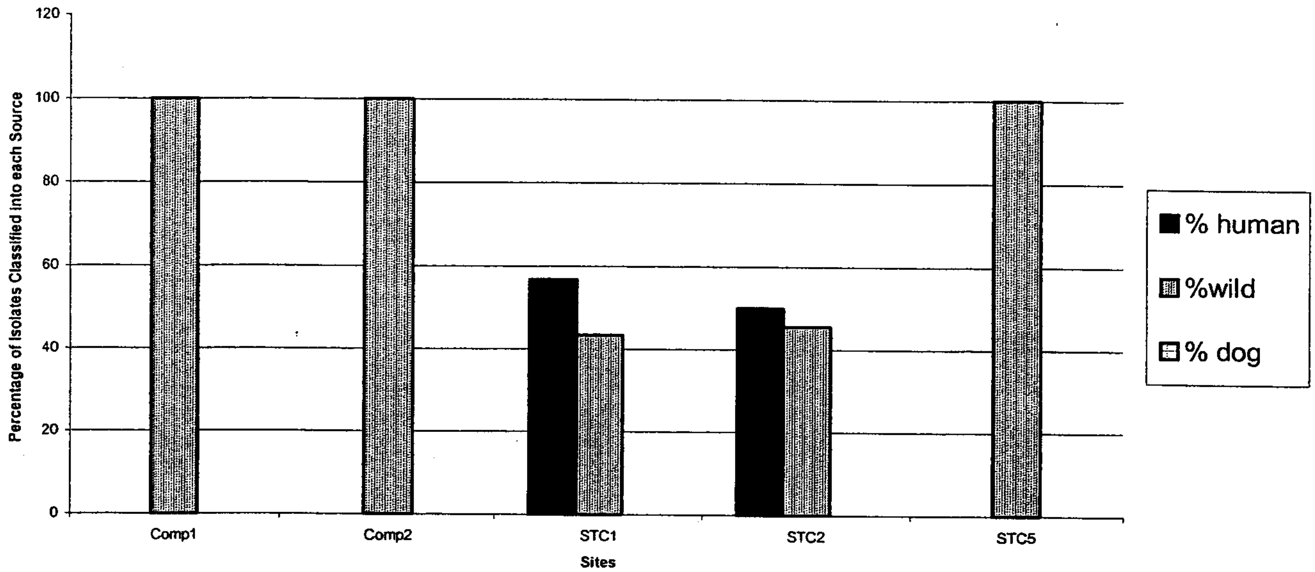

Figure 3

Categorization of Isolates from Each of Five Sites on 7/25/00

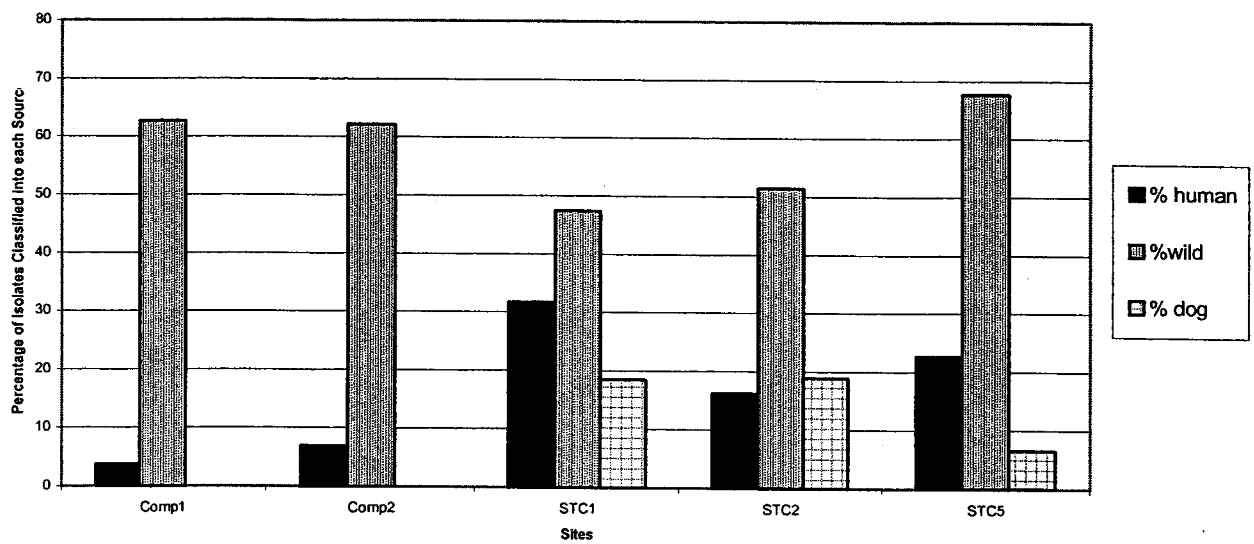

Figure 4.

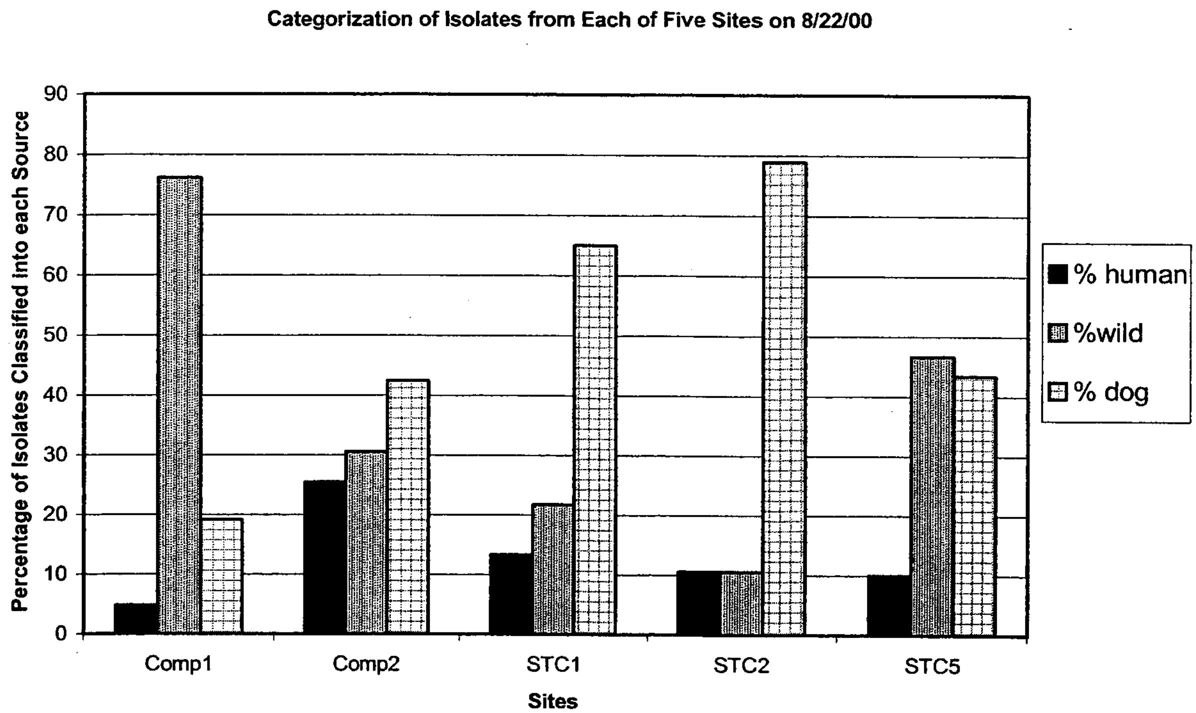

Figure 5.

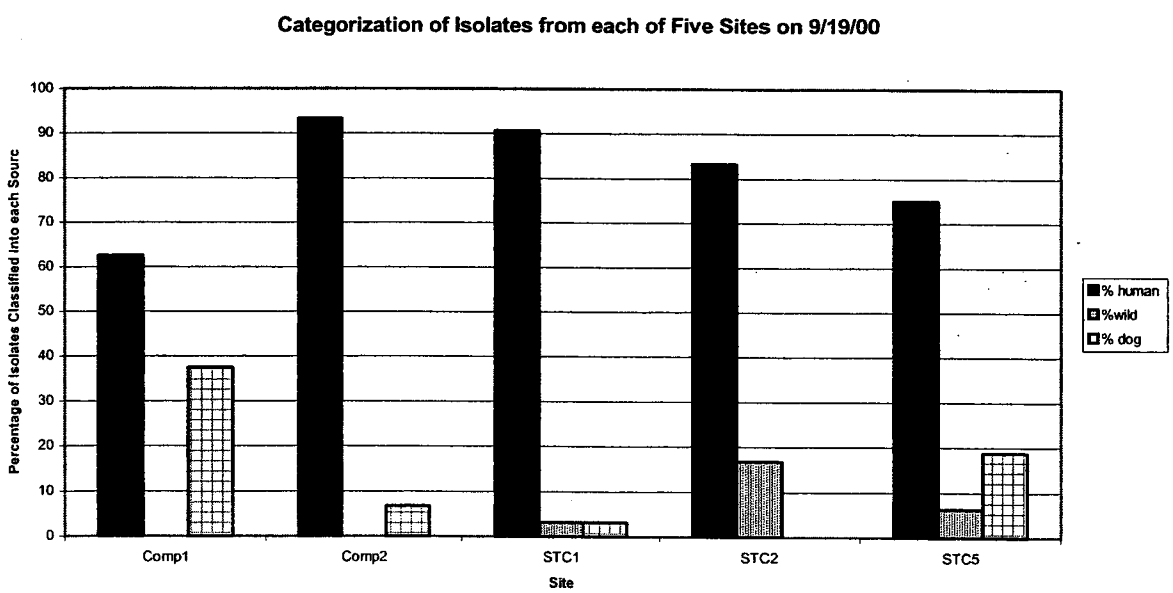

Figure 6.

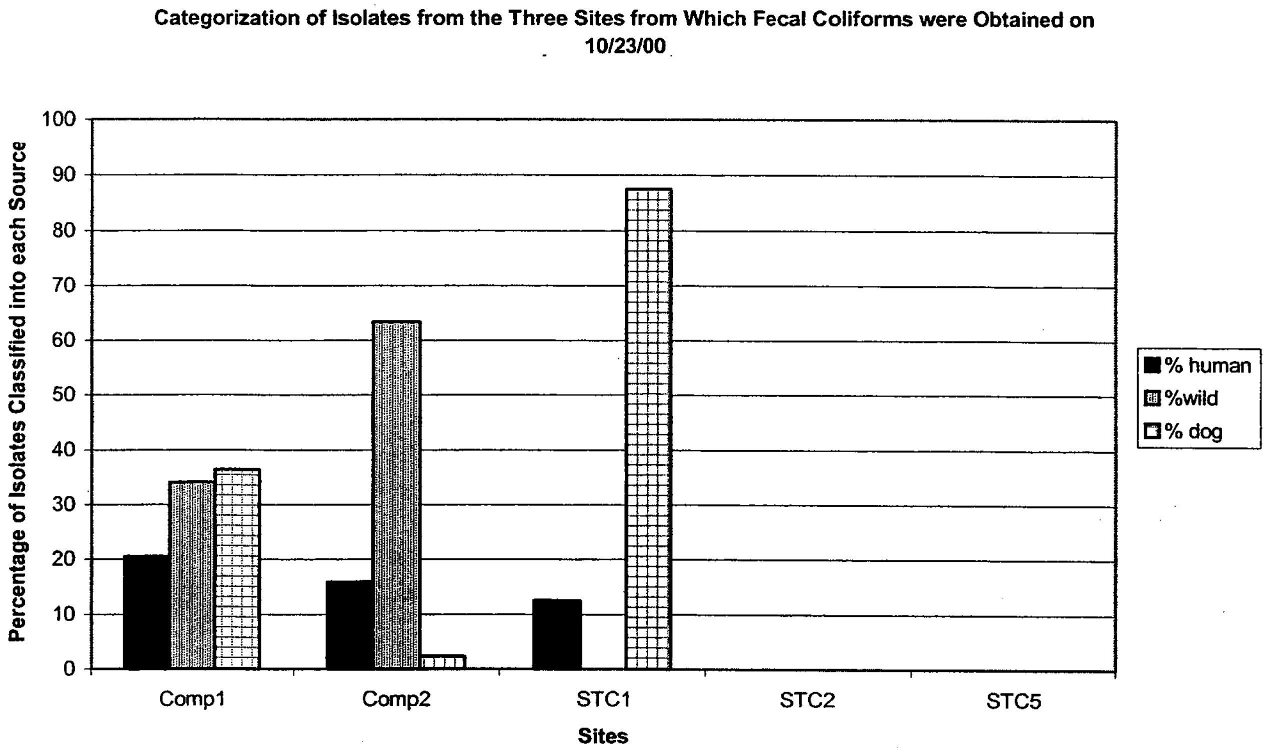

Figure 7.

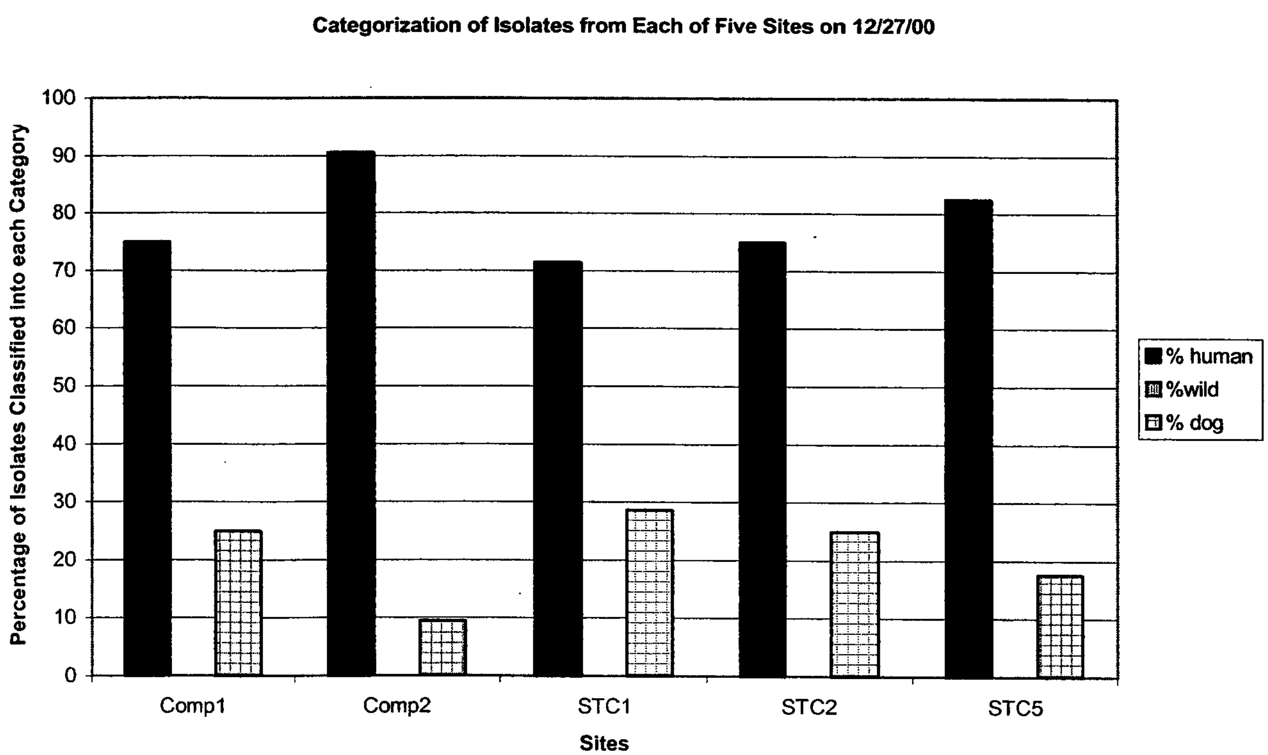

Figure 8.

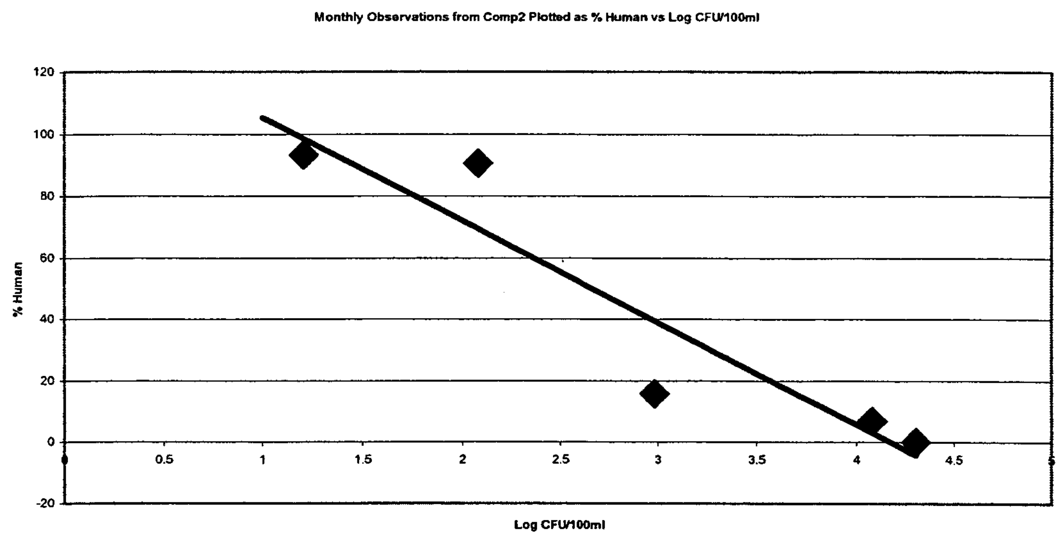

Figure 9.

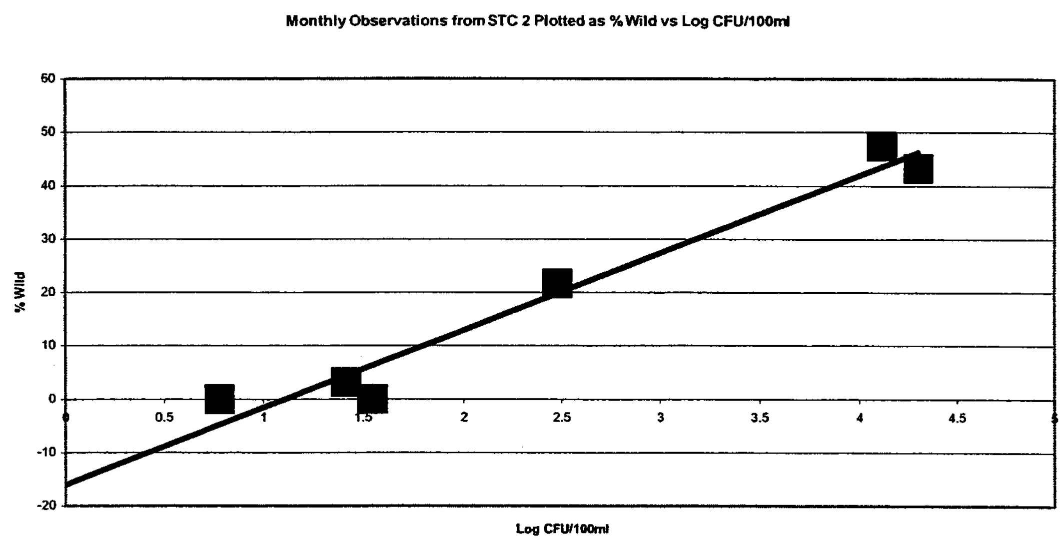

Figure 10.

Environmental Evaluation of a Candidate Spoil Disposal Site for Stevenson Creek Section 206 Environmental Restoration Project

21 August 2002

Prepared for
Jacksonville District
US Army Corps of Engineers
400 West Bay Street
Jacksonville, Florida 32202

by
Dial Cordy and Associates Inc.
490 Osceola Ave
Jacksonville, Florida 32250

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (the "Corps"), in cooperation with the City of Clearwater (the local sponsor), has proposed restoration activities for the tidally influenced portion of Stevenson Creek, a small creek flowing into Clearwater Harbor (Pinellas County, Florida). The restoration is proposed under Section 206 of Water Resources Development Act of 1996. Proposed elements of the restoration include dredging silt, clay, and some sand from two portions of the creek.

To assist the Corps and local sponsor in the selection of a spoil disposal site, Dial Cordy and Associates Inc. (DC&A) conducted an investigation of one potential disposal site in Hillsborough County, Florida (Figure 1). The site, which would be contained within an approximately 400-acre property owned by the City of Clearwater, is accessed from Patterson Road, approximately 1 mile south of its juncture with Highway 582 (Lake Fern- Tarpon Springs Road). The City of Tarpon Springs (Pinellas County, Florida) is approximately 6 miles west of the candidate spoil disposal site. The primary objectives of the investigation included determining if and where jurisdictional wetlands may be impacted due to planned activities, and whether species listed as endangered or threatened utilized the site and would be impacted by activities.

2.0 METHODS

Evaluation of the candidate spoil disposal site comprised both field and desktop investigations. A field visit was conducted on 17 July 2002 by a DC&A biologist and staff from the City of Clearwater (hereafter, the "City") and the Corps to determine the preferred position of the candidate spoil disposal site within the City's property. Following initial site selection, existing habitats within and adjacent to the candidate disposal site were observed (via vehicle transects and point observations) and examined to determine likely wildlife utilization and to attempt to find sign or presence of species listed as endangered or threatened. Furthermore, four points were selected within the candidate site (designated with "COE-#" in Figure 3) to confirm through examination of vegetation, soils, and hydrology the lack of jurisdictional wetlands where spoil may be placed. Data taken at these points were recorded on data forms for routine wetland determination based on the Army Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). Finally, photographs of the candidate site and surrounding habitats were also taken from the four sampling points and one additional point outside the candidate site.

During the week following the site visit, further investigations of the candidate spoil disposal site were carried out using digital map databases, a soils map, aerial photographs, and other sources.

3.0 RESULTS

Land Use and Habitats. Land use surrounding the property owned by the City is primarily agricultural/rural. However, there are many new residential developments that are under construction in the vicinity. The City property is currently leased to an individual who utilizes much of the site as pasture for cattle and horses. One corner of the property has been developed as a trap-shooting range and mobile home park. This parcel, and much of the property used for pasture was used approximately ten years ago as a depository for municipal sludge (T. Finch, pers com). These sludge fields are no longer recognizable at the surface because herbaceous vegetation now completely covers areas where materials were deposited.

Ground-truthing confirmed habitat inventory information from the *Florida Land Cover (GAP Project)* and *Habitat and Landcover* map themes of the Florida Geographic Data Library (FGDL) (see Geo-Facilities Planning and Information Research Center, 2002). According to the *Habitat and Landcover* map theme, the candidate site is listed as "grassland (agriculture)," and the undeveloped/uncleared habitats on the property that surround the candidate site include "barren" land and "hardwood swamp" (to the east and south), "hardwood forest and hammock", "pinelands," and "hardwood swamp" to the west, and a corridor of additional "grasslands" along an access road to the north. According to the *Florida Land Cover* map theme, the candidate site and areas to the immediate north and east area categorized as "agriculture," with "swamp forest composite group" a bit farther to the east. The latter is also listed for habitats west of the candidate site. "Cypress forest compositional group" exists to the northwest and south of the candidate site.

Soils. Soils underlying the candidate site are mapped as "Zolfo fine sands," "Myakka fine sands," and "Pomello fine sands" (Figure 2), which are described as somewhat poorly drained, poorly drained and very poorly drained, and moderately well drained, respectively (Soil Conservation Service, 1989). Zolfo series sands comprise the majority of the substrate under the candidate site. Where sludge was deposited, native soils are found only inches below the surface. Detailed observations of soils were utilized in order to determine the presence/absence of jurisdictional wetlands (see below).

Jurisdictional Wetlands. Data taken at the four sample stations within the survey area were used to confirm the lack of evidence of the presence of jurisdictional wetlands (see Appendix A). Appendix B includes photos of vegetation taken at each point, and also includes photos of the landscape of the candidate site and the vicinity. No jurisdictional wetlands were determined to be present within the boundaries of the environmental survey (Figure 3). However, wetlands were confirmed to be present in adjacent habitats. These were designated as "cypress forest compositional group" (see Plates 17 and 18 in Appendix B, plotted as "COE-W" in Figure 3), "swamp forest composite group", and "hardwood swamp"; and some of those designated as "pinelands" in the FGDL.

Wildlife. Wildlife utilization of the candidate site consists primarily of livestock. Little other wildlife was observed during the site visit. Pastures within the environmental survey boundaries may be used by foraging birds (e.g., killdeer, cattle egrets), rodents, and snakes, although none were observed during the site visit. No species listed as threatened or endangered (see Table 1), or their sign, was observed. In addition, habitats within the environmental survey area are not likely to be used by listed species.

4.0 CONCLUSIONS

No wetlands exist within the candidate disposal site. In addition, wetlands adjacent to the candidate site are not anticipated to be impacted by the proposed action, as long as no impacts occur within approximately 100 feet of the wetlands. In general, wetland boundaries adjacent to the candidate site fall approximately 50 feet from the tree-lines associated with the wetlands (see Plate 18 in Appendix B). Wetlands can be discerned by a break in topography and a subtle shift in the plant species composition. Because there is sufficient space within the interior of the candidate site for deposition of dredged material from Stevenson Creek, wetland boundaries surrounding the site were not marked with flagging tape in the field.

Since no sign or presence of species listed as threatened or endangered were observed, or are likely to occur on the site, using the candidate site for the disposal of dredge material will not impact such species.

5.0 SOURCES CITED/CONSULTED

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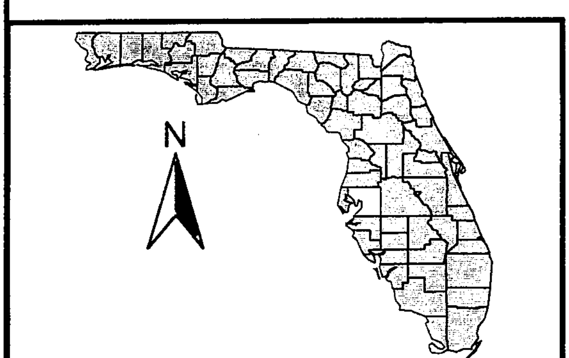
Soil Conservation Service. 1989. Soil survey of Hillsborough County, Florida. United States Department of Agriculture. Washington, D.C. 168 pp.

Table 1: Vertebrate species listed as endangered (LE), threatened (LT), or of special concern (LS) and known to occur in Hillsborough County*

Scientific Name	Common Name	Federal Status	State Status
	FISH		
Centropomus undecimalis	common snook	N	LS
	AMPHIBIANS		
Rana capito	gopher frog	N	LS
	REPTILES		
Alligator mississippiensis	American alligator	T(S/A)	LS
Caretta caretta	loggerhead	LT	LT
Chelonia mydas	green turtle	LE	LE
Crocodylus acutus	American crocodile	LE	LE
Dermochelys coriacea	leatherback	LE	LE
Drymarchon corais couperi	eastern indigo snake	LT	LT
Gopherus polyphemus	gopher tortoise	N	LS
Lepidochelys kempii	Kemp's ridley	LE	LE
Pituophis melanoleucus mugitus	Florida pine snake	N	LS
Pseudemys concinna suwanniensis	Suwannee cooter	N	LS
Stilosoma extenuatum	short-tailed snake	N	LT
	BIRDS		
Ajaia ajaja	roseate spoonbill	N	LS
Aphelocoma coerulescens	Florida scrub-jay	LT	LT
Aramus guarauna	limpkin	N	LS
Charadrius alexandrinus	snowy plover	N	LT
Charadrius melodus	piping plover	LT	LT
Egretta caerulea	little blue heron	N	LS
Egretta rufescens	reddish egret	N	LS
Egretta thula	snowy egret	N	LS
Egretta tricolor	tricolored heron	N	LS
Eudocimus albus	white ibis	N	LS
Falco peregrinus	peregrine falcon	E(S/A)	LE
Falco sparverius paulus	southeastern American kestrel	N	LT
Grus canadensis pratensis	Florida sandhill crane	N	LT
Haematopus palliatus	American oystercatcher	N	LS
Haliaeetus leucocephalus	bald eagle	LT	LT
Mycteria americana	wood stork	LE	LE
Pandion haliaetus	osprey	N	LS**
Pelecanus occidentalis	brown pelican	N	LS
Rynchops niger	black skimmer	N	LS
Speotyto cunicularia floridana	Florida burrowing owl	N	LS
Sterna antillarum	least tern	N	LT
	MAMMALS		
Podomys floridanus	Florida mouse	N	LS
Sciurus niger shermani	Sherman's fox squirrel	N	LS
Trichechus manatus	manatee	LE	LE

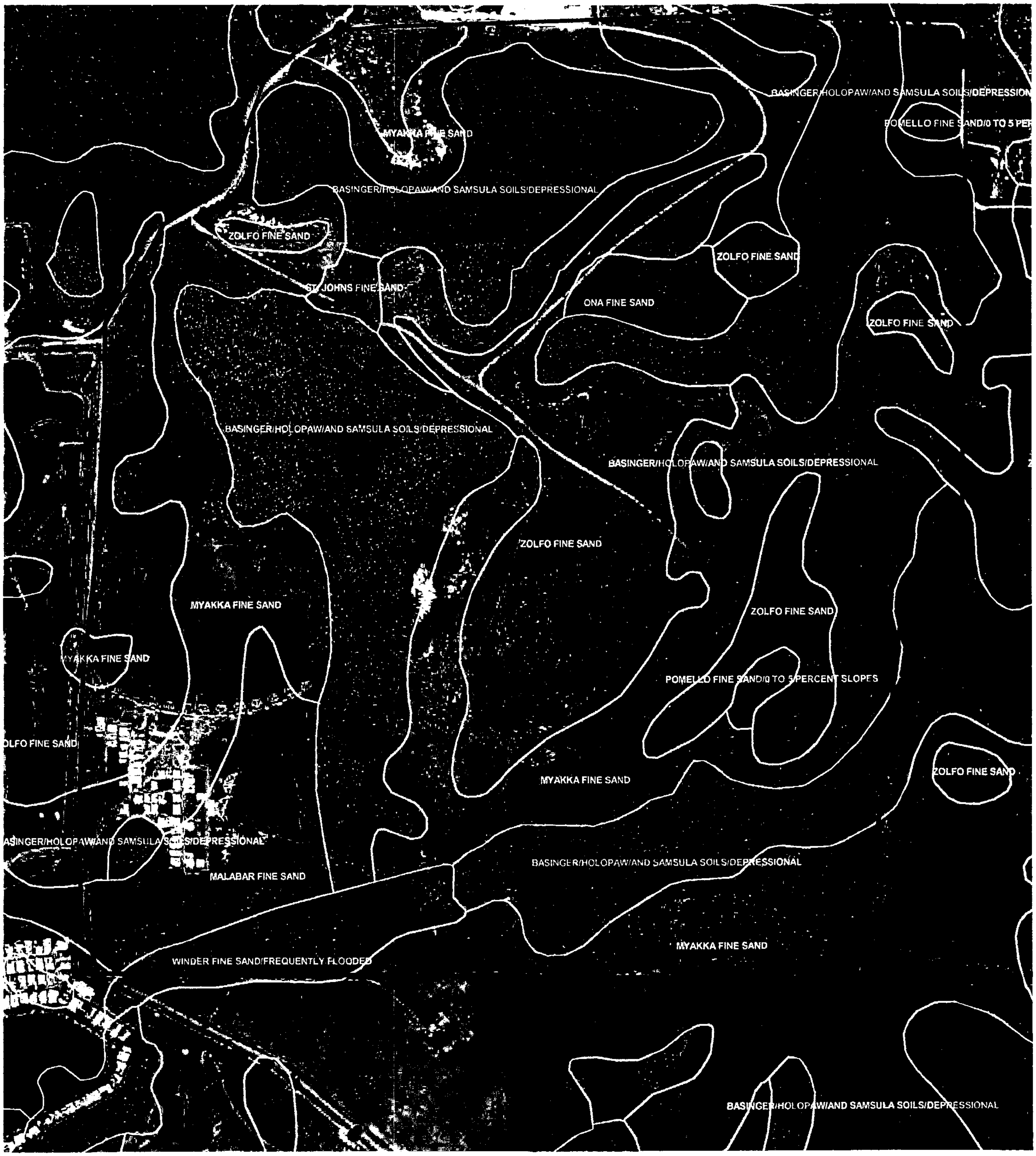
*source: Florida Natural Areas Inventory (http://www.fnai.org/HILL-SUM.HTM, accessed 26 July 2002)



Location Map

Stevenson Creek Restoration Candidate Spoil Disposal Site

Scale 1" = 4000'	Drawn By: CSD
Date: July, 2002	
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J02-585
	Figure 1



Legend

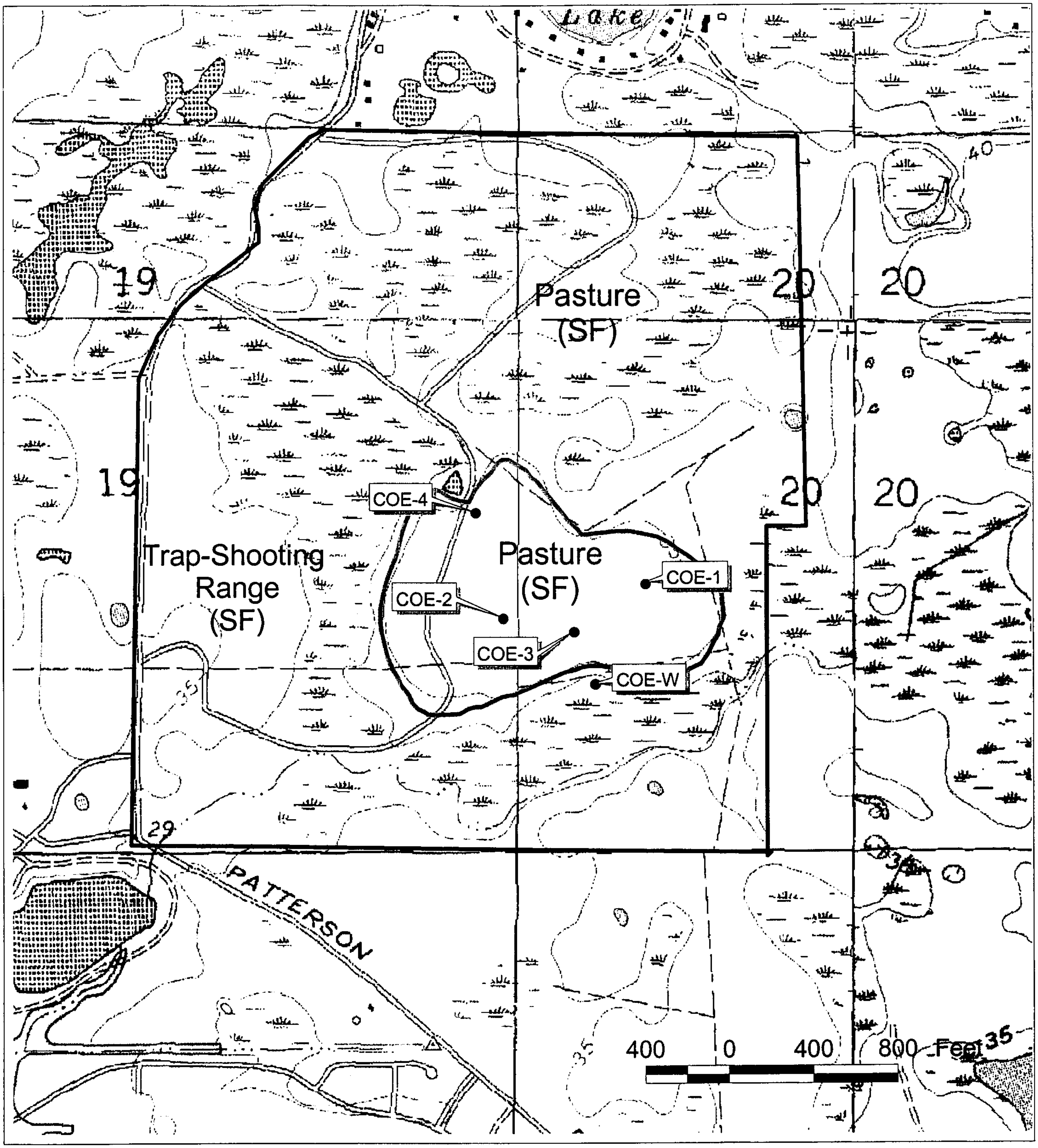
N W E S

NRCS Soil Survey Hillsburough County, Florida

—— City of Clearwater Property Boundary

600 0 600 1200 Feet

Soils Map Stevenson Creek Restoration Candidate Spoil Disposal Site	
Scale: 1"= 700'	Drawn By: CSD
Date: July, 2002	
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J02-585
	Figure 2



Legend

(SF) Former Sludge Field

City of Clearwater Property Boundary

Environmental Survey Area

COE Sample Point

N W E S

Survey Boundary Map Stevenson Creek Restoration Candidate Spoil Disposal Site	
Scale: 1" = 1000'	Drawn By: CSD
Date: July, 2002	
DIAL CORDY AND ASSOCIATES INC Environmental Consultants	J02-585
	Figure 3

Draft

Letter Report

Evaluation of GeoSynthetic Fabric Contaminant Retention Properties for the Stevenson Creek, Florida, Dredging Study

by
Tommy E. Myers
US Army Engineer Research and Development Center
Waterways Experiment Station
Environmental Laboratory
Vicksburg, Mississippi 39180-6199

For the
US Army Engineer District, Jacksonville
Jacksonville, Florida

27 September 2002

Background

1. The U.S. Army Engineer District, Jacksonville (CESAJ) has undertaken a water and sediment quality study of Stevenson Creek estuary, as requested by the City of Clearwater in Pinellas County, Florida. The U.S. Army Engineer Research and Development Center (ERDC) Environmental Laboratory (EL) was requested to perform the following tasks for the Jacksonville District via Customer Order W32CS521925465 in support of the Stevenson Creek, FL feasibility study:

a. analyze sediment for arsenic, cadmium, chromium, iron, nickel, lead, mercury and organic priority pollutants,
b. Conduct the standard elutriate test for priority pollutants,
c. Conduct pressure filtration tests on geosynthetic fabrics and analyze filtrates for suspended solids and the metals listed in item (a), and
d. Reduce data and prepare a letter report.

2. The EL study is part of a feasibility study of dredging Stevenson Creek, FL in order to improve sediment and water quality in the creek. Figure 1 shows the site location. The Geothechnical and Structures Laboratory (GSL) at the ERDC has conducted a companion study on the geotechnical feasibility of using geosynthetic fabric containers (GFCs) to dewater and contain dredged material from Stevenson Creek (Lee and Fowler 2002). The GSL study and this study are targeted on an area of fine grained organic sediment that has not been previously characterized.

3. Due to unavailability of a nearby confined disposal facility of sufficient size to dewater the dredged material in the traditional manner, innovative solutions are needed for dewatering and volume reduction prior to dredged material disposal. Per telephone conversations with CESAJ, approximately 80,000 cubic yards of dredged material will be produced by dredging Stevenson Creek. Dewatering the dredged material in geosynthetic fabric containers prior to off-site disposal is an option that CESAJ tasked ERDC to help evaluate.

4. This letter report is specifically for fine-grained material in an area of Stevenson Creek that is thought to represent the worst-case for dewatering. The material in this area consists of an approximate 3-ft thick layer of organic muck that rests on top of typical sandy material creek bottom. The muck layer has a strong rotten egg smell, i.e, hydrogen sulfide.

Purpose

5. The primary purpose of this study was to provide information on the water quality of filtrate produced by candidate GFCs. This information is needed by CESAJ to evaluate potential environmental impacts of using GFCs for the Stevenson Creek project. Additionally, EL was tasked to conduct the standard elutriate test on sediment from that portion of Stevenson Creek containing fine-grain sediment since this material has not been previously sampled and tested.

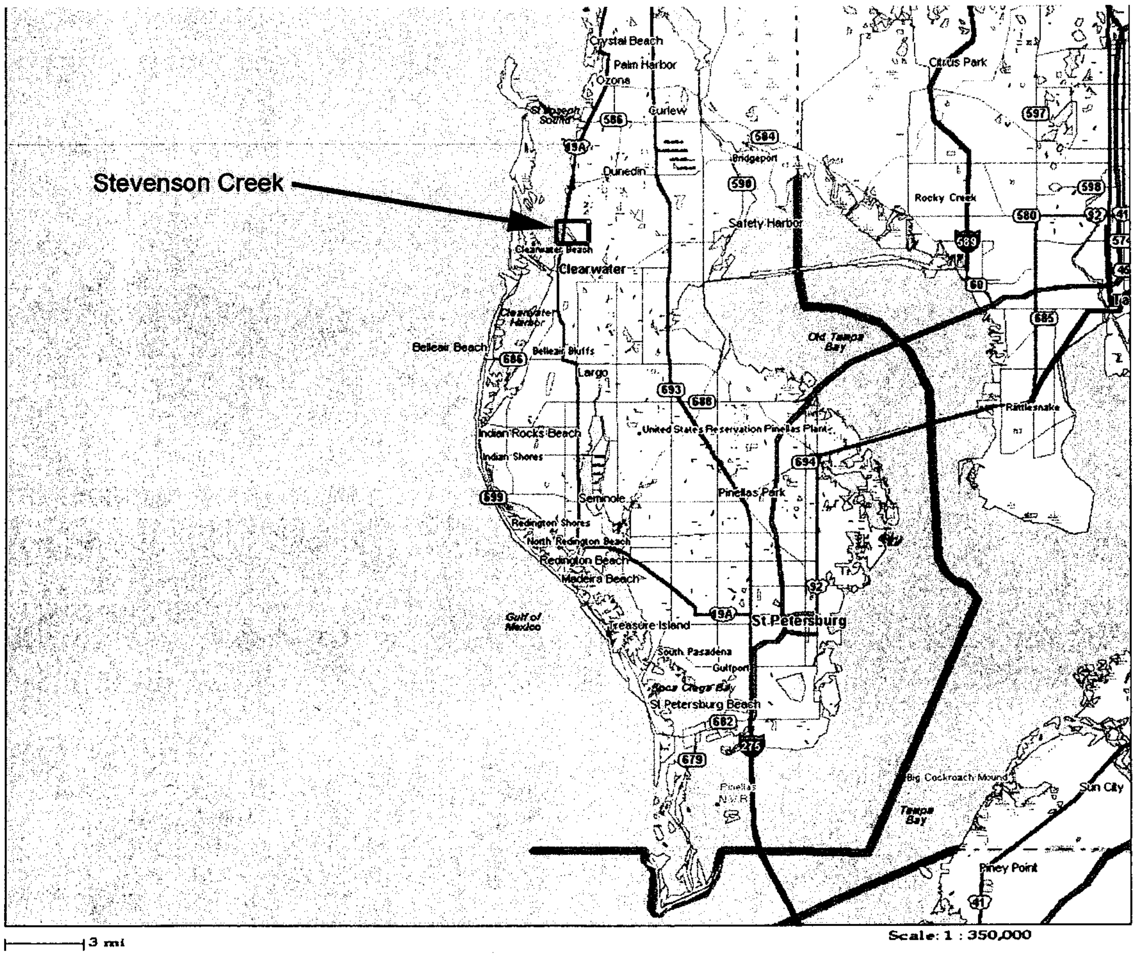


Figure 1. Stevenson Creek in Clearwater, Florida, site location map (Lee and Fowler, 2002).

Previous Studies

6. PPB Environmental Laboratories, Inc. (2000) collected and analyzed twelve (12) sediment samples from Stevenson Creek. The area containing the fine-grain sediment that is described in this report was not sampled. PPB Environmental Laboratories, Inc. (2000) also conducted the standard elutriate test on the sediments they collected.

7. Pesticides (aldrin, chlordane, 4,4'-DDT, 4,4'-DDD, 4,4'DDE, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, lindane, toxaphene, and methoxychlor) were below detection limits (5 to 12 ng/g) in every sample. Seventeen (17) polycyclic aromatic hydrocarbons (PAHs) were analyzed. Most PAHs were below detection limits (0.1 to 0.26 :g/g) in most samples. Overall results for the metals analyses are shown in Table 1.

The data in Table 1 indicate significant variability in metals contamination in Stevenson Creek sediments.

8. As expected, pesticide and PAH concentrations in the standard elutriates reported by PPB Environmental Laboratories, Inc. (2000) were below the detection limits. Metals concentrations in the standard elutriates are summarized in Table 2.

Table 1. Means, Standard Deviations, and Ranges for Metals in Stevenson Creek, FL Sediments (ug/g, dry wt. basis)[1]

	Mean	Std. Deviation	Range
Aluminum	11,600	8,860	1,120 – 29,000
Arsenic	1.45	1.15	0.14 – 4.44
Barium	45.9	30.5	7.9 – 70.3
Cadmium	0.44	0.52	<0.10 – 1.76
Chromium	28.3	28.5	3.00 - 101
Copper	18.4	22.0	1.42 – 70.6
Iron	2,946	2,560	421 – 7,820
Lead	34.1	44.7	3.00 – 77.5
Mercury	0.12	0.14	<0.05 – 0.53
Nickel	8.83	8.68	0.58 – 22.8
Selenium	<0.05	<0.05	<0.05
Silver	0.60	1.02	<0.05 – 3.66
Tin	1.43	0.52	0.24 – 2.76
Zinc	51.5	62.4	9.78 - 230

[1] from PPB Environmental Laboratories, Inc. (2000)

Table 2. Means, Standard Deviations, and Ranges for Metals in Stevenson Creek, FL Standard Elutriates (ug/P)[1]

	Mean	Std. Deviation	Range
Arsenic	10.1	7.38	4.5 – 26.3
Barium	46.6	44.3	8.5 – 139
Cadmium	*	*	<0.2 – 0.6
Chromium	1.76	1.9	< 0.5 – 7.2
Copper	**	**	**
Iron	95.0	232	< 4.0 – 824
Lead	*	*	< 3.0 – 29.2
Mercury	*	*	<0.10 – 0.26
Nickel	***	***	< 2.0
Selenium	***	***	< 5.0
Silver	*	*	<0.10 – 0.30
Tin	***	***	< 20
Zinc	10.5	10.5	3.3 – 40.0

* Most samples below detection limit (BDL);
** All but one sample lower than site water;
*** all samples BDL
[1] from PPB Environmental Laboratories, Inc. (2000)

Bulk Sediment Chemical Analyses and Standard Elutriate Tests – Fine Sediment

Sediment Analyses

9. Sediment and site water from the fine grain muck area were collected and shipped by CESAJ to the Waterways Experiment Station (WES) on ice in coolers. Samples were stored in the dark at 4° C until analyzed or used in testing. Sediment was analyzed in triplicate by the Environmental Chemistry Branch (ECB) at the ERDC for the metals listed in Paragraph 1 and organic priority pollutants using standard methods specified in USEPA SW-846. Most of the organic priority pollutants were below detection limits. The entire data set for organic priority pollutants (96 compounds) is presented in Appendix A. Those organic priority pollutants that exceeded the detection limit (16 compounds) are listed in Table 3. Several pesticides and PAHs that were not detected in the previous PPB Environmental Laboratories, Inc. (2000) chemical analysis of sediments from Stevenson Creek were detected in the sediment from the organic muck. However, all the concentrations detected were very low. For dieldrin, the ECB result was just above the detection limit reported by PPB Environmental Laboratories, Inc. In cases where the ECB result was slightly higher than the PPB Environmental Laboratories, Inc. detection limit, the ECB analyst qualified the result as non-confirmed on the confirmatory column used in the analysis (entries in Table 3 with a # symbol).

Table 3. Detectable Organic Compounds in Fine Grain Sediment From Stevenson Creek, FL (ng/g)

Analyte	Bulk Sed 1	Bulk Sed 2	Bulk Sed 3
B-BHC	6.70	6.62	7.37
PPDDD	4.63 J	4.18 J	6.19 J
PPDDE	20.1	18.5	20.2
Dieldrin	8.86	8.25	8.49
Heptachlor Epoxide	3.84	3.22 J	3.81
PCB 1254	82.8	74.3	78.7
A-Chlordane	8.87 #	8.06 #	9.09 #
G-Chlordane	13.1	11.9	13.3
Pyrene	1200 J	1000 J	1200 J
Chrysene	880 J	810 J	910 J
Benzo(a)Anthracene	610 J	540 J	610 J
Benzo(b)Fluoranthene	1000 J	930 J	1100 J
Benzo(k)Fluoranthene	730 J	610 J	780 J
Benzo(a)Pyrene	820 J	700 J	870 J
Indeno(1,2,3-c,d)Pyrene	760 J	620 J	780 J
Benzo(G,H,I)Perylene	760 J	670 J	750 J

J: Estimated concentration above MDL but below LRL
#: Calculated concentration is > 40% difference between primary and secondary columns

The LRL in Table 3 is the lowest analyte concentration that can be accurately measured and reported, as opposed to simply detected, and the MDL in Table 3 is the analyte method detection limit determined according to procedures in 40CFR Appendix B to part 136.

10. Overall, the ECB data for organic chemicals in the fine grain muck are consistent with the PPB Environmental Laboratories, Inc. (2000) data for sediments from Stevenson Creek, FL. Both data sets indicate very low to non-detectable concentrations of organic chemicals in Stevenson Creek, FL sediments. For this reason, the site water supplied to WES by CESAJ was not analyzed for organic priority pollutants.

11. Metals concentrations in the sample of fine grain muck from Stevenson Creek are listed in Table 4. The metals data in Table 4 show that the drum of fine grain sediment used for testing by ERDC was chemically homogeneous after mixing. Arsenic and iron concentrations in the fine grain muck exceeded those previously reported by PPL Laboratories, Inc. (2000) for other sampling sites in Stevenson Creek in most cases. The other metals were at the high end of the range previously reported by PPL Laboratories, Inc. (2000) for Stevenson Creek sediment. Ribbon graphs for As, Cu, and Fe concentrations in Stevenson Creek sediments were prepared by SAJ using the PPL Laboratories, Inc. (2000) data. These graphs were revised to show the As, Cu, and Fe concentrations in the fine muck relative to the previously measured concentrations in other portions of Stevenson Creek (Figures 2, 3, and 4, respectively).

Table 4. Metals Concentrations (ug/g) in Fine Grain Muck[1] from Stevenson Creek, FL

Metal	Replicate 1	Replicate 2	Replicate 3	Mean	Std Deviation
Arsenic	8.49	8.79	8.60	8.63	0.15
Cadmium	1.40	1.40	1.38	1.39	0.01
Chromium	54.1	46.2	48.1	49.5	4.1
Copper	57.0	49.9	50.2	52.4	4.0
Lead	78.8	75.1	76.3	76.7	1.9
Mercury	0.253	0.268	0.256	0.259	0.008
Nickel	12.3	10.3	11.0	11.2	1.0
Iron	9630	9590	9260	9490	203

[1] sediment tested by ERDC

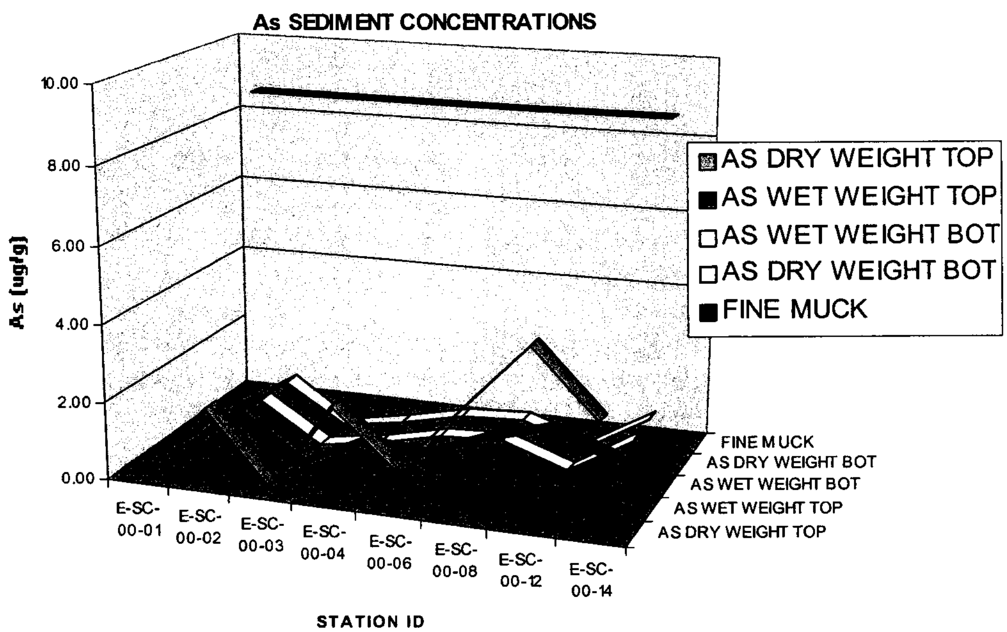


Figure 2. Arsenic concentrations in Stevenson Creek sediments (from SAJ, revised).

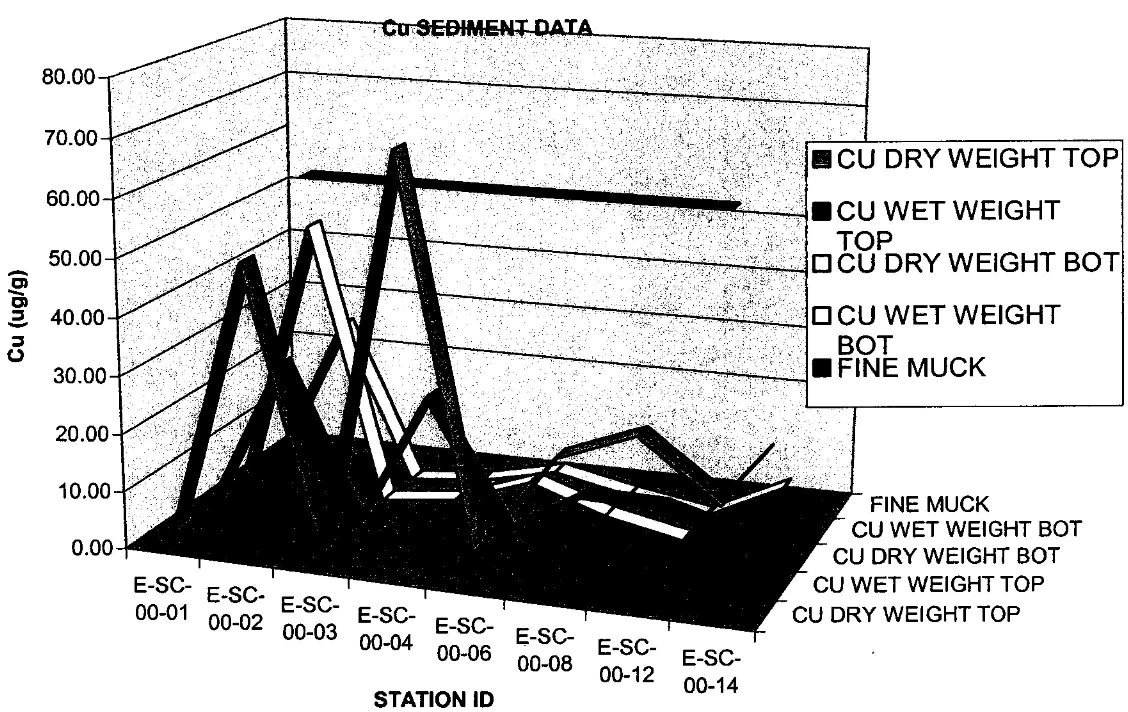


Figure 3. Copper concentrations in Stevenson Creek sediments (from SAJ, revised).

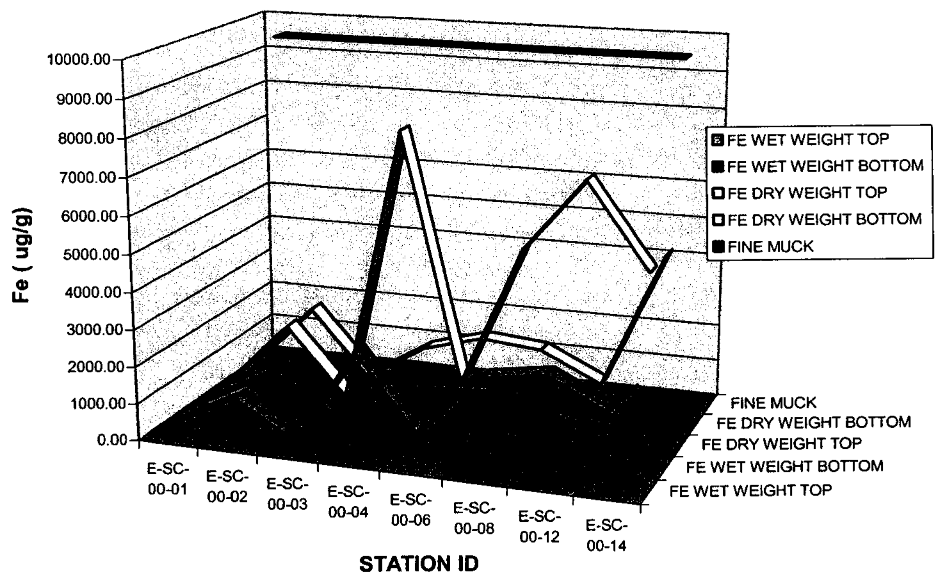


Figure 4. Iron concentrations in Stevenson Creek sediments (from SAJ, revised).

Standard Elutriates

12. The standard elutriate test was conducted in triplicate by ECB using sediment and site water samples described in Paragraph 9. Procedures were as described by Plumb (1981). As expected, organic priority pollutant concentrations in the standard elutriates from the fine grain muck were below the detection limits (Appendix B). Metal concentrations in standard elutriates from the fine grain muck are listed in Table 5. The metal concentrations in the site water used to conduct the standard elutriate test are also listed in Table 5.

Pressure Filtration Tests

Methods and Materials

13. Pressure filtration tests were conducted in triplicate using procedures similar to those described by Moo-Young et al. (1999). The tests were conducted using a Millipore Hazardous Waste Filtration System (Millipore Corporation, Bedford, MA). This device is made of stainless steel and is coated with Teflon to eliminate heavy metal contamination. The filtration devise has a filter area of 97 cm^2 (15.04 in^2). Tests on two geosynthetic fabics were conducted at 27.6 kPa (4 psi).

Table 5. Metals Concentrations (mg/P) in Standard Elutriates From Stevenson Creek Fine-Grain Sediment[1] and Site Water				
Metal	Replicate 1	Replicate 2	Replicate 3	Site Water
Antimony	<0.003	<0.003	<0.003	<0.003
Arsenic	0.093	0.089	0.087	0.07
Beryllium	<0.001	<0.001	<0.001	<0.001
Cadmium	0.0002	0.0003	0.0002	0.0018
Chromium	0.009	0.012	0.006	0.004
Copper	0.020	0.019	0.020	0.021
Lead	0.005	0.006	0.005	0.004
Mercury	<0.00010	<0.00010	<0.00010	<0.00010
Nickel	0.011	0.012	0.011	0.009
Selenium	0.212	0.210	0.214	0.219
Silver				
Thallium	<0.002	<0.002	<0.002	<0.002
Zinc	0.012	0.011	0.022	0.01
[1] sediment tested by ERDC				

The geotextile fabrics selected for testing were TC Mirafi's GT500/HP665 with an apparent opening size (AOS) of 0.425 mm (US Sieve 40) and the HP570 with AOS of 0.600 mm (US Sieve 30). The basic test procedure was as follows:

- The lower portion of the filtration apparatus was assembled and a pre-cut circle of fabric was placed on the filter holder. The fabric was pre-cut to allow a slight overlap to prevent leakage. Then the upper portion of the filtration apparatus was assembled.
- Sediment was slurried with site water at a 4:1 ratio by volume of water-to-sediment. Approximately 450 ml of slurry was poured into the filtration apparatus.
- Pressure from a nitrogen cylinder was gradually applied until 27.6 kPa (4 psi) was achieved.
- Filtrate was collected until flow ceased and preserved with 1 ml of concentrated Ultrex nitric acid.
- The filtration apparatus was disassembled and the fabric with filter cake intact was retrieved and placed in a sandwich bag and sealed for storage.

The site water used to conduct the pressure filtration tests was again analyzed, but this time in triplicate for the metals listed in Paragraph 1. These data are listed in Table 6.

Table 6. Metals Concentrations (mg/P) in Site Water from Stevenson Creek, FL[1]					
Metal	Replicate 1	Replicate 2	Replicate 3	Mean	Std Deviation
Arsenic	0.013	0.015	0.013	0.014	0.001
Cadmium	0.0013	0.0009	0.0011	0.0011	0.0002
Chromium	0.003	0.001	0.002	0.002	0.001
Copper	0.015	0.008	0.015	0.013	0.004
Lead	0.002	0.003	0.006	0.004	0.002
Mercury	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Nickel	0.010	0.008	0.011	0.010	0.0015
Iron	2.17	2.24	1.91	2.11	0.17
[1] collected by SAJ for ERDC testing with fine grain muck					

Filtrate Quality

14. During the pressure filtration tests, it was noted that the initial filtrate delivered through the fabrics was turbid. This turbidity diminished rapidly as filtrate delivery continued. Filtrates from the HP570 fabric were more turbid than filtrates from the HP665 fabric, probably because the AOS of the HP570 fabric is larger than the AOS of the HP665 fabric. Total metals concentrations and suspended solids in filtrates are listed in Table 7. The data in Table 7 show a number of interesting features as follows:

- suspended solids were higher in filtrates from the HP570 fabric than in filtrates from the HP665 fabric,
- total metals concentrations in filtrates from the HP570 fabric were higher than in filtrates from the HP665 fabric,
- and there appears to be a correlation between total metals concentrations and suspended solids concentration.

Table 7. Total metals Concentrations (mg/P) and Suspended Solids (mg/P) In Filtrates from Pressure Filtration Tests						
	HP570 AOS 30 (0.600 mm)			HP665 AOS 40 (0.425 mm)		
	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
Arsenic	0.104	0.166	0.191	0.065	0.075	0.072
Cadmium	0.0071	0.0171	0.0232	0.0022	0.0028	0.0028
Chromium	0.37	0.81	1.31	0.107	0.140	0.158
Copper	0.205	0.466	0.638	0.061	0.078	0.089
Lead	0.385	0.966	1.45	0.111	0.138	0.159
Mercury	0.00154	0.003	0.00359	0.00047	0.00058	0.00068
Nickel	0.073	0.159	0.227	0.026	0.032	0.034
Iron	68.5	161	228	20.5	26.7	27.7
Sus Solids	2824	7632	11,610	800	1056	1204

These observations suggest that the metals in the filtrates were primarily in the particulate phase. The correlation between suspended solids and metals was evaluated by linear regression of metals concentrations onto suspended solids concentrations. The regression curves are shown in Figures 5 – 8.

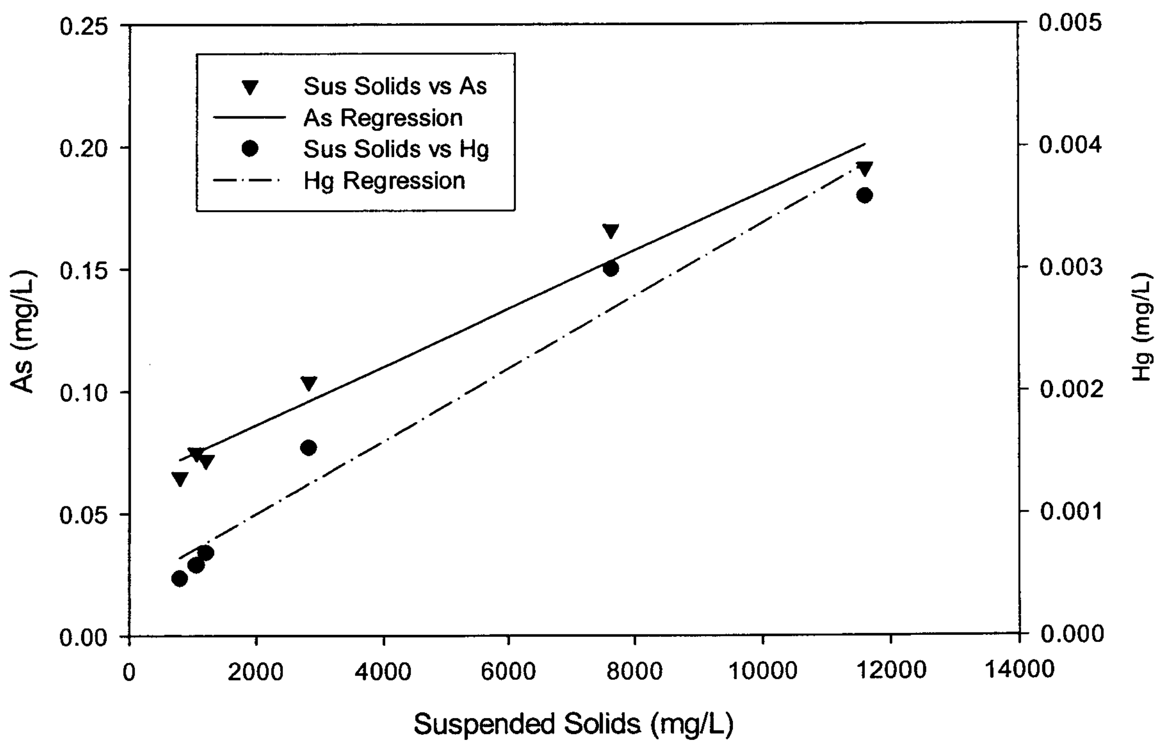


Figure 5. Total As and Hg dependency on suspended solids concentration in filtrate.

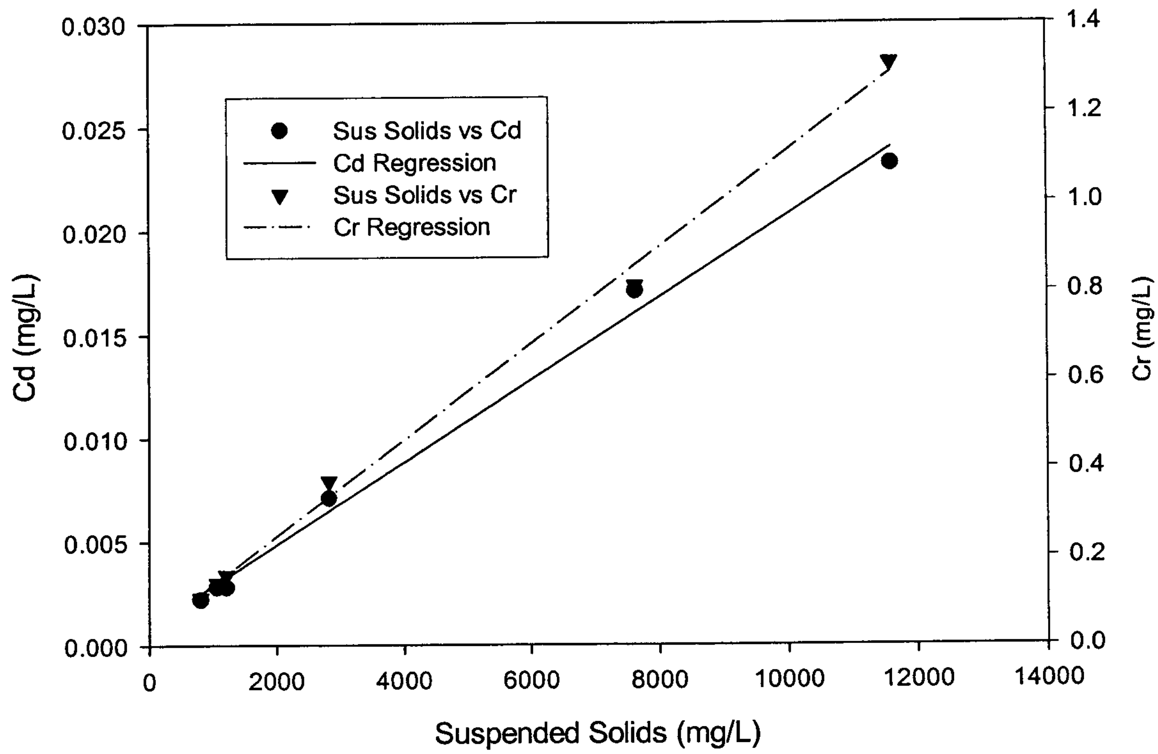


Figure 6. Total Cd and Cr dependency on suspended solids concentration in filtrate.

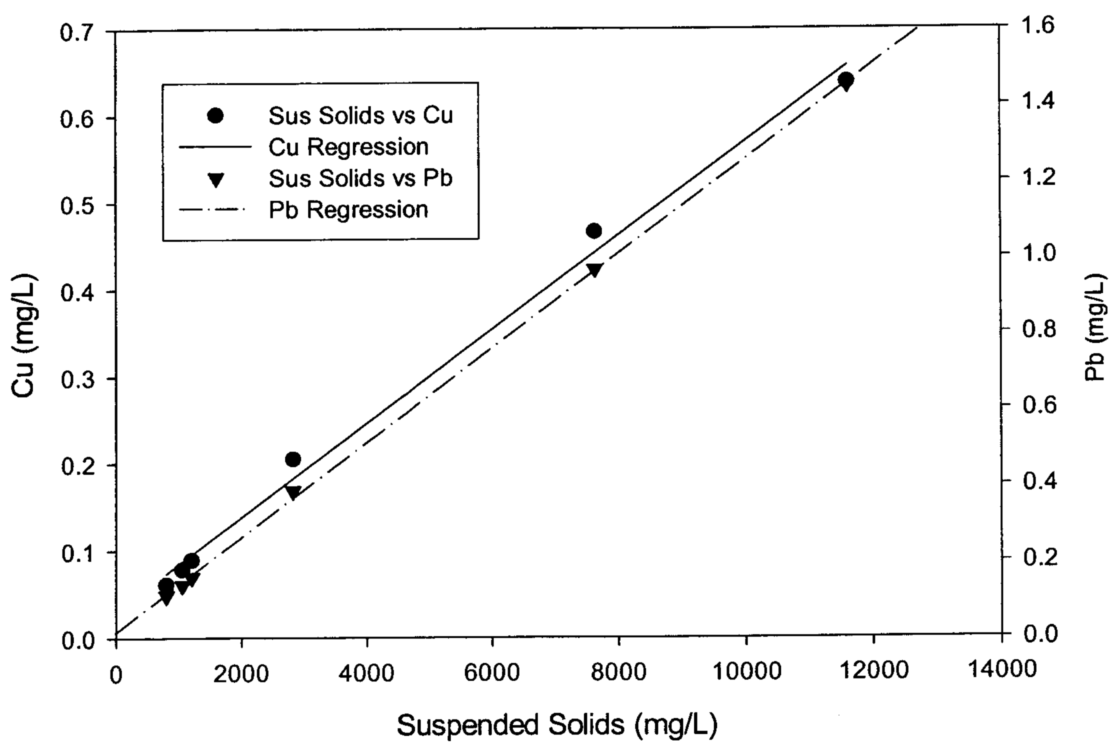


Figure 7. Total Cu and Pb dependency on suspended solids concentration in filtrate.

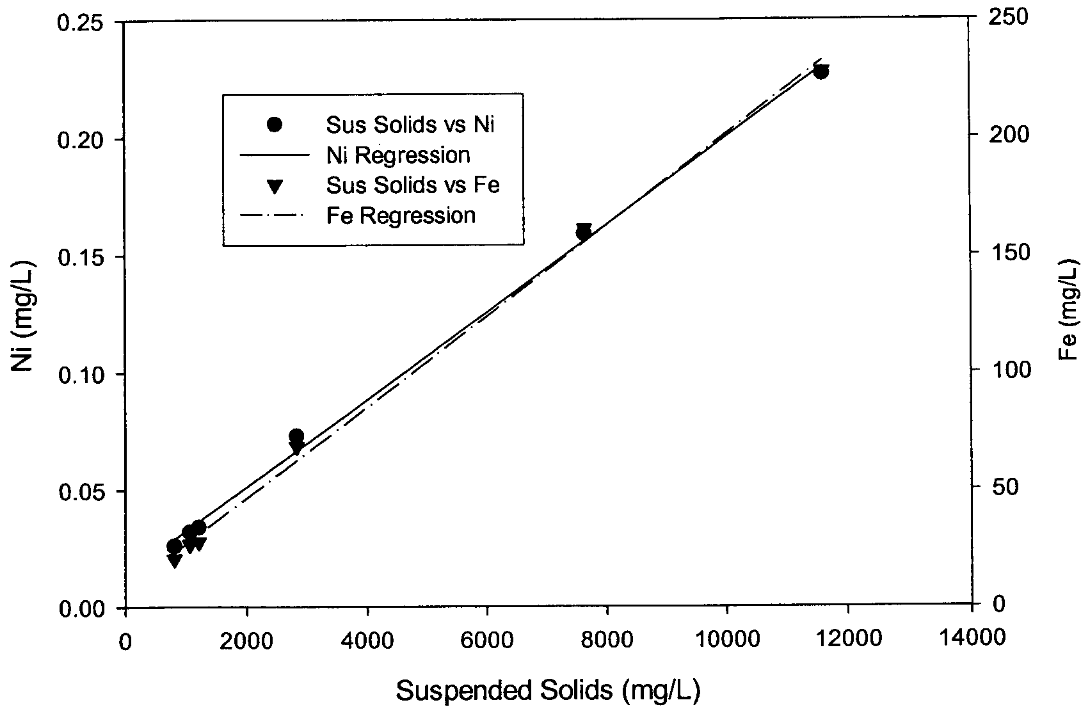


Figure 8. Total Ni and Fe dependency on suspended solids concentration in filtrate.

The correlation coefficients (r^2 values) obtained from the regression analysis (Table 8) indicate that 96 to 99+ percent of the variation in metals concentrations in the filtrates can be accounted for as a linear variation in filtrate suspended solids concentration. Thus, total metals concentrations in the filtrates are proportional to the suspended solids concentration, and there is a very strong correlation between the two.

Table 8. Correlation Coefficients (r^2) for Metals Versus Suspended Solids in Filtrates

	r^2 value
Arsenic	0.9730
Cadmium	0.9940
Chromium	0.9966
Copper	0.9941
Lead	0.9996
Mercury	0.9647
Nickel	0.9978
Iron	0.9971

Dissolved metal concentrations and the fraction dissolved were calculated from a mass balance analysis using the mean sediment metals concentration from Table 4 and the suspended solids concentrations for each replicate filtrate in Table 6. The calculation is given below.

$$C_{dis} = C_{tot} - SS\,C_{sed} \qquad (1)$$

$$F_{dis} = \frac{C_{dis}}{C_{tot}} \qquad (2)$$

where

C_{dis} = dissolved metal concentration, mg/P
C_{tot} = total metal concentration, mg/P (from Table 7)
C_{sed} = mean sediment metal concentration, mg/mg (from Table 4)
SS = suspended solids concentration, mg/P (from Table 7)
F_{dis} = fraction dissolved, dimensionless

The values obtained using equations 1 and 2, respectively for dissolved metal concentration and the fraction dissolved are listed in Table 9. As expected the fraction metal in the dissolved phase decreased as the suspended solids concentration increases. Dissolved metal concentrations tended to increase as the suspended solids concentrations increase. Note that the suspended solids concentrations increase with row number in Table 9.

Table 9. Calculated Dissolved Metal Concentrations and Fraction Metal In Dissolved Phase in Filtrates from Pressure Filtration Tests

	Dissolved (mg/P)							
	As	**Cd**	**Cr**	**Cu**	**Pb**	**Hg**	**Ni**	**Fe**
HP665 Replicate 1	0.058	0.001	0.067	0.019	0.050	0.00026	0.017	12.9
HP665 Replicate 2	0.066	0.001	0.088	0.023	0.057	0.00031	0.020	16.7
HP665 Replicate 3	0.062	0.001	0.098	0.026	0.067	0.00037	0.021	16.3
HP570 Replicate 1	0.080	0.003	0.230	0.057	0.168	0.00081	0.041	41.7
HP570 Replicate 2	0.100	0.006	0.432	0.066	0.381	0.00102	0.074	88.6
HP570 Replicate 3	0.091	0.007	0.735	0.030	0.560	0.00058	0.097	118
	Fraction Dissolved (dimensionless)							
HP665 Replicate 1	0.894	0.495	0.630	0.313	0.447	0.559	0.655	0.630
HP665 Replicate 2	0.878	0.476	0.627	0.291	0.413	0.528	0.630	0.625
HP665 Replicate 3	0.856	0.402	0.623	0.291	0.419	0.541	0.603	0.588
HP570 Replicate 1	0.766	0.447	0.622	0.278	0.437	0.525	0.567	0.609
HP570 Replicate 2	0.603	0.380	0.534	0.142	0.394	0.341	0.462	0.550
HP570 Replicate 3	0.475	0.304	0.561	0.046	0.386	0.162	0.427	0.517

15. Given that the bulk of the suspended solids were released in the first few milliliters of filtrate sample collected and these solids were retained in the sample that was analyzed until the total volume of filtrate sample was collected, there is some question as to what was the dissolved metal concentrations in the final portions of filtrate collected, i.e. filtrate containing very low suspended solids. As shown in Figures 5 - 8, the total metal concentrations in the filtrates were linearly dependent on suspended solids concentrations, and as indicated in Table 9 dissolved metal concentrations tended to increase with suspended solids concentrations. It is reasonable therefore to examine the dependency of dissolved metal concentrations on suspended solids and seek a method for predicting dissolved metal concentrations as a function of suspended solids concentrations. Figures 9 and 10 are plots of dissolved metals concentrations versus suspended solids concentrations. The figures were prepared using the entire data set in Table 7. The higher suspended solids concentrations are for the HP570 fabric, and the lower suspended solids concentrations are for the HP665 fabric.

16. Figure 9 shows the behavior of dissolved arsenic, cadmium, chromium, and copper as a function of suspended solids concentration. Had the curves indicated an asymptotic approach to some minimum dissolved metal concentration as the suspended solids concentrations approached zero, then the curves could be extended toward zero solids concentration, and dissolved metal concentrations could be projected for suspended solids concentrations lower than those in the data set. However, the slopes of the curves are too steep at suspended solids concentrations below 3,000 mg/P to project beyond the data with confidence. Cadmium may be an exception since the first three entries in Table 9 appear to represent a minimum value.

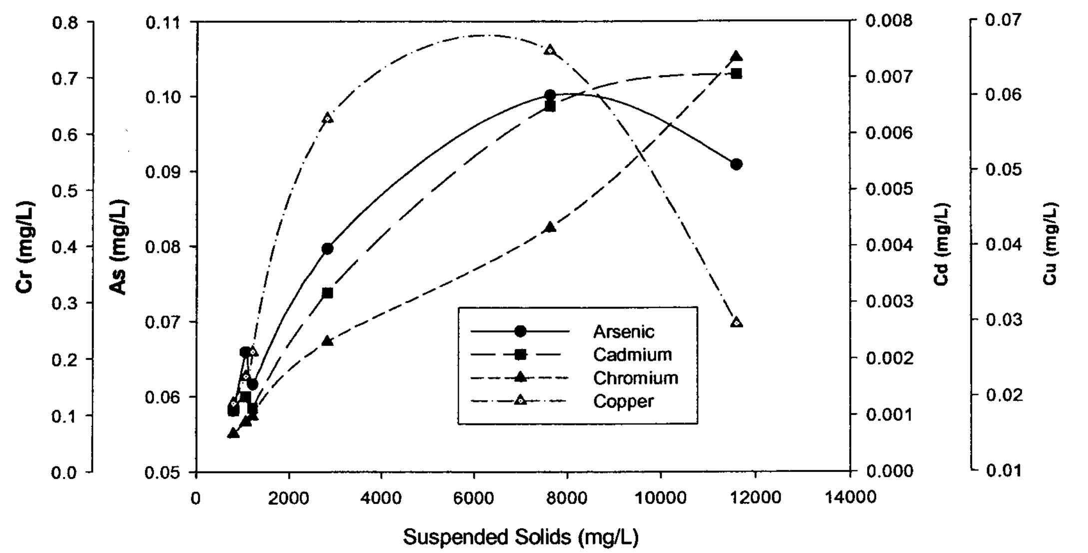


Figure 9. Dissolved arsenic, cadmium, chromium, and copper concentrations versus suspended solids concentration.

Figure 10 shows the behavior of dissolved lead, mercury, nickel, and iron as a function of suspended solids concentration. Some of the curves in Figure 10 are more linear than those shown in Figure 9, but again there is no evidence of an asymptotic approach to some minimum dissolved metal concentration as the suspended solids concentrations approach zero.

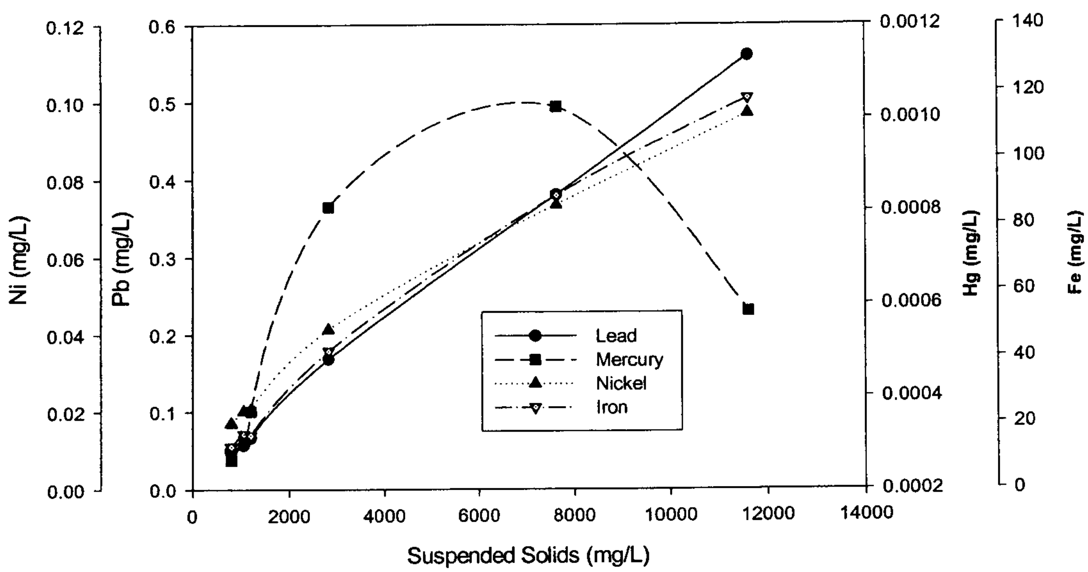


Figure 9. Dissolved lead, mercury, nickel, and iron concentrations versus suspended solids concentration.

17. The graphs do not provide a way to predict concentrations of dissolved metals at suspended solids concentrations representative of fabric filtrate after the initial discharge of suspended solids; however, there are bounds. Dissolved metal concentrations should lie somewhere between the metal concentrations in the site water and the dissolved metal concentrations at the minimum solids concentrations measured in the pressure filtration test. Since the dissolved metal concentrations decrease with decreasing suspended solids, the minimum concentrations in Table 9 represent the expected upper bounds for dissolved metal concentrations in fabric filtrates with suspended solids concentrations less than those measured in the pressure filtration tests.

<u>Suspended Solids Release</u>

18. In order to measure suspended solids release during pressure filtration, the procedures described in Paragraph 13 were slightly modified. The modified procedure involved collection of small sample volumes in the early stages of the test and then collection of increasingly larger sample volumes instead of collection of one large sample. Sample volume with time was measured, and suspended solids were determined on the various samples. No preservatives were added to the samples and no chemical

analyses were performed. Otherwise, procedures were the same as described in Paragraph 13.

20. Figures 11 and 12 show suspended solids concentration versus cumulative volume of filtrate collected for the HP665 and HP570 fabrics, respectively. The suspended solids axis in both figures is a common log scale. These graphs show a very rapid decline in suspended solids concentrations as the volume of water that passes through the fabric increases. Thus, most of the solids release occurs at the start of filtration as a cake is formed on the fabric. Cake formation is important in solids retention and therefore in contaminant retention. The graphs of suspended solids concentration versus cumulative volume of filtrate delivered indicate that cake formation is faster and more reproducible on the HP665 fabric than on the HP570 fabric and filtration efficiency is better for the HP665 fabric than for the HP570 fabric.

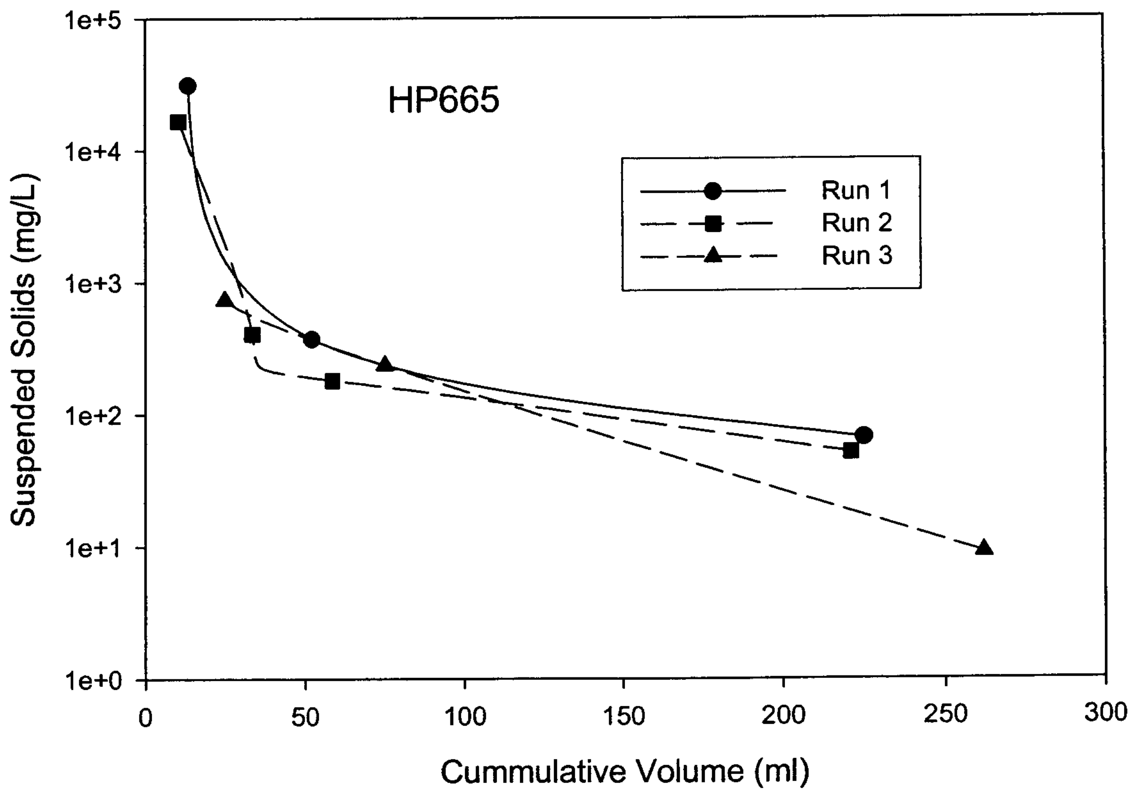


Figure 11. Suspended solids concentration with filtrate volume delivered, HP665 fabric.

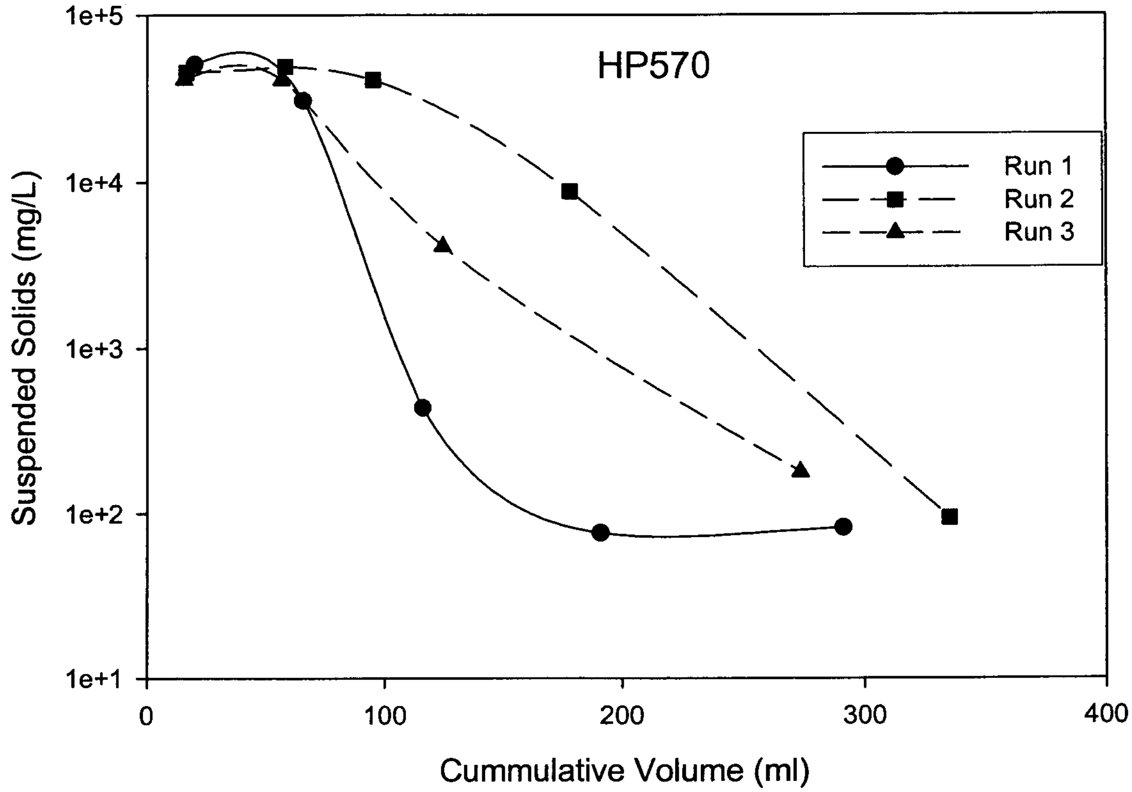


Figure 12. Suspended solids concentration with filtrate volume delivered, HP570 fabric.

Cake Formation

21. Figures 13 and 14 are photographs of the cakes formed on the fabrics.

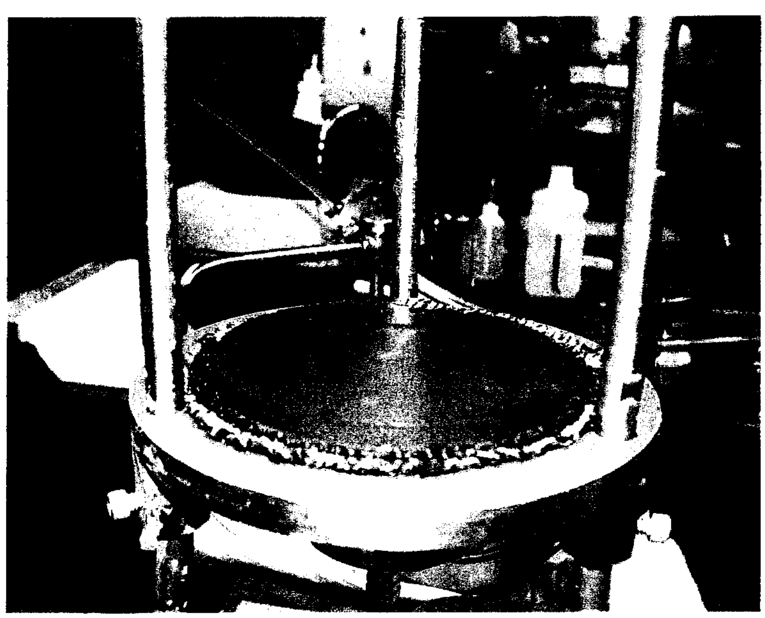


Figure 13. Photograph of cake formed on HP665 fabric.

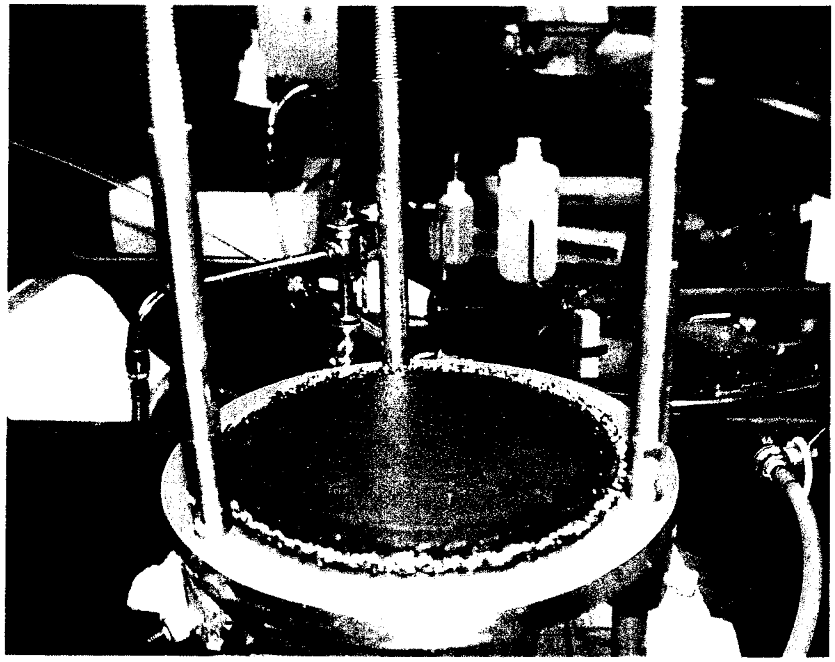


Figure 14. Photograph of cake formed on HP570 fabric.

Measurements of cake and liner thickness were made with a vernier caliper. The results are listed in Table 10. Eight measurements of thickness were made on each cake formed during the testing program, producing 48 measurements of cake thickness for the HP570 fabric and 40 measurements for the HP665 fabric. The number of cake thickness measurements differed because one of the cakes for fabric HP665 was inadvertently discarded. A Smith-Satterthwaite t-test (Miller and Freund 1977) was performed on cake thickness and the small difference in cake thickness was significant at the $p = 0.005$ level. Interestingly, the thinner fabric was the better performing liner in terms of solids retention. This is probably due to the type of weave used to manufacture the thinner fabric.

Table 10. Mean Thickness (mm) and Standard Deviation (mm) for Fabrics and Cakes formed on the Fabrics[1].

Material	Mean Thickness	Standard Deviation	n
HP570 Fabric	3.38	0.200	8
HP665 Fabric	1.69	0.113	8
Cake for HP570 Fabric	5.62	0.816	48
Cake for HP665 Fabric	6.47	0.782	40

[1] Global means and standard deviations

Global cake water contents for each fabric and the sediment are listed in Table 11. Cake and sediment water contents were measured in triplicate. The six runs with the fabrics resulted in 6 cakes each, but one cake for the HP665 fabric was inadvertently discarded as previously noted.

Table 11. Mean Water Contents and Standard Deviations for Cakes and Sediment

Sample	Water Content (%)	Standard Deviation (%)	n
Cake for HP570 Fabric	355	23.0	18
Cake for HP665 Fabric	361	37.4	15
Sediment[1]	392	3.1	3

[1] Sediment in drum supplied by SAJ

Cake water contents were slightly lower than the water content of the sediment before it was slurried with water. Cake water contents for the two fabrics were similar. The Smith-Satterthwaite t-test (Miller and Freund 1977) showed no significant difference in water content between the cakes for the two fabrics or between the cakes and the original sediment.

Flow

22. The ability to transmit water while retaining solids is an important property of fabric performance. Figures 13 and 14 show the flow and time relationships for the filtration tests for the HP570 and HP665 fabrics, respectively, at 27.6 kPa (4 psi). In all tests, the flow of water through the fabrics and sediment slowed with time. Reduction in flow with time is caused by the formation of a cake on the fabric. Initially, particles smaller than the effective opening of the fabric, passed through. This has been previously discussed in the section on suspended solids retention. However, as the finer particles pass through, larger particles combine to bridge over the apertures in the fabrics. Finer particles then become more likely to be trapped in the bridging zone. This process ultimately yields a filter cake that filters solids and continues to grow in thickness. Once the filter cake has been established in a unidirectional flow situation, further reduction in flow is slowed and the system approaches a quasi-equilibrium.

23. The flows toward the end of the tests when the cakes were fully developed were similar for each fabric. These flows were in the range of 4 to 6 ml/min. In more useful units, these flows were approximately 14 to 20 gal/sq ft•day.

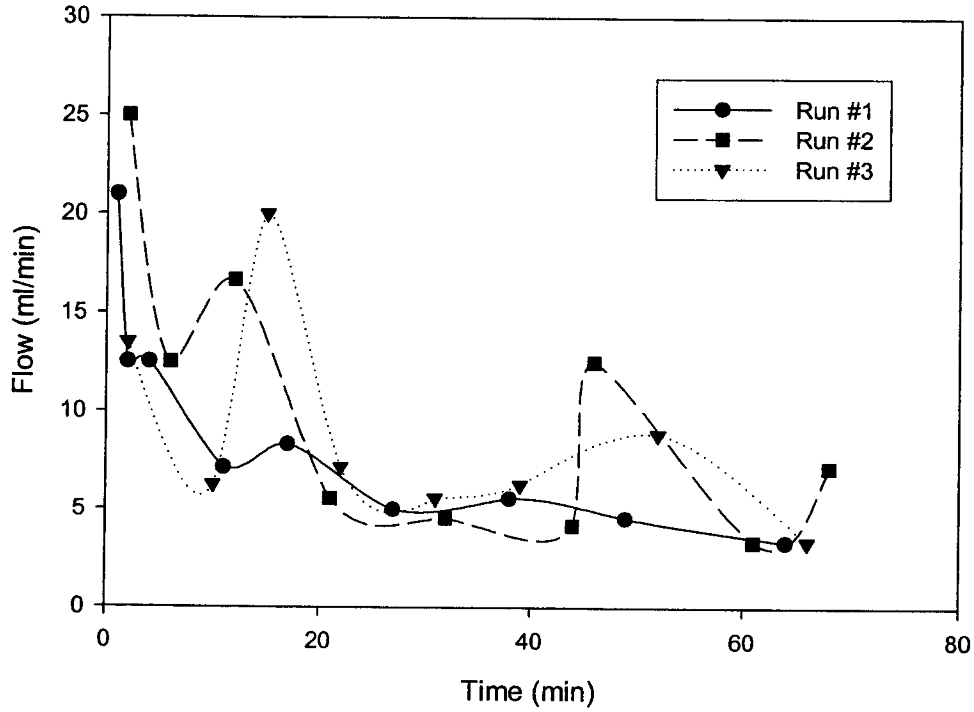


Figure 13. Flow and time relationship for HP570 fabric at 27.6 kPa (4 psi).

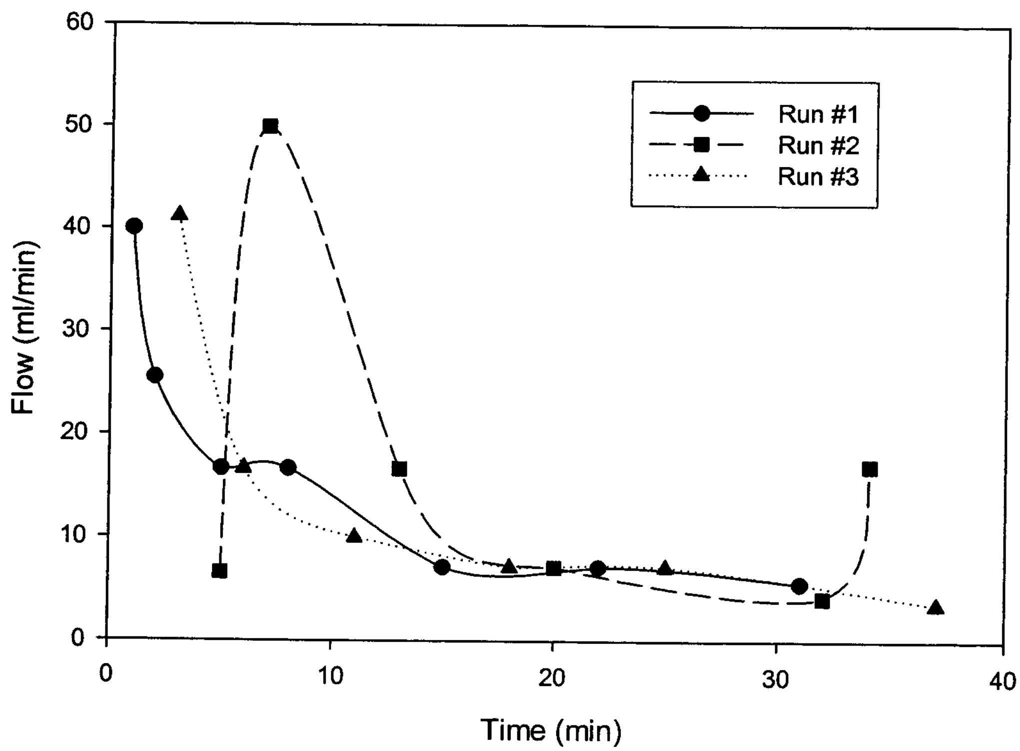


Figure 14. Flow and time relationship for HP665 fabric at 27.6 kPa (4 psi).

Summary and Conclusions

24. Tests were conducted to investigate the contaminant retention properties of two geosynthetic fabrics for dewatering contaminated dredged material. The sediment was characterized by chemical analysis, and the standard elutriate test was also run. Fabric performance was investigated using a pressure filtration system to simulate dewatering of a dredged material slurry produced by hydraulic dredging.

25. The HP665 fabric performed the best in terms of solids and contaminant retention. The pressure filtration tests indicated an initial release of turbidity and suspended solids that rapidly diminished as a cake was formed on the fabric. After the initial release of solids, the filtrates were clear to the eye. Suspended solids measurements showed that some solids (probably very fine) were present in the filtrates that were clear to the eye. Cake water contents were approximately the same or slightly lower than the water content of the in situ sediment.

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Environmental Benefits of Stevenson Creek Section 206 Ecosystem Restoration Project

12 November 2002
REVISION

Prepared for
Jacksonville District
US Army Corps of Engineers
400 West Bay Street
Jacksonville, Florida 32202

by
Dial Cordy and Associates Inc.
490 Osceola Avenue
Jacksonville Beach, Florida 32258

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Stevenson Creek is a tidal estuary in the City of Clearwater (Pinellas County), Florida. The drainage basin encompasses approximately 6,000 acres, and the watershed is currently 90 to 95 percent developed with a mixture of residential (low, medium, and high density), light industrial, commercial, recreational, and open space. Untreated runoff, discharges from point sources such as wastewater treatment plants, and removal of vegetative buffers have degraded the aquatic habitat and natural resource value of the Stevenson Creek system, and has also affected the quality of marine/estuarine resources in Clearwater Harbor.

The Preliminary Restoration Plan (PRP) of the U.S. Army Corps of Engineers- Jacksonville District (Corps) identified a number of restoration measures to improve the aquatic ecosystem in the study area. The recommendations included removal of muck sediments from the estuary, exotic vegetation removal, seagrass planting in the dredged estuary, and shoreline planting.

Several site visits during 2001 and 2002 were conducted to gather the information necessary to evaluate the Stevenson Creek watershed in terms of its overall ecological and biological condition, and to determine appropriate evaluation targets for ecological improvements for the proposed project. The surveys examined wetland community characteristics, creek substrate and structural parameters, water quality factors, and stream flora and fauna. Investigations also involved quantification of wetland value using Estuarine Wetland Rapid Assessment Procedure (E-WRAP), and quantification of aquatic habitat value. After data were compiled and evaluated, specific parameters were identified for use as criteria on which to assess the environmental benefits of project alternatives.

2.0 METHODS

Separate methods were used for wetlands and aquatic/marine habitats in determining the environmental baseline conditions and benefits with the project treatments. The established E-WRAP methodology used a 0 to 1 scale rating system, with 0 being the lowest value and 1 being the highest. The resulting number (score) was multiplied by the total area (acres) receiving the score, resulting in the total ecological value. The method used for determining the aquatic/marine habitat value developed for this project also used a 0 to 1 rating system, and the resulting score was also multiplied by the total area (acres). This approach gave equal weight to wetland and aquatic/marine habitats and environmental benefits.

2.1 Wetland Evaluation Protocol

Although E-WRAP was initially developed to assist in the evaluation of estuarine wetlands for regulatory purposes, it was determined that E-WRAP was the most appropriate method to quantify both the environmental values of existing wetlands and the environmental benefits of project treatments. E-WRAP was developed by the Florida Mitigation Bank Review Team (MBRT) and a host of scientists familiar with coastal systems in Florida. It is based on the Wetland Rapid Assessment Procedure (WRAP), SFWMD Technical Publication REG-001, September 1997, by Raymond E. Miller, Jr. and Boyd E. Gunsalus. A copy of the E-WRAP methodology is included in Appendix A.

The E-WRAP matrix established a numerical ranking for individual ecological and anthropogenic factors that can strongly influence the success of restoration projects. The methodology also incorporated concepts from the U.S. Fish and Wildlife Service's (FWS) "Habitat Evaluation Procedures" (HEP) and accounted for the holistic values of estuarine wetlands used by HEP, such as foraging and nesting value, connectivity, water management value, and species diversity. Each of the evaluation factors was given equal importance and weight in the E-WRAP methodology.

2.2 Wetland Evaluation Criteria

Wetlands serve many important roles in supporting the ecological health of aquatic systems. Coastal wetlands act as an important agent for removing detrimental substances (phosphates, metals, etc.) carried by runoff from developed areas. They also serve as refugia and/or spawning grounds for recreationally and commercially important marine species. Finally, coastal wetlands provide shade and protective cover for aquatic species, and provide habitat for terrestrial species that utilize aquatic systems. The following sections provide a description of the specific variables evaluated in the E-WRAP process. In order to better predict the various *with project conditions* for each variable, water surface elevation data, velocity data, and discharge data from hydrodynamic model assessments conducted by the Corps were interpreted.

2.2.1 Fish and Wildlife Utilization

Wetlands provide many species of wildlife with basic needs such as water, food, nesting, and roosting. While some species prefer uplands for nesting and rearing of their young, their primary food sources are found in wetlands. Water-dependent species such as fish and wading birds have special requirements with regard to duration and magnitude of hydrologic inundation and access.

2.2.2 Wetland Overstory/Shrub Canopy of Desirable Species

The “wetland overstory/shrub canopy of desirable species” variable takes into account the presence, health, and appropriateness of the wetland shrub and overstory canopy. Many estuarine wetland plant species have adapted to a restricted range of hydrologic regimes, salinity, and temperature. Wetland overstory/shrub canopy provides many benefits to wildlife species such as cover, food, nesting, and roosting areas.

2.2.3 Wetland Vegetative Groundcover of Desirable Species

The "groundcover" variable is a measure of the presence, condition, and appropriateness of the wetland groundcover (i.e., herbaceous vegetation). Such vegetation can provide refugia for macroinvertebrates, fishes, reptiles, amphibians, and small mammals, and can also comprise food sources for certain invertebrates, mammals, and waterfowl/wading birds.

2.2.4 Adjacent Upland/Wetland Buffer

The "adjacent upland/wetland buffer" variable is a measure of the adjacent habitat support for the subject wetland. This variable is evaluated based on the adjacent buffer size and ecological attributes the buffer is providing to the wetland (e.g., sediment removal, nutrient uptake, cover, food source, and roosting areas).

2.2.5 Wetland Hydrology

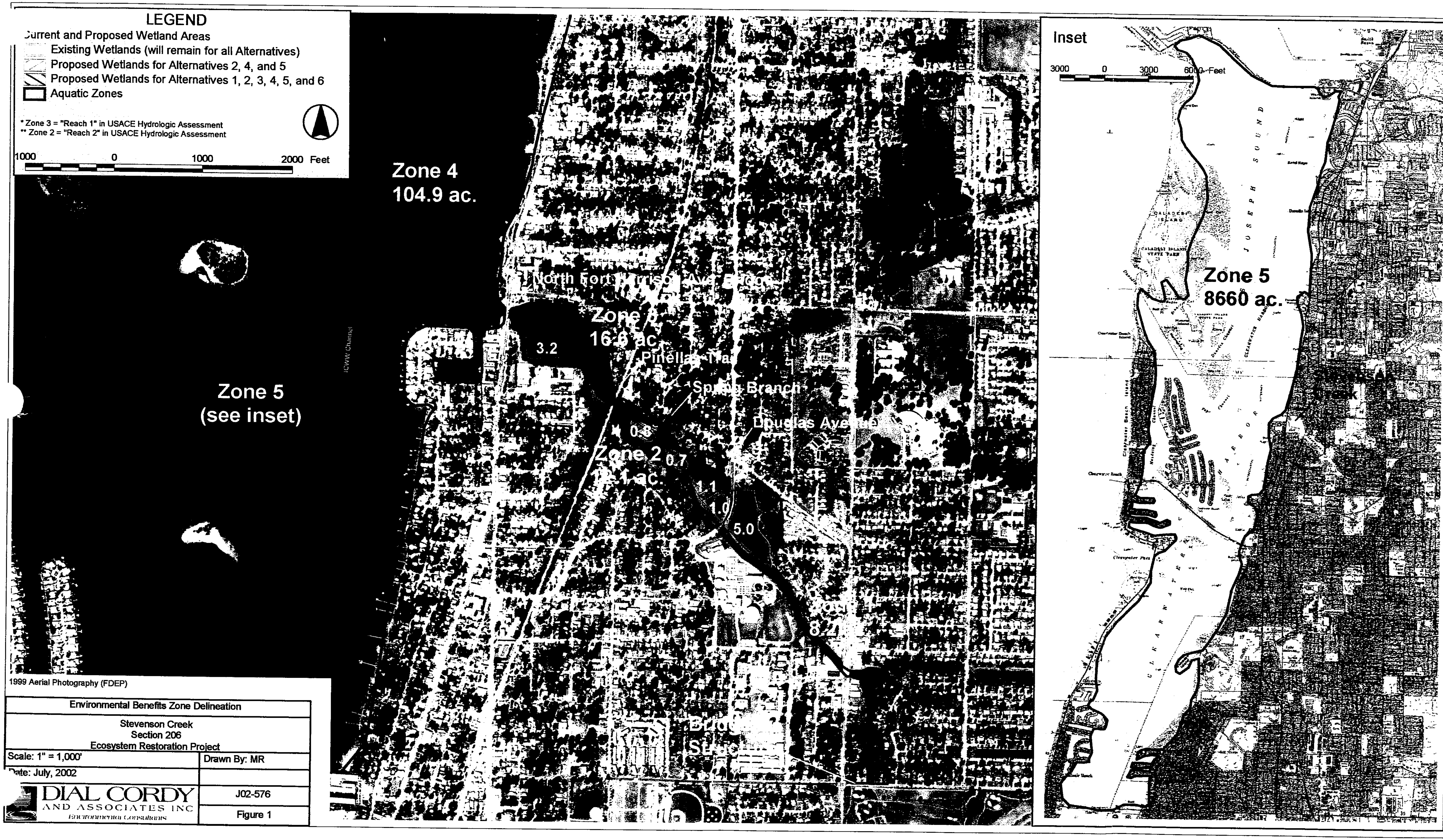
Wetland hydrology refers to the magnitude and duration of tidal inundation within a wetland system, and is evaluated by assessing plant morphological characteristics, plant community structure, soil morphology, and indications that the hydrology of the system has been altered by roads, ditches, canals, levees, or other anthropogenic means.

2.2.6 Water Quality Input and Treatment

The E-WRAP method of evaluating water quality within a wetland relies on assessing the land use immediately affecting the wetland and the amount of pretreatment given to surface water entering the wetland. Water quality can have extreme effects on the value of wetlands. An overabundance of nutrients can promote growth of exotic vegetation or other undesirable plants, low dissolved oxygen can limit or exclude important fish and benthic organisms, and presence of toxic substances such as pesticides can alter the biotic community structure.

2.3 Aquatic and Marine Habitat Evaluation Protocol

Based on information and assumptions related to the three aquatic-habitat evaluation criteria, numerical values ranging from 0 to 1 were assigned to each element or possible action that was a part of an alternative, to several combinations of elements, and to combinations of elements that comprise each alternative (for each of the five project zones discussed in Section 2.5). Assigning a value of "1" to a category denotes that under a given condition or action, aquatic habitat would be essentially pristine, whereas "0" denotes an extremely degraded, disturbed, or altered system.


LEGEND
Current and Proposed Wetland Areas
Existing Wetlands (will remain for all Alternatives)
Proposed Wetlands for Alternatives 2, 4, and 5
Proposed Wetlands for Alternatives 1, 2, 3, 4, 5, and 6
Aquatic Zones
* Zone 3 = "Reach 1" in USACE Hydrologic Assessment
** Zone 2 = "Reach 2" in USACE Hydrologic Assessment
1000 0 1000 2000 Feet
Zone 4
104.9 ac.
Zone 5
(see inset)
North Fort Harrison Ave Bridge
* Zone 3
16.8 ac.
3.2
Pinellas Trail
Spring Branch
Douglas Avenue
0.8
** Zone 2
12.1 ac.
0.7
1.1
1.0
5.0
8
Inset
3000 0 3000 6000 Feet
Zone 5
8660 ac.
1999 Aerial Photography (FDEP)
Environmental Benefits Zone Delineation
Stevenson Creek
Section 206
Ecosystem Restoration Project
Scale: 1" = 1,000'
Drawn By: MR
Date: July, 2002
DIAL CORDY AND ASSOCIATES INC
Environmental Consultants
J02-576
Figure 1

2.4 Aquatic and Marine Habitat Evaluation Criteria

Aquatic and marine habitats can be assessed in a manner similar to that used to assess wetlands. However, because of the nature of aquatic systems, certain parameters used in assessments of wetlands are less important (e.g., upland buffers), and others are more important (e.g., water quality). To ensure that all relevant physical, chemical, and biological parameters are taken into account, the management objective of the system must be considered. Therefore, major factors influencing overall ecological health and the preservation or enhancement of Essential Fish Habitat (EFH) (as designated by the National Marine Fisheries Service) were used to assess estuary baseline condition and condition under each of the alternatives. For this study, increased ecological health is defined by increased biodiversity of native species, increased resiliency of populations, the ability to produce viable populations of consumer taxa, and an increased functional similarity to pristine systems (i.e, sustainable population structure of predators and prey, natural size-class distribution within a given population, etc.). Essential Fish Habitats are habitats critical to the reproduction, growth, feeding, and movements of managed marine species, such as common snook (*Centropomis undecimalis*), gray snapper (*Lutjanus griseus*), spiny lobster (*Panulirus argus*), and pink shrimp (*Penaeus duorarum*). Factors related to EFH and the overall ecological health of the estuary were grouped under the following categories: (1) water quality, (2) habitat substrate and structure, and (3) species richness and assemblage composition. In order to better predict the various *with project conditions* for each variable, water surface elevation data, velocity data, and discharge data from hydrodynamic model assessments conducted by the Corps were interpreted.

2.4.1 Water Quality

Water quality parameters that affect environmental value include trophic state, dissolved oxygen, water clarity, and salinity regime. Trophic status is determined based on system primary production, which in turn relies on the availability of nutrients (primarily phosphorus and nitrogen) in the water column and sediments. Sufficient primary production is necessary for phytoplankton and plants to provide food and structural resources (plants) to consumer and resident taxa, but too much production can result in decreased water clarity and dissolved oxygen levels, which are detrimental to many species. Water clarity is affected by the concentration of suspended algae, solids, dissolved organics, and other compounds. Increased water clarity encourages the recruitment and growth of SAV. Low dissolved oxygen levels may result from decomposition processes from such events as algae blooms or influx of organic material into a system. Sufficient levels of oxygen must be available to both sustain decomposition processes and contribute to respiration in organisms that must extract oxygen from water to live (fishes, shrimps, oysters, polychaetes, etc.). Dissolved oxygen levels typically increase with flushing (exchange of water with larger bodies of water) rate. Flushing also influences the salinity regime of the estuary. Some organisms tolerate a wide range of salt concentrations ("oligohaline" species), such as mullet, while others are more restricted in tolerance ("stenohaline"), and therefore distribution is more limited, such as fishes of the snapper-grouper complex.

2.4.2 Habitat Substrate and Structure

Habitat substrate and structure strongly influence the species composition of estuary fauna. Substrates influence the population density and species richness of fauna based on particle grain size. Typically habitats with sand-size grains have higher species diversity (for nekton, benthos, and infauna) than those with finer substrates (such as silt). Also, sands provide habitat more adequate for the recruitment of attached algae and seagrasses. In turn, macroalgae, seagrasses, and other vegetation, such as mangroves and emergent vegetation provide structure, cover, and refugia for invertebrates and juvenile fishes.

2.4.3 Species Richness and Assemblage Composition

Species richness (number of species) has long been used as an indicator of ecosystem health. Richness provides individuals within a biological community with various opportunities to carry out ecological interactions, especially with regard to predator/prey interactions. When species richness declines, the potential for additional species to become extirpated from a community increases. Biodiversity, by definition, is an extension of richness, but also takes into account the numerical balance of various species in the assemblage. Research suggests that increased biodiversity increases the resiliency of communities so that if disturbed by stochastic events (chance occurrences, such as hurricanes, floods, etc.) or human activities, populations "equilibrate" to former levels that are once again adequate for carrying out ecological interactions.

Favorable species assemblage composition comprises desirable species, such as those found in the most pristine environments, but has few if any nonindigenous species. Assemblages including invasive species are less desirable, as they impede natural ecological processes. Also, invasive species typically indicate that a community has undergone some level of disturbance from humans. Favorable assemblages include endangered, threatened, or otherwise protected and/or managed species, such as common snook (listed by the State of Florida as a *Species of Special Concern*) and other species for whom use of EFH regulations are necessary in order to maintain sustainable populations (i.e., commercially important species, such as species of the snapper-grouper complex, pink shrimp, and spiny lobster).

2.5 Geographic Description of Zones Used in Analyses

Once the environmental benefits model was developed, the aquatic and wetland resources of the study area were evaluated, and the environmental benefit scores were calculated. Because the treatments would have varying effects on different areas within the Stevenson Creek study area, the study area was separated into five distinct areas (Figure 1), including:

Table 6. Aquatic Benefits Gain

Treatment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Envir. Gain
Baseline Condition	0	0	0	0	0	0
Without Project	0	0.0	0.0	0	0	0
W_1	0	0.061	0.166	0.525	0	0.752
W_2	0	0	0	0	0	0
C_1	0.328	0.3	0	0	0	0.628
X_1	0	0.121	2.49	5.25	8.6	16.46
X_{2A}	0.041	0.61	0.166	0	0	0.817
X_{2B}	0.082	1.21	0.332	1.049	0	2.67
M_1	0.041	0.242	2.01	5.25	8.6	16.14
M_2	0.164	0.95	0.415	3.15	0	4.68
W_1,W_2	0	0.242	0.664	0.525	0	1.43
X_1X_{2A}	0.164	1.33	2.49	5.25	8.6	17.83
X_1,X_{2B}	0.246	1.57	2.82	5.77	17.1	27.51
M_1,M_2	0.246	1.43	2.41	6.29	17.1	27.48
X_1,M_1,X_{2A}	0.164	1.82	4.02	6.82	25.7	38.52
X_1,M_1,X_{2B}	0.246	2.18	4.29	9.97	25.7	42.39
X_1,X_{2A},M_2	0.41	2.38	3.65	8.39	25.7	40.53
Alt 1 (X_1, M_1)	0.164	0.61	4.15	9.44	17.1	31.46
Alt 2 (X_1, M_1,X_{2A},M_2)	0.738	2.57	4.96	12.59	42.83	63.69
Alt 3 (W_1,X_1, M_1)	0.164	0.73	4.69	9.97	25.7	41.25
Alt 4 (W_1, X_1, M_1,X_{2A},M_2)	0.779	2.85	5.23	13.64	42.83	65.33
Alt 5 (W_1,X_1,M_1,W_2,X_{2A},M_2)	0.779	3.04	5.36	13.74	42.83	65.75
Alt 6 (W_1,X_1,M_1,W_2,X_{2B})	0.4	3.03	5.09	12.59	42.83	63.94

Table 5. Aquatic Habitat Value (Score x Acreas)

Treatment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Baseline Condition	2.05	4.84	6.64	57.70	4711.30
Without Project	2.05	4.84	6.64	57.70	4711.30
W_1	2.05	4.90	6.806	58.22	4711.30
W_2	2.05	4.84	6.64	57.70	4711.30
C_1	2.38	5.14	6.64	57.70	4711.30
X_1	2.05	4.96	9.13	62.94	4719.87
X_{2A}	2.09	5.45	6.81	57.70	4711.30
X_{2B}	2.13	6.05	6.97	58.74	4711.30
M_1	2.09	5.08	7.37	62.94	4719.87
M_2	2.21	4.75	7.06	60.84	4711.30
W_1,W_2	2.05	5.08	7.30	58.22	4711.30
X_1X_{2A}	2.21	6.17	9.13	62.94	4719.87
X_1,X_{2B}	2.30	6.41	9.46	63.46	4728.43
M_1,M_2	2.30	6.66	7.77	63.99	4728.43
X_1,M_1,X_{2A}	2.21	6.66	9.38	64.51	4737.00
X_1,M_1,X_{2B}	2.30	7.02	9.65	67.66	4737.00
X_1,X_{2A},M_2	2.46	6.18	10.29	66.09	4737.00
Alt 1 (X_1, M_1)	2.21	5.45	9.51	67.14	4728.43
Alt 2 (X_1, M_1,X_{2A},M_2)	2.79	6.37	10.32	70.28	4754.13
Alt 3 (W_1,X_1, M_1)	2.21	5.57	10.05	67.66	4737.00
Alt 4 (W_1, X_1, M_1,X_{2A},M_2)	2.83	6.65	10.59	71.33	4754.13
Alt 5 ($W_1,X_1,M_1,W_2,X_{2A},M_2$)	2.83	6.84	10.72	71.44	4754.13
Alt 6 (W_1,X_1,M_1,W_2,X_{2B})	2.62	7.87	10.45	70.28	4754.13

Area of aquatic habitat for Zone 1 - 8.2 acres
Area of aquatic habitat for Zone 2 - 12.1 acres; with M_2 - 9.5 acres
Area of aquatic habitat for Zone 3 - 16.6 acres; with M_1 - 13.4 acres
Area of aquatic habitat for Zone 4 - 104.9 acres
Area of aquatic habitat for Zone 5 - 8566 acres

Table 4. Aquatic Habitat Scores

Treatment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Baseline Condition	0.25	0.4	0.4	0.55	0.55
Without Project	0.25	0.4	0.4	0.55	0.55
W_1	0.25	0.405	0.41	0.555	0.55
W_2	0.25	0.4	0.4	0.55	0.55
C_1	0.29	0.425	0.4	0.55	0.55
X_1	0.25	0.41	0.55	0.6	0.551
X_{2A}	0.255	0.45	0.41	0.55	0.55
X_{2B}	0.26	0.5	0.42	0.56	0.55
M_1	0.255	0.42	0.55	0.6	0.551
M_2	0.27	0.5	0.425	0.58	0.55
W_1,W_2	0.25	0.42	0.44	0.555	0.55
X_1X_{2A}	0.27	0.51	0.55	0.6	0.551
X_1,X_{2B}	0.28	0.53	0.57	0.605	0.552
M_1,M_2	0.28	0.55	0.58	0.61	0.552
X_1,M_1,X_{2A}	0.27	0.55	0.7	0.615	0.553
X_1,M_1,X_{2B}	0.28	0.58	0.72	0.645	0.553
X_1,X_{2A},M_2	0.3	0.65	0.62	0.63	0.553
Alt 1 (X_1, M_1)	0.27	0.45	0.71	0.64	0.552
Alt 2 (X_1, M_1,X_{2A},M_2)	0.34	0.67	0.77	0.67	0.555
Alt 3 (W_1,X_1, M_1)	0.27	0.46	0.75	0.645	0.553
Alt 4 (W_1, X_1, M_1,X_{2A},M_2)	0.345	0.7	0.79	0.68	0.555
Alt 5 (W_1,X_1,M_1,W_2,X_{2A},M_2)	0.345	0.72	0.8	0.681	0.555
Alt 6 (W_1,X_1,M_1,W_2,X_{2B})	0.3	0.65	0.78	0.67	0.555

Table 3. Wetland Benefits Gain

Treatment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Envir. Gain
Baseline	0	0	0	NA	NA	0
Without Project	0	0	0	NA	NA	0
W_1	0	0	0	NA	NA	0
W_2	0	0	0	NA	NA	0
C_1	0.25	0.06	0	NA	NA	0.31
X_1	0.05	0.01	0	NA	NA	0.06
X_{2A}	0.05	0.02	0	NA	NA	0.07
X_{2B}	0.05	0.02	0	NA	NA	0.07
M_1	0.05	0.01	2.43	NA	NA	2.49
M_2	0.25	2.19	0	NA	NA	2.44
W_1, W_2	0	0	0	NA	NA	0
X_1X_{2A}	0.1	0.03	0	NA	NA	0.13
X_1, X_{2B}	0.1	0.03	0	NA	NA	0.13
M_1, M_2	0.3	2.26	2.53	NA	NA	5.09
X_1, M_1, X_{2A}	0.2	0.05	2.5	NA	NA	2.75
X_1, M_1, X_{2B}	0.2	0.05	2.5	NA	NA	2.75
X_1, X_{2A}, M_2	0.35	2.26	0	NA	NA	2.61
Alt 1 (X_1, M_1)	0.15	0.04	2.5	NA	NA	2.69
Alt 2 (X_1, M_1, X_{2A}, M_2)	0.45	2.37	2.62	NA	NA	5.44
Alt 3 (W_1, X_1, M_1)	0.15	0.04	2.5	NA	NA	2.69
Alt 4 ($W_1, X_1, M_1, X_{2A}, M_2$)	0.45	2.37	2.62	NA	NA	5.44
Alt 5 ($W_1, X_1, M_1, W_2, X_{2A}, M_2$)	0.45	2.37	2.62	NA	NA	5.44
Alt 6 ($W_1, X_1, M_1, W_2, X_{2B}$)	0.2	0.05	2.5	NA	NA	2.75

Table 2. Wetland E-WRAP Totals (E-WRAP x Wetland Acres).

Treatment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Baseline	3.25	0.44	0	NA	NA
Without Project	3.25	0.44	0	NA	NA
W_1	3.25	0.44	0	NA	NA
W_2	3.25	0.44	0	NA	NA
C_1	3.5	0.5	0	NA	NA
X_1	3.3	0.45	0	NA	NA
X_{2A}	3.3	0.46	0	NA	NA
X_{2B}	3.3	0.46	0	NA	NA
M_1	3.3	0.45	2.43	NA	NA
M_2	3.5	2.63	0	NA	NA
			0		
W_1,W_2	3.25	0.44	0	NA	NA
X_1X_{2A}	3.35	0.47	0	NA	NA
X_1,X_{2B}	3.35	0.47	0	NA	NA
M_1,M_2	3.55	2.70	2.53	NA	NA
X_1,M_1,X_{2A}	3.45	0.49	2.50	NA	NA
X_1,M_1,X_{2B}	3.45	0.49	2.50	NA	NA
X_1,X_{2A},M_2	3.6	2.70	0	NA	NA
			0		
			0		
Alt 1 (X_1, M_1)	3.4	0.48	2.50	NA	NA
Alt 2 (X_1, M_1,X_{2A},M_2)	3.7	2.81	2.62	NA	NA
Alt 3 (W_1,X_1, M_1)	3.4	0.48	2.50	NA	NA
Alt 4 (W_1, X_1, M_1,X_{2A},M_2)	3.7	2.81	2.62	NA	NA
Alt 5 (W_1,X_1,M_1,W_2,X_{2A},M_2)	3.7	2.81	2.62	NA	NA
Alt 6 (W_1,X_1,M_1,W_2,X_{2B})	3.45	0.49	2.50	NA	NA

Acreage of wetlands for Zone 1 - 5.0 acres

Acreage of wetlands for Zone 2 - 1.0 acres; M_2 increases total to 3.6 acres

Acreage of wetlands for Zone 2 - 0 acres; M_1 increases total to 3.2 acres

Table 1. Wetland E-WRAP Scores

Treatment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Baseline	0.65	0.44	0	NA	NA
Without Project	0.65	0.44	0	NA	NA
W_1	0.65	0.44	0	NA	NA
W_2	0.65	0.44	0	NA	NA
C_1	0.70	0.5	0	NA	NA
X_1	0.66	0.45	0	NA	NA
X_{2A}	0.66	0.46	0	NA	NA
X_{2B}	0.66	0.46	0	NA	NA
M_1	0.66	0.45	0.76	NA	NA
M_2	0.70	0.73	0	NA	NA
W_1,W_2	0.65	0.44	0	NA	NA
X_1X_{2A}	0.67	0.47	0	NA	NA
X_1,X_{2B}	0.67	0.47	0	NA	NA
M_1,M_2	0.71	0.75	0.79	NA	NA
X_1,M_1,X_{2A}	0.69	0.49	0.78	NA	NA
X_1,M_1,X_{2B}	0.69	0.49	0.78	NA	NA
X_1,X_{2A},M_2	0.72	0.75	0	NA	NA
Alt 1 (X_1, M_1)	0.68	0.48	0.78	NA	NA
Alt 2 (X_1, M_1,X_{2A},M_2)	0.74	0.78	0.82	NA	NA
Alt 3 (W_1,X_1, M_1)	0.68	0.48	0.78	NA	NA
Alt 4 (W_1, X_1, M_1,X_{2A},M_2)	0.74	0.78	0.82	NA	NA
Alt 5 (W_1,X_1,M_1,W_2,X_{2A},M_2)	0.74	0.78	0.82	NA	NA
Alt 6 (W_1,X_1,M_1,W_2,X_{2B})	0.69	0.49	0.78	NA	NA

Zone 1 – Stevenson Creek from the sediment-collection apparatus at Palmetto Street downstream to the Douglas Avenue bridge. The Zone 1 study area includes 8.2 acres of aquatic habitat and 5 acres of wetlands.

Zone 2 – Stevenson Creek from the Douglas Avenue bridge downstream to Pinellas Trail bridge. This zone includes 12.1 acres of aquatic habitat and 1 acre of existing wetlands. **Note:** Zone 2 has been designated as "Reach 2" in the Corps hydrodynamic model assessment.

Zone 3 – Stevenson Creek from Pinellas Trail bridge downstream to the North Fort Harrison Avenue bridge. This zone includes 16.6 acres of aquatic habitat and no wetlands. **Note:** Zone 3 has been designated as "Reach 1" in the Corps hydrodynamic model assessment.

Zone 4 – The area of Clearwater Harbor immediately adjacent to the mouth of Stevenson Creek, between the Intracoastal Waterway channel and North Fort Harrison Avenue bridge. Zone 4 includes 104.9 acres of marine habitat and no wetlands.

Zone 5 – The entire area of Clearwater Harbor between SR 526 and SR 686. Zone 5 includes 8,856 acres of marine habitat (wetlands not applicable).

2.6 Description of Project Treatments and Alternatives

A number of treatments were chosen for evaluation of their potential benefits to the aquatic and wetland resources in the study area (Figure 1). This section describes the various treatments included in this evaluation.

W_1 Widen North Fort Harrison Avenue bridge opening from 115 feet to 250 feet. The purpose of this treatment was to provide additional flushing for the estuary and to provide a more natural hydrologic connection between the estuary and the harbor.

W_2 Widen Pinellas Trail bridge opening from 117 feet to 232 feet. The purpose of this treatment is to reduce the flow restriction at Pinellas Trail bridge and to partially restore the hydrologic condition in the creek.

C_1 Install 36-inch culvert under the Douglas Avenue bridge to connect the wetlands north of the creek and just east of the bridge with the pool area of the creek just north of the creek on the west side of the bridge. This treatment is intended to increase the hydrologic and biological connection between the wetland and the creek.

X_1 Remove silt material from Zone 3 (i.e., Reach 1) between North Fort Harrison Avenue bridge and Pinellas Trail bridge. Clean sand will be used in dredged area, if required, to bring bottom depth up to -3.5 feet NGVD. The purpose of this treatment is to remove a substantial source of nutrient loading in the Stevenson Creek/Clearwater Harbor system, remove a source of siltation affecting seagrass beds in Clearwater Harbor west of North Fort Harrison Avenue bridge, and improve water circulation and flushing efficiency. Organic/silt material would be removed, and clean sand would be used to provide a higher-quality substrate.

X_{2A} Remove silt and dredge a thalweg in Zone 2 (i.e., Reach 2) between Pinellas Trail bridge and Douglas Avenue bridge to a depth of -2.5 feet. The channel would reflect a natural, meandering system and follow the current dominant flow pathway. No mangrove or wetland construction is included. The purpose of this treatment is to remove a substantial source of nutrient loading in the Stevenson Creek/Clearwater Harbor system, remove a source of siltation affecting seagrass beds in Clearwater Harbor west of North Fort Harrison Avenue bridge, and improve water circulation and flushing efficiency. All of the organic/silt material would be removed, and clean sand, if required, would be used to provide a higher-quality substrate.

X_{2B} Remove silt and dredge entire creek in Zone 2 (i.e., Reach 2) between Pinellas Trail bridge and Douglas Avenue bridge to a depth of -2.5 feet. No mangrove or wetland construction is included. The purpose of this treatment is to remove a substantial source of nutrient loading in the Stevenson Creek/Clearwater Harbor system, remove a source of siltation affecting seagrass beds in Clearwater Harbor west of North Fort Harrison Avenue bridge, and improve water circulation and flushing efficiency. All of the organic/silt material would be removed, and clean sand, if required, would be used to provide a higher-quality substrate.

M_1 Create 3.2-acre island and plant with red mangroves in Zone 3 (i.e., Reach 1). A 3.2-acre island would be created from appropriate material and planted with red mangrove seedlings. The additional mangroves would provide habitat for nesting birds, and tidally inundated foraging areas for fishes. **Note:** This island has been also termed "mangrove shelf" in the Corps hydrodynamic model assessment.

M_2 Create additional 2.6 acres of mangrove island wetlands in Zone 2 (i.e., Reach 2). A total or 2.6 acres of mangrove wetlands would be created from appropriate material and planted with red mangrove seedlings. The additional mangroves would provide habitat for nesting birds, and tidally inundated foraging areas for fishes.

Six primary alternatives for ecosystem restoration were analyzed. Treatment X_{2A} and X_{2B} are mutually exclusive elements, with each providing a different dredging scheme for Zone 2. In addition, treatment M_2 cannot be used in conjunction with X_{2B}. These were the only restrictions observed in combining the treatments into project alternatives. The constituent elements of the alternatives are listed in Table 7Tables 1 through 7 are found at the end of the text), but are listed below as well for convenience.

Alternative 1	X_1, M_1
Alternative 2	X_1, M_1, X_{2A}, M_2
Alternative 3	W_1, X_1, M_1
Alternative 4	$W_1, X_1, M_1, X_{2A}, M_2$
Alternative 5	$W_1, X_1, M_1, W_2, X_{2A}, M_2$
Alternative 6	$W_1, X_1, M_1, W_2, X_{2B}$

3.0 RESULTS

Prior to calculating the environmental benefits to be gained by the various treatments and alternatives, each zone was evaluated according to the previously described methodologies to provide a baseline value. In addition, each zone was evaluated under the *without project* condition given the standard "50-year/life-of-project" assumption. Due to the highly developed nature of the watershed, however, the *without project* condition would likely not change from the current baseline condition. Therefore, the calculated values for the *without project* condition are the same as the baseline values. The following is a summary of the baseline conditions for wetland and aquatic habitat within the evaluation zones.

Zone	Wetland Value	Aquatic Habitat Value	Total
1	0.65 x 5 acres = 3.25	0.25 x 8.2 acres = 2.05	5.30
2	0.44 x 1 acre = 0.44	0.40 x 12.1 acres = 4.84	5.28
3	0 (no wetlands)	0.40 x 16.6 acres = 6.64	6.64
4	0 (no wetlands)	0.55 x 104.9 acres = 57.7	57.70
5	0 (no wetlands)	0.55 x 8566 acres = 4711.3	4711.30

3.1 Wetland Benefits

Individual E-WRAP scores were calculated for each zone with each individual proposed treatment and are provided in Table 1. In addition, E-WRAP scores were calculated for combinations of treatments including the six alternatives plans under consideration. Table 2 provides the total E-WRAP value of each zone (E-WRAP score x wetland acres). Zone 2 currently has 1.0 acre of wetlands, however, treatment M_2 would create an additional 2.6 acres of estuarine wetlands. Zone 3 currently has a thin fringe of mangrove wetlands along a portion of the southern bank, but the area was too small to calculate, and was not considered in this evaluation. Under treatment M_1, 3.2 acres of wetlands would be created. Table 3 summarizes the wetland environmental benefits gained from the individual treatments per zone. The table also provides the total wetland gain with each measure and alternative.

Among the individual treatments, the greatest wetland benefits were realized from treatments M_1 (2.49) and M_2 (2.44). This is due to the fact that creation of high-quality mangrove wetlands adds more value than any other improvement to the small amount of existing wetlands. In addition, adding 2.6 acres of mangrove wetlands through implementing M_2 in Zone 2 significantly raises the ecological value (from 0.44 to 0.73) of Zone 2 (which currently houses only a single acre of wetlands), and the ecological value (from 0.65 to 0.70) of Zone 1's five acres of wetlands due to the close proximity of the wetlands. The combination of treatments M_1 and M_2 provided an environmental benefit of 5.09.

The most benefits realized from any of the examined combinations included Alternative 2, Alternative 4, and Alternative 5 (5.44, each). Hydrodynamic model assessments conducted by the Corps demonstrated that implementation of each of these alternatives (as well as Alternative 6), may result in decreased inundation depth (from 4.8" to possibly 2.4") and/or increased non-inundation interval for wetlands adjacent to Douglas Avenue during parts of the tidal cycle closest to lowest low water.

3.2 Aquatic and Marine Habitat Benefits

Individual aquatic habitat benefit scores were calculated for each zone with each individual proposed treatment and are provided in Table 4. In addition, aquatic habitat scores were calculated for combinations of treatments including the six alternatives plans under consideration. Table 5 provides the total aquatic habitat value of each zone (aquatic habitat score x aquatic habitat acres). Table 6 summarizes the aquatic habitat environmental benefits gained from the individual treatments per zone. The table also provides the total aquatic habitat "gain" with each measure and alternative for the entire project.

Among the individual treatments, the greatest aquatic habitat benefits (16.46 and 16.14, respectively) were realized from treatments X_1, the dredging and backfilling (with sand) of the reach between the North Fort Harrison Avenue bridge and the Pinellas Trail bridge (Zone 3), and M_1, which results in the creation of a mangrove island (Zone 3). The "environmental gain" from either of these two elements was more than three times that of the next most beneficial element (M_2), the installation of mangrove islands in the reach between the Pinellas Trail bridge and the Douglas Avenue bridge (Zone 2). It may be interesting to note that although the size of the overall aquatic habitat available decreases with the installation of mangrove islands (i.e., wetlands), overall aquatic habitat quality increases appreciably. Such areas provide refugia for juvenile shrimps and snook, and fuel a detritus-based food web. Aquatic habitat benefits due to X_1 activities were due primarily to improvements in substrate, which would become viable for recruitment of benthos and infauna, and possibly even the establishment of seagrasses in shallow areas. Replacement of substrate would also yield improvements in water quality and seagrass productivity west of the North Fort Harrison Avenue bridge, and possibly provide an attractive habitat for foraging fishes that may even migrate farther up the stream.

Among single elements, the element with the least benefit to aquatic habitats was the widening of the Pinellas Trail bridge (W_2), which contributed no "gains" whatsoever. Other elements that, *when not combined with other elements*, seemed not to improve the aquatic habitat were the installation of a culvert under Douglas Avenue (C_1), widening the bridge at North Fort Harrison Avenue (W_1), and dredging only a thalweg through Zone 2 (X_{2A}).

In general, as elements were combined, resulting aquatic system benefits increased with the number of elements, i.e., combinations with more elements held greater benefits for the aquatic system. Most of the examined combinations of two elements yielded benefits ranging from 27.48 to 31.46 (the combination of bridge-widening elements was an outlier, having a benefit of only 1.43, and X_1X_{2A} had a benefit of only 17.83), combinations with three elements ranged from 38.52 to 42.39, and those having four, five, or six elements varied surprising little, ranging from 63.69 (Alternative 2) to 65.75 (Alternative 5). The inclusion of the mangrove-island element (M_1) in combinations having two or three elements provided moderate aquatic-habitat value gains, and the addition of the North Fort Harrison Avenue bridge widening (W_1) provided significant gains when added to Alternative 1 to create Alternative 3.

Alternative 2 has the fewest elements of those combinations that have gain values in the 60s. All four of the alternatives having gain values in the 60s involve some type of dredging and mangrove installation in Zone 2, and two of those alternatives (5 and 6) also involve widening the stream bed by altering the Pinellas Trail bridge. Hydrodynamic model assessments conducted by the Corps demonstrated that implementation of any of these alternatives (as well as Alternative 4), may result in decreased water depth (up to approximately 7" less) in the more upstream section of Zone 2 and in Zone 1 during parts of the tidal cycle closest to lowest low water.

4.0 DISCUSSION

Table 7 summarizes the total environmental benefits to wetlands and aquatic habitat for each treatment and alternative. Treatment W_2 provided no environmental benefit when implemented alone, but W_1 provided some benefit when implemented in connection with other treatments. Treatment M_1 provided the most benefit (18.63) as a stand-alone treatment, followed by treatment X_1 (16.52). M_2 also provided notable gains as a single element (7.12).

Alternative 5 shows the highest environmental benefit (71.19), followed closely by Alternative 4 (70.77), and Alternative 2 (69.13). All of these alternatives include treatments X_1, M_1, X_{2A}, and M_2 (Alternative 2). Alternative 4 incorporates treatment W_1 with those four elements, and Alternative 5 adds treatments W_1 and W_2 to those found in Alternative 2. Alternative 6 also shows high benefits (66.69), but differs from Alternative 5 by replacing treatments X_{2A} and M_2 with X_{2B}. Although hydrodynamic model assessments conducted by the Corps demonstrated that for all the alternatives 2, 4, 5, and 6 water levels and persistence of inundation may be decreased during the portion of the tidal cycle at and around lowest low water, habitat quality in wetlands and aquatic habitats are not expected to decrease. However, there may be a change in vegetation and/or fish and wildlife community assemblage.

To better understand the interaction of elements used in alternatives, several additional combinations, or "design suites," of two or three elements were also investigated (see Table 7). Three of the investigated design suites, having three elements each, provided environmental benefits commensurate with Alternative 3. In addition, two other design suites, having two elements each, had benefits probably not significantly different than that of Alternative 1. The following table summarizes the ranking of the six alternatives with regard to environmental benefits.

Alternative 5	71.19
Alternative 4	70.77
Alternative 2	69.13
Alternative 6	66.69
Alternative 3	43.94
Alternative 1	34.15

Table 7. Total Environmental Benefits for All Treatments and Alternatives

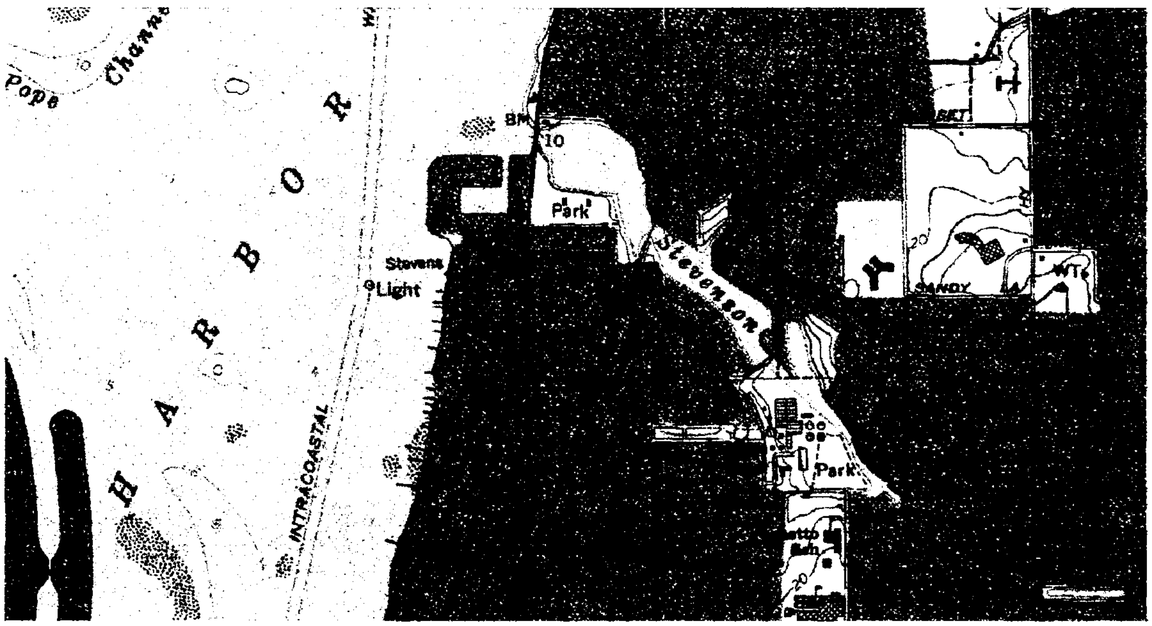
Treatment	Aquatic	Wetland	Total
Baseline Condition	0	0	**0**
Without Project	0	0.0	**0.0**
W_1	0.752	0	**0.752**
W_2	0	0	**0**
C_1	0.628	0.31	**0.938**
X_1	16.46	0.06	**16.52**
X_{2A}	0.817	0.07	**0.887**
X_{2B}	2.67	0.07	**2.74**
M_1	16.14	2.49	**18.63**
M_2	4.68	2.44	**7.12**
W_1,W_2	1.43	0	**1.43**
X_1X_{2A}	17.83	0.13	**17.96**
X_1,X_{2B}	27.51	0.13	**27.64**
M_1,M_2	27,48	5.09	**32.57**
X_1,M_1,X_{2A}	38.52	2.75	**41.27**
X_1,M_1,X_{2B}	42.39	2.75	**45.14**
X_1,X_{2A},M_2	40.53	2.61	**43.14**
Alt 1 (X_1, M_1)	31.46	2.69	**34.15**
Alt 2 (X_1, M_1, X_{2A}, M_2)	63.69	5.44	**69.13**
Alt 3 (W_1, X_1, M_1)	41.25	2.69	**43.94**
Alt 4 ($W_1, X_1, M_1, X_{2A}, M_2$)	65.33	5.44	**70.77**
Alt 5 ($W_1, X_1, M_1, W_2, X_{2A}, M_2$)	65.75	5.44	**71.19**
Alt 6 ($W_1, X_1, M_1, W_2, X_{2B}$)	63.94	2.75	**66.69**

Appendix A

E-WRAP Methodology

Historic Assessment and Remote Sensing Survey of the Stevenson Creek Estuary, Pinellas County, Florida

Contract Number: DACW17-01-M-0168



Prepared for:

Jacksonville District Office
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Prepared by:

Mid-Atlantic Technology and Environmental Research, Inc.
441 Blossoms Ferry Road
Castle Hayne, North Carolina 28429

Wes Hall
Principal Investigator
15 September 2002

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Abstract

The U.S. Army Corps of Engineers, Jacksonville District, has proposed maintenance dredging of Stevenson Creek Estuary in the City of Clearwater, Pinellas County, Florida. Because of the potential for shipwrecks and other submerged cultural resources in the vicinity, the Jacksonville District contracted Mid-Atlantic Technology and Environmental Research, Inc. (M-AT/ER) of Castle Hayne, North Carolina, to conduct a historic assessment and remote sensing survey to identify any submerged cultural resources in the vicinity of the proposed dredging. Following a review of previous investigation and an examination of historic maps, M-AT/ER conducted field investigations for the above-referenced project on 1 and 2 November 2001.

There were numerous magnetic and acoustic target signatures in Stevenson Creek. The majority of the targets were associated with bridge crossings, private docks, outfall pipe, shoreline debris, and ferrous debris (identified exposed above the water). Five targets were not readily identified with visible debris or structures. A local resident also reported that some type of wooden vessel was located in the vicinity of these targets. Although the majority (if not all) of the targets are most likely associated with modern debris, archaeological investigations to identify and assess at least 2 (two) of the targets are recommended. Avoidance of these targets during dredging activities would be difficult given the confines of the creek and shallow waters.

TABLE OF CONTENTS

Page

List of Figures

Introduction

The U.S. Army Corps of Engineers, Jacksonville District, has proposed maintenance dredging of the Stevenson Creek Estuary in the city of Clearwater, Pinellas County, Florida. Historic shipwrecks are known to have occurred in the general vicinity of the creek; therefore, in compliance with the National Historic Preservation Act of 1966, as amended; the Archeological and Historic Preservation Act of 1979, as amended; and the Abandoned Shipwreck Act of 1987; and 36 CFR Part 800[1], the USACE is administering underwater archaeological investigations at the project location.

To this end, the USACE contracted Mid-Atlantic Technology and Environmental Research, Inc. (M-AT/ER) of Castle Hayne, North Carolina, to conduct an underwater archaeological remote sensing survey of the proposed dredging areas. The underwater archaeological investigations included magnetometer[2], fathometer, and side-scan sonar[3] surveys of the areas to be directly impacted by dredging. In addition to field investigations, primary and secondary archival research was conducted to provide a historical background of the study area. Fieldwork was performed between 2 November and 5 November 2002.

Project Location

Stevenson Creek is located in Pinellas County approximately 1.6 miles north of Florida State Highway 60 in Clearwater, Florida. The mouth of the creek opens to Clearwater Harbor and the Intracoastal Waterway. The project area for these investigations included the estuary from Edgewater Avenue to Douglas Avenue (Figure 1).

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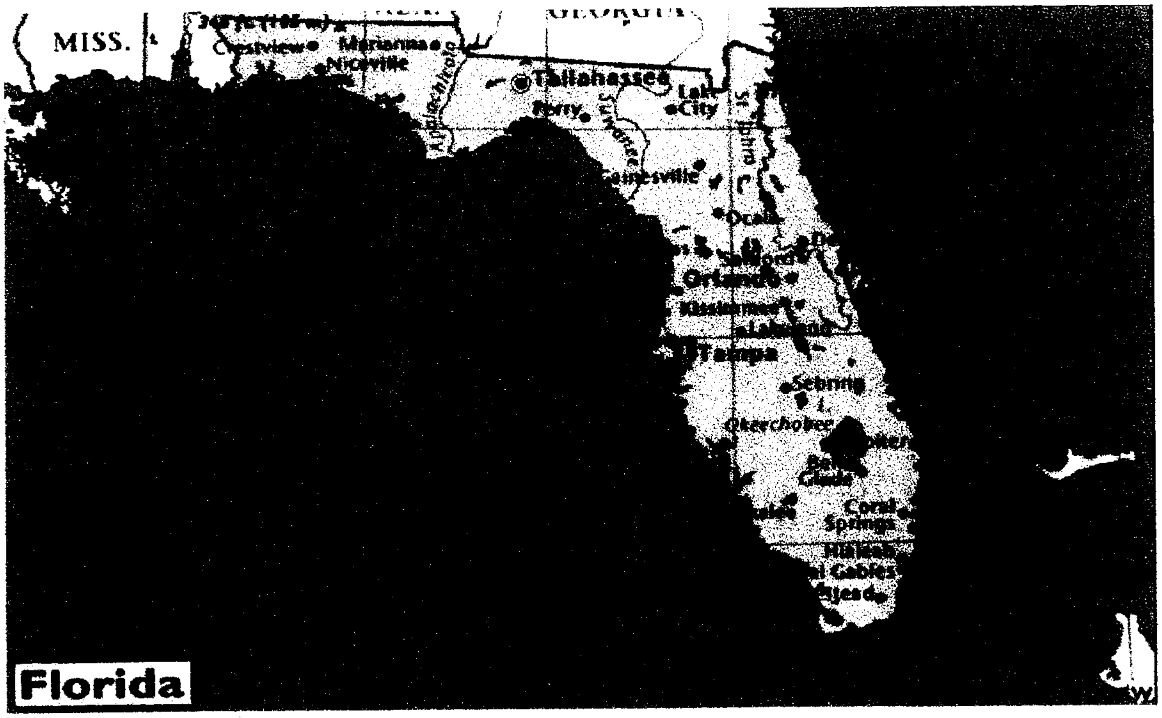
1 A national policy for historic preservation has been established in accordance with authorization contained in Sections 106 and 110 (formerly E.O. 11593) of the National Historic Preservation Act of 1966, as amended following the Advisory Council on Historic Preservation Regulations (36 CFR 800). Executive Order 11593 and the Historic Preservation Act Amendments of 1980 specified that the Federal Government shall provide leadership in preserving, restoring, and maintaining the historic and cultural environment of the nation. In 1988, the Abandoned Shipwreck Act (Public Law 100-298) declared that the states (or territories of the U.S.) are to manage shipwrecks in state waters. As a result of these acts and other legislation, State and Federal agencies are required to administer cultural properties under their control in a spirit of stewardship and trusteeship. Each agency is required to initiate such measures as are necessary to insure that policies, plans, and programs will preserve sites, structures, and objects of historical or archaeological significance that exist on properties owned by the Federal Government or that are subject to federal regulation.

2 A magnetometer is an electronic instrument that measures localized changes in the earth's magnetic field. By using a magnetometer in a controlled survey, the presence of ferrous materials can be detected. Since most historically significant shipwrecks contain relatively large amounts of iron or steel in the form of fasteners, anchors, cannons, or engines, etc., their presence can frequently be detected by a magnetometer survey.

3 Side-scan sonar is an underwater acoustic instrument that by electronic means generates a graphic representation of the bottom surface. By interpretation of these graphic records, the user can identify geographic changes in the bottom or man-made objects protruding above the bottom surface.



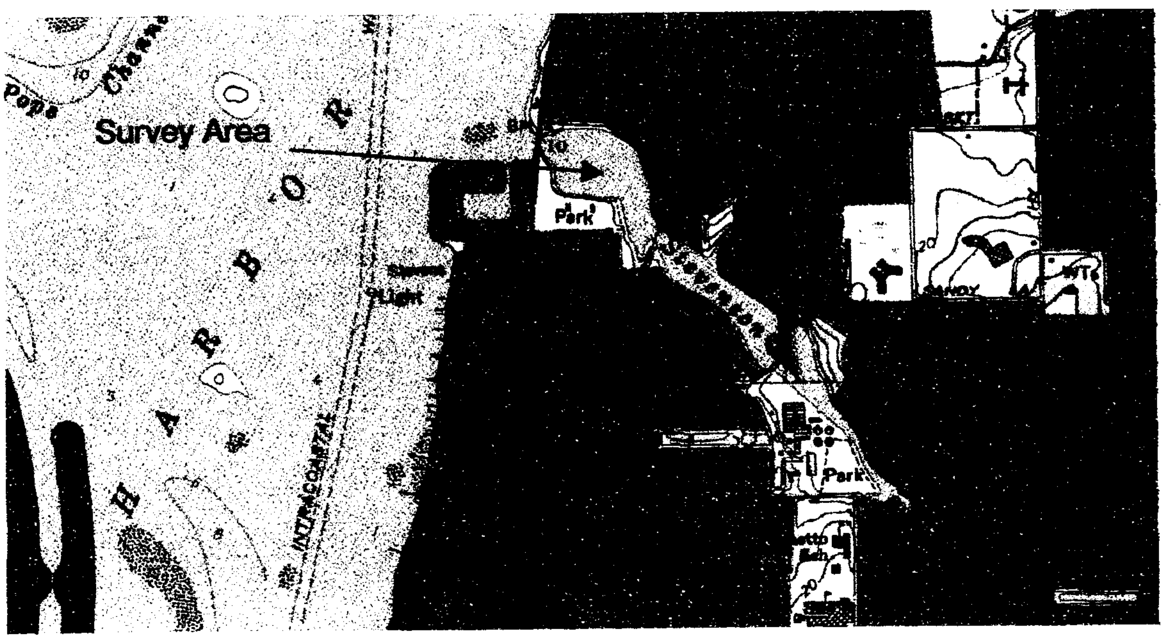


Figure 1. Project Location Map - U.S.G.S. Clearwater

Historic Background

Prehistoric Period

According to recent archaeological estimates, man has inhabited Florida for at least 12,000 years. The first inhabitants, known as Paleo-Indian were nomadic hunter-gatherers living in an environment much drier and cooler than today. Ocean levels, due to the prevalence of glaciers, were approximately 350 feet below current sea levels, resulting in subsequently low water tables as well as a considerably wider savannah-like Florida peninsula (Gannon 1996:2). Most of the temporary settlement sites of these early inhabitants, less than a hundred of which have been discovered, have generally been found in association with fresh water surface areas and cenotes (Bland and Johnston 1998:8). Such areas provided Paleo-Indian not only with a necessary supply of water, but also an abundance of fresh-water fish, turtles, and the various game animals that such areas attracted. The remains of large prehistoric animals, such as mammoths, have often been found in association with Paleoindian projectile points near several fresh water springs and rivers (Borremans 1990: 6). These sites have in fact yielded a variety of these stone projectile points including Suwannee, Clovis, and Simpson types. Atlatls, bone pins, stone knives, and scrapers were also found in these areas (Bland and Johnston 1998: 8; Milanich 1995: 48-59). Of the Paleoindian sites discovered, very few have been found on the Atlantic Coast. According to archaeologists, this does not necessarily mean that this area of coastal Florida was uninhabited at the time. It is likely, rather, that the presence of early man exists in underwater contexts on the continental shelf, given the significant rise in sea level since Paleoindian times (Borremans 1990: 3-9).

Evidence of this change in sea level, as well as changes in climate, tool technologies, and subsistence patterns all mark the transition into the period known as the Archaic. Archaeologists have separated the Archaic Period, spanning from 7500 B.C. to 500 B.C., into three distinct sections of time known as Early, Middle, and Late periods.

By 7500 B.C., the climate was becoming increasingly warmer and wet due to large scale glacial melting (Milanich 1995: 3). Pleistocene mega-fauna, highly visible during the Paleoindian period, was virtually extinct by early Archaic times. Many archaeologists attribute this to the inability of these prehistoric animals to adapt to the changing environment, while others say that over-hunting of these prehistoric animals could have contributed to their extinction (Milanich 1995: 3-6). Early Archaic Indians, therefore, had to rely more heavily on other means of subsistence. Although still hunters, mostly of smaller game, such as deer or raccoon, they were also avid fishermen and collectors of shellfish and wild plants. Marks made by projectile points have been detected on the bones of various animal remains, while the points themselves have also been located in association with such remains (Bland and Johnston 1998:9). It is the increased specialization of these and other tools that mark the transition into the early Archaic. Tool assemblages have been found in abundance at almost all of the known Archaic sites, most of which include lithic choppers, projectile points, knives, and scrapers. Early Archaic groups also utilized the bones of small game animals to make various bone tools, including, fish hooks and bone pins (Russo 1990). This high number of a wide assemblage of tools combined with the large number of sites found, numbering 1500 throughout Florida, has indicated to archaeologists that there was a significant and continuous population increase during the Archaic period (Russo 1990). Excavation of peat deposits at the Windover Pond site located in Brevard County revealed remarkably well-preserved human remains dating to the early Archaic, around 5000 to 6000 B.C., indicating that these early Indians performed ceremonial burial practices (Gannon 1996).

Populations continued to increase during the Middle Archaic with the emergence of vast areas of wetlands. Archaeologists delineate the transition based on the appearance of a variety of new and more specialized tools, including the Newnan point, found at several different sites. An increasingly lush landscape allowed inhabitants to become more sedentary than their semi-nomadic ancestors. Most of Florida likely provided an abundance of plants as well as a variety of fish and shellfish, especially at sites on the Atlantic coast (Milanich 1995: 4). Only recently have archaeologists excavated these marine sites, and since have determined that many semi-permanent sites existed along the Atlantic coastal strand during the Middle Archaic. Habitation sites include caves, and various surface water locales, which were much more abundant due to the continuous rise in sea level. The high quantities of artifacts and the evidence of frequent burials, indicates increased sedentism as well as population growth (Bland and Johnston 1998:10).

Around 3,000 B.C. climatic conditions began to stabilize, resulting in an environment very similar to Florida today. Archaeological evidence suggests that Late Archaic populations continued to grow. Increasingly sedentary inhabitants began to form villages, the remains of which have been found throughout the state, especially in coastal regions. Large shell middens found associated with these villages as well as the remains of mollusks and snails and bones of small animals indicate that these early Indians were exploiting all areas of their habitat. Although a large number of these sites have been located and excavated, rising sea levels have likely washed over many of these ancient villages, burying them beneath the sea floor (Milanich 1995:21). These villagers were also responsible for the crafting of the first known fired clay pottery to appear in Florida's archaeological record. This ceramic style is known as Orange style pottery. For this, many archaeologists have named the period following this development in 2000 B.C., the Orange Period (Milanich and Fairbanks 1980: 152). Regional variations of pottery had developed by 500 B.C. marking the end of the Late Archaic.

When describing the Post-Archaic Period, commonly known as the Woodland Period, archaeologists generally use regional descriptions to classify culture areas and traditions. A particularly well-developed area, dating to the beginning of this Transitional Period around 500 B.C., is the St. Johns culture area found in northeastern Florida and the Central Lake District (Chance and Smith 1992: 11). It is here that archaeologists discovered the earliest evidence of a significant change in ceramic manufacture, which predominates throughout Florida in later years. This coiled style of pottery, some elaborately decorated and some entirely undecorated as well as complex tool assemblages, formed mostly from chert have been found in the St Johns drainage area. During the St. Johns I sub-period, the first of six, pottery was stamped probably for identification purposes (Chance and Smith 1992: 11). In addition, in this region, some 600 years later, in 100 A.D., elaborate decorations covered the ceramic vessels and construction of the first burial mounds had begun. Later, around 1000 A.D., larger similarly constructed mounds were built, but were used, not as burial sites, but rather as ceremonial sites, or temples. By this time, corn was being cultivated, along with a variety of other crops, including gourds. The majority of village sites found are dated to the period following the first evidence of corn production in 750 AD (Milanich 1995: 6).

The nearby Deptford culture as well as Swift Creek cultures, located northwest of the St. Johns area, and the Weeden Island culture to the northeast are thought to have been closely connected with the St. Johns culture. Many ceramic styles distinct to these regions have been found associated with St. Johns burial mounds.

In wooded areas of Western Florida, the Alachua culture flourished. Relatively expansive Alachua villages were constructed near freshwater sources on high ground. Very little is known about the ceremonial tradition of these people. Although two burial mounds as well as a variety of decorated, corded pottery have been found, excavations have yielded very little that could help to characterize the ritual life of the Alachua people (Milanich and Fairbanks 1980: 169-180; Chance and Smith 1992: 13). Numerous other culture areas, including the Belle Glade tradition in Southern Florida, existed during the Woodland period. The Glades tradition as well as others continued for generations into the beginning of the Spanish Period (Milanich and Fairbanks 1980: 180-187).

Historic Period

The first Spanish known explorers to have arrived in Florida were led by Juan Ponce de Leon in 1513. This expedition began what is historically called the First Spanish period, a period now known to have encompassed almost two centuries of Spanish exploitation and settlement of a land and its people.

When Europeans arrived in Florida in the mid-16th century, approximately 100,000 Indians are thought to have inhabited the region. There were roughly eight distinct groups of Native Americans living in various regions of Florida. They are classified by the particular cultural characteristics that differentiate them including the region they inhabited, patterns of subsistence and other unique cultural patterns.

The Timucuan Indians occupied parts of Southeastern Georgia and part of the northern region of the Florida peninsula, including the central lake district in north-central Florida. The entire population probably exceeded 40,000 at the time of European contact. They were largely fishermen and gatherers, but also hunted small game animals. Much of what they collected and/or killed has been identified through the evidence of residues left on ceramic pots. The Timucuans were also experienced agriculturalists, cultivating many varieties of maize, beans, and squash (Milanich and Fairbanks 1980:218-219, 227).

The Apalachee Indians inhabited the area surrounding the Aucilla River west to the Apalachicola River valley on Florida's panhandle. They were also hunters and farmers who supplemented their diet by fishing and collecting various plants, fruits, and other food sources from the native vegetation. According to early Spanish accounts, they would later prove to be of the most violent of native groups. Before European settlement, they are thought to have numbered around 25,000 (Milanich and Fairbanks 1980:228, 230; Gannon 1996: 23).

The Tocobaga lived in the area of present-day Pasco and Sarasota Counties. They planted maize, pumpkins, beans, and collected large quantities of shellfish. Mounds were also constructed in the Tocobaga region, built to serve as either temples or burial sites. Their population is estimated to have been between 5,000 and 8,000 when the first explorers arrived in the early 16th century (Milanich and Fairbanks 1980:204-205, 230-232).

The Tequesta, descendants of the previous Glades culture groups of the Post-Archaic Period, inhabited the coastal zone from Pompano Beach to Cape Sable including present-day Broward County. Their main village was located on the Miami River in Dade County. According to the accounts of Ponce de Leon, they were heavily dependent on marine resources including sea mammals such as porpoise and manatee. He describes in detail their uncanny ability to rope these creatures rodeo-style from their handcrafted wooden canoes (Milanich and Fairbanks 1980: 234). The Tequesta were also hunters of small animals and gatherers of a variety of plants. For centuries, they stayed politically and socially connected mostly with each other but also with other allied tribes with canoe trails. These trails meandered through interior wetland areas. The Tequesta set up campsites at appropriate locations, and would periodically stop to exploit the area's resources. Fortunately, they left evidence in the form of middens at these sites, some of which include burials. Much of what archaeologists know of this group has been preserved at these sites and found through various excavations. In the early 16th century, they likely numbered between 5,000 and 7,500 (Bland and Johnston 1998:13; Milanich and Fairbanks 1980: 234-235, 237).

Among the smallest groups of natives were the Keys Indians who are thought to have reached a population of 500 to 1,000 at the time of Spanish contact. It is estimated that they arrived in the Florida Keys around 800 AD. They were similar in culture to the Tequesta, and their diet was largely dependent on marine food sources, including whale. Canoes, some equipped with sails, were extensively used for transportation and trade (Milanich and Fairbanks 1980:232, 237-238).

Two other small groups living along the Atlantic Coast were the Ais and Jeaga. The Ais were a fierce people living in small communities along the Indian River and upper St. Johns below the region occupied by the Timucuans. The Jeaga were located south of the Ais along coastal lagoons. Both cultures were hunter-gatherers relying heavily on marine resources such as fish, coco plums, sea grapes, and palm berries. They manufactured various types of canoes, including a type of catamaran made by lashing two canoes together. The total population of the two tribes was about 2,000 persons (Bland and Johnston 1998:13; Milanich and Fairbanks 1980:238-239).

The largest and most powerful of the Florida tribes were the Calusa. They inhabited the coastal strand of southwest Florida from Charlotte Harbor south to Cape Sable. Mound building was a common characteristic of the Calusa culture. Calos, their main city, was located on Mound Key in Estero Bay near Ft. Myers Beach. The chief resided here with his family and held a certain amount of power over not only his own people, but neighboring tribes as well. Intermarriage especially in relation to the Tequesta served to increase the political influence of the tribe. The Calusa, like other native groups, were heavily dependent on marine resources as well as the large variety of small game and plants available to them. Their population is thought to have reached 20,000 before Spanish contact (Milanich and Fairbanks 1980:241-246; Bland and Johnston 1998:13).

Despite their high numbers as well as a keen ability to exploit the environment, these native populations declined rapidly after Spanish contact. They had no defense against the diseases transmitted by European explorers. Consequently, numbers decreased from 100,000 to only a few thousand by the early-18th century (Milanich and Fairbanks 1980:250).

Spanish Florida

Early Spanish and European explorers were concerned, not with the fate of natives, but rather with their search for wealth in the form of gold, precious minerals, slaves, habitable, arable land, or simply of the adventure that came with discovery and exploration. Although Ponce de Leon is known as the founder of Florida and was the first to record his travels, it is likely that other European explorers preceded him. Maps published in 1502 and 1511 show land that appears to represent the Florida peninsula. These explorers were probably victims of the Indian hostility that Ponce de Leon would later record, however were not fortunate enough to return to their homeland to recount such experiences.

Ponce de Leon and his crew landed near today's Palm Beach. Finding the area deserted, they proceeded southward toward Lake Worth Inlet. Local natives, probably the Jeaga or the Ais, attacked the exploration party as they approached the Indians' territory (Milanich and Fairbanks 1980:239). Despite casualties, He and his followers continued into Jupiter Inlet only to receive a similar reception by an even larger group of Indians. Ponce de Leon continued to explore Florida's coast, rounded the Keys, and pushed along the West Coast to San Carlos Bay. At Sanibel, the Calusa attacked the fleet and ultimately drove Ponce de Leon and his men back to Puerto Rico (Gannon 1996:20).

The expeditious explorer was not defeated. Juan Ponce, determined to succeed in conquering the hostile land, returned to Florida in 1521 with the king's permission to establish an official colony, complete with farms and missions and modern Spanish structures. Local Indians responded with violence and did their best to destroy every crop and every structure as soon as it appeared on the landscape. After receiving what would prove to be a fatal arrow wound from the last of many Indian attacks, Ponce de Leon retreated with his settlers to Cuba, where he died soon after (Gannon 1996:21).

This was one of the first of many fruitless attempts to settle the hostile region. However, from the time Ponce de Leon set foot on Florida's coast, until it's cession to England in 1763, Spanish politics and institutions succeeded in exploiting and ultimately eliminating entire populations of native societies.

Hearing of Ponce de Leon's discovery and the rumored "golden cities" of the New World, Panfilo de Narvaez, seeking gold and a settlement site, landed at Tampa Bay in 1528. Three hundred men joined Narvaez; however, tragically, only four would return to Spain alive. Severe weather en route to the New World as well as the brutal reception of the Indians once they arrived in Florida doomed this ambitious trip. Most of what we know of the region and its inhabitants during this time is taken from the accounts one of the four survivors, Nunez Cabeza de Vaca who traveled and lived with the natives for fourteen years (Gannon 1996: 23).

Another expeditious adventurer, Hernando de Soto, was determined to conquer the notoriously hostile region. In 1539, he landed in Florida, and traveled northward into the North Carolina Mountains before turning west and south to discover the Mississippi River (Dunn 1972:13). He planned to discover the precious metals and stones that Narvaez and his men had failed to find. He used precautions not considered by Narvaez, employing translators and procuring accessible, well-provisioned ships for he and his men. However, the hostility and trickery of the Apalachee of Northern Florida and Southern Georgia took many lives, and De Soto and his men eventually found themselves wandering northward in an aimless search of the riches and resources that they would never find. De Soto died of an unknown disease near what is now the

Mississippi River in 1542. Those remaining fled toward Havana, leaving no sign of settlement. All that was left in the wake of this expedition were the bodies of De Soto and many of his men (Gannon 1996: 32).

Spain, still determined to set up settlement sites in Florida, next commissioned Tristan de Luna y Arellano to establish a settlement and garrison near today's Pensacola Bay. Soon after Arellano's arrival, a hurricane devastated their fleet, killing several and destroying all provisions. Although many of the men survived for some time off the land, mutiny and near starvation persisted and quickly ended the mission (Milanich and Fairbanks 1980:213-214; Gannon 1996:23, 28, 32). Spanish exploration remained at a standstill until the French became interested in settling the region over a decade later.

In France, a group of Protestants began to focus on exploration of the Atlantic Coast. In 1562, Frenchman, Jean Ribaut (or RibauLt) arrived North of Florida, near the Carolinas. After discovering what is now Port Royal harbor in present-day South Carolina, he led the construction of a colony there, known as Charlesfort (Smith et. al 1997:9). However, this was poorly received in Europe, and after his arrest in England, construction, and settlement ended (Gannon 1996:40-41). In 1564, a second group under Rene de Laudonniere returned to the Atlantic Coast, landing south of Port Royal. He and his men constructed Fort Caroline at the mouth of the St. Johns River. The Saturiwa Timucuans, who met the settlers upon arrival, proved, at first, to be peaceful and their agricultural knowledge helpful. However, supplies began to run low and animosity between the Indians and the settlers arose. In addition, the settlers themselves were threatening mutiny. Vessels fleeing from the fort called attention to the French settlement and were soon targeted by the Spanish. The king of New France called on Ribaut to again lead a garrison into Florida to re-supply Fort Caroline and to reinforce the settlement. France's effort to save and further establish the fort was what finally prompted action by the Spanish Crown (Gannon 1996:41). Hearing of Ribaut's mission, the King of Spain sent Pedro Menendez de Aviles with a fleet of Spanish vessels loaded with men and provisions to expel the French from Florida's Coast. Menendez arrived in August 1565 near St. Augustine, founding the area as a Spanish base. With a force of more than a thousand men, it wasn't long before Menendez and his men captured Fort Caroline. In the meantime, Ribaut's fleet was caught in a storm and driven ashore south of St. Augustine. Most of the survivors of Ribaut's fleet were tricked into capture and later slaughtered by Menendez and his men. This event deterred France's interest in Florida for some time (Gannon 1996:41-46; Milanich 1995:144-150).

In addition to the garrison at St. Augustine, Menendez also attempted to set up posts equipped with troops and missionaries at various other stations along the coast. The purpose of the outposts was to aid shipwrecked sailors and to Christianize and "civilize" the natives (Gannon 1996:67-69). Outposts were established among the Ais (southeast Florida coast), Tequesta (Miami), Calusa

(Ft.Myers), and Tocobaga (Tampa Bay). These Jesuit missions, however, proved tragically unsuccessful. Local natives slaughtered numerous Jesuit missionaries, successfully scaring off remaining settlers and causing them to flee from the outposts, ultimately leaving them completely abandoned by 1569 (Milanich 1980:214-215; Bland and Johnston 1998:13; Gannon 1996:50).

However, soon after the retreat of the Jesuits, Fransiscan friars took their place. They set up missions and associated settlement sites at more than 80 locations. These missions existed for over a century until 1702 (Gannon 1996: 50).

Missionaries not only succeeded in converting a large number of Indians, but also, through the introduction and subsequent spread of diseases such as smallpox, measles, typhoid and yellow fever almost completely wiped out several indigenous populations. A 1689 survey estimated that the Timucuan speaking population had declined by 98 percent since the arrival of Columbus in 1492 (Milanich 1995:216-218; Gannon 1996:78-99). After 1680, due to this drastic population reduction, as well as the resulting overall weakening of indigenous groups, Indians were more easily captured, and therefore were sought out by many Europeans as slaves. Indians were often used to fight in battle. This was especially true during Queen Anne's War. After the English had claimed and established themselves in the Carolinas, they compiled troops of captured Indians as well as Englishmen and in 1702 headed toward Florida intending to overtake St. Augustine.

The Spanish, however, managed to defeat the English. Despite this defeat, British troops succeeded in devastating settlement sites and forts previously established by the Spanish (Gannon 1996:113-115; Milanich 1995:222-224, 228).

Tensions continued to rise between Spanish, French, and English colonists. In 1740, during the War of Jenkins Ear, James Oglethorpe, Georgia's governor, led another attack on St. Augustine (Gannon 1996:111). The British were again repelled, but did succeed in weakening Spanish control of Florida. Many settlers and natives alike were lost in battle and acres of crops destroyed. According to a map produced in 1757, the Atlantic coast south of St. Augustine was almost completely vacant, with the exception of groups of fish rancheros that had established themselves as far north as Jupiter Inlet (Milanich 1995:230).

In 1754 with tensions over colonial issues and territory claims at new heights, the French and Indian War broke out. Spain, aware of her weakening position as ruler of Florida and the dominance of English rule, fatefully decided to join forces with France, in hopes of holding on to Florida. However, the English defeated the French at every turn. Still unable to take St. Augustine, they planned an attack on Havana, and easily overtook the port. The Spanish, then, had no choice but to hand Florida to the English, in order to regain the important Cuban port. Many remaining Indians were taken to Cuba when Spanish troops evacuated (Gannon 1996:115; Bland and Johnston 1998:14).

British Florida

The British government ruled in Florida from 1763 until 1783, creating the colonies of east and west Florida divided by the Apalachicola River, with St. Augustine as its Eastern capital and Pensacola in the West (Gannon 1993:18). Great Britain hoped to turn Florida into an economic power through the development of large plantations meant for commercial production of agriculture. Products such as hides, indigo, sugar, timber, citrus, rice proved to be successful exports while slaves became the chief import (Smith et. al 1997: 10).

The British also focused on attracting European settlers to the new territory through land improvements including the development of roads and town construction. British surveyors were sent to Florida to develop the first road (called King's Road when construction was completed) and to establish land grants. The project was successful and Florida's population steadily increased. With the increase in population came an increase in water travel, mostly by cargo ships. Vessels used during this time were mostly "frigates, brigs, schooners, and sloops," as well as a few navy vessels which frequented the ports of Pensacola and St. Augustine (Smith et. al 1997:10).

Trouble came when American colonists began speaking out against European rule, which ultimately led to the Colonial Revolution in 1776. During the Revolutionary War, Florida's ports became increasingly important to the British settlers and their small army. British ships brought military supplies, troops, and provisions. However, as the war continued, pressure increased on all sides, with the colonial army in the North and Spanish settlers and military forces in Mississippi. Near the end of the war, Great Britain's hold on Florida was weakening and by 1783, Great Britain finally gave in and ceded Florida back to Spain in exchange for the Bahamas (Smith et. al 1997:10, 11).

Spanish Reoccupation

Spain formally regained control of Florida in 1784. The province remained divided by the Apalachicola River into east and west colonies with their same respective capitals. Florida land was offered in the form of grants to encourage U.S. citizens to immigrate to the Spanish colony. Many U.S. southerners obliged and set up homesteads throughout Florida. Farming remained as the economic base with rice, cattle, and timber being chief exports. Cotton also became an important economic source in the early 1800s (Gannon 1996:160-161). Fernandina, Jacksonville, Tampa, St. Marks, St. Joe, and Apalachicola became important ports used for exporting and importing these goods (Smith et. al 1997:10).

Although Spain was experiencing new success in this once desolate region, largely due to the advancements of the British, the Spanish hold on Florida was not entirely secure. The United States proved to be a serious threat to the Spanish colonies. In 1793, a military force was sent from Georgia into Florida in order to "free" the province from monarchal rule. They seized a fort near Jacksonville, planning to represent the citizens of Florida who wished to join the United States and claim Florida's independence, but were soon after expelled by Spanish forces (Gannon 1996:162).

During the war of 1812, however, U.S. forces were eventually successful in their endeavors to take over the colony. Georgian invaders arrived at Fernandina on Amelia Island, but were not well received. Southern Seminoles, as well as African-Americans who had been brought there by the British fought against the invaders along side the Spanish. However, U.S. forces proved unstoppable. They defied the orders of their own government, continuing to raid and burn entire forts and settlement sites. By the end of the war in 1819, Spain had no choice but to surrender Florida to the United States. By 1821, not one Spanish soldier remained (Gannon 1996:163-164).

Seminole Wars

The Seminole Indians were not native to Florida, but rather were descendants of the Creek Indians who immigrated to Florida from Georgia and other areas of the Southeast in the early 18th century. They eventually settled in various regions throughout Florida during the British occupation. Many Seminoles were of mixed races, some of Creek and African-American descent, others of Creek and Anglo descent (Covington 1993:5). After the American Revolution, tensions over property, runaway slaves, and cattle raiding increased between Georgia residents and the Seminoles (Mahon 1985:19). This tension began to result in violence, and residents finally succeeded in pushing the Seminoles farther south (Gannon 1996:191, Paige 1987:26).

The First Seminole War began in 1817 when American soldiers from Fort Scott in southern Georgia attacked Seminoles from the bank of the Flint River. Indian retaliatory strikes were met by troops led by Andrew Jackson, who went on to subdue the Seminoles just below the Georgia border (Gannon 1996:191-192). In 1823, the Treaty of Moultrie Creek forced the defeated Seminoles to reside on a reservation in central Florida (Bland and Johnston 1998:14; Paige 1987:26).

A large number of settlers migrated to Florida in the years following its cession to the U.S. These settlers tried to force the existing Indians off the land that they wished to claim as their own creating renewed tension and hostility. In 1835, the Second Seminole War began. The U.S. government sent a sizeable military force to fend off Seminole attacks; however, U.S. troops were unfamiliar with their guerrilla tactics and unable to overcome them. Such tactics helped to prolong the war, which lasted close to seven years.

On December 28, 1835, the Seminoles eliminated an entire company of troops under Major Francis Dade. Slowly though, mostly due to overwhelming numbers, U.S. troops began to defeat the Seminoles in various battle, and were eventually able to overcome them. General Jessup led his men in battle at Loxahatchee on January 24, 1838. His troops succeeded in defeating the Seminoles near Jupiter Inlet in the last significant battle of the Second Seminole War. War was declared officially over in 1842 (Paige 1987:33; Mahon 1985:234).

Although the Seminoles, most of which were either killed, or captured and removed from the area, no longer posed a threat to colonial settlement, much of the East Coast of Florida was deserted in the years after the war. Plantations near St. Augustine were ruined. The majority of white settlers had fled (Paige 1987:33). The U.S. government, in hopes of encouraging the settlers to return, passed the Armed Occupations Land Act (AOA) in 1842. This piece of legislation offered any man capable of "armed defense" a large piece of land located near the Peace River. The action proved to be successful (Gannon 1996: 217-218). During the next few years, the AOA attracted 6,000 such men and their families. With them, however, came yet a third uprising of the remaining Seminoles. This uprising, called The Third Seminole War, proved to be less of a threat to the population. It ended two years after it began in 1857 (Bland and Johnston 1998:15; Mahon 1985:321).

A New State

In 1845, Florida became the nation's 27th state. The antebellum years, due in part to the passing of the AOA as well as the Swamps and Overflowed Lands Act in 1850, were marked by rapid growth (Bland and Johnson 1998:15). The population, in fact, doubled over a period of fifteen years. By 1860, Florida's population was 140,000, up from 70,000 in 1845. Forty percent of these new inhabitants were imported slaves. Slave trade was vital to Florida's largely Agricultural economy. Cotton, cattle, and logging were Florida's three largest industries up until and even beyond the time of the Civil War (Gannon 1993:40; Gannon 1996:222, 226).

Being that most of Florida's inhabitants were Southern U.S. immigrants, Florida voters chose to side with the Southern Confederacy when the Civil War began in 1861. Shortly thereafter, in 1862 Federal forces seized such coastal centers as Fernandina, Jacksonville, St. Augustine, Cedar Key, Tampa, and Apalachicola. As in other coastal regions of the confederacy, Union naval ships formed blockades on Florida's Coast in an effort to prevent Blockade Runners from delivering much needed supplies to troops and civilians alike (Gannon 1993:42). Many Blockade Runners were either destroyed or captured in the process. Those that succeeded, however, served to support the Confederate Army with provisions obtained at Florida ports as well as those they traded for, using "nearly every inlet in the state" in their clandestine runs (Derr 1989:303). Cotton, turpentine, and tobacco were smuggled to such destinations as Havana and the

British Bahamas to be exchanged for wartime necessities (Derr 1989:303). Other than these port related activities, very few battles of any significance occurred in Florida during the Civil War.

After the Civil War ended, Florida was able to recover relatively quickly given their minimal involvement in wartime battles. Florida ports continued to be regionally important to trade and exchange markets, bringing investors, technological specialists, and developers from all over the world. Over the next few decades, with the help of these progressive thinkers, Florida gradually became one of the most popular, most technologically advanced states in the South. Between 1860 and 1880 the population increased by 90 percent (Gannon 1993:52-53). Attracting hundreds of investors and immigrants alike, this influx of people eventually led to large-scale development of both coastal and inland areas. Three key industrialists who contributed to this development were William D. Chipley, Henry B. Plant, and Henry M. Flagler. Their most notable achievement was the development of the railroad system, which by 1896, stretched across 2,560 miles of Florida, from coast to coast. This system was largely responsible for Florida's commercial and agricultural economic boom of the late-19th century (Gannon 1993:53, 60). Large cruise ships began to frequent Florida's ports, which helped to further develop Florida's tourist industry. The citrus industry, as well as cattle ranching and logging also grew rapidly (Gannon 1993:64; Derr 1989:63). By 1900 the States population had again almost doubled, numbering 520,000 (Gannon 1993:63,65). The arrival of the automobile and airplane in the 1920s stimulated a tourist industry making it "a mass phenomenon unbounded by distance or time..." (Derr 1989: 175). This trend in population growth as well as tourism would continue with varying intensity throughout the 20th century.

Florida Maritime History

Throughout Florida history, maritime activity has played a vital role in the area's development. Spanish settlements such as St. Augustine and Pensacola became important ports for trade with Havana and Mexico. During the British period, plantations in Florida produced rice, indigo, sugar, and citrus, all of which were popular trade goods, and therefore heavily exported. Almost all imported goods intended for any of the British colonies, including, for the first time in history, slave laborers, were shipped from England to directly to Florida's Eastern ports. Western ports were used mostly for exchange with the Caribbean sugar islands. Illegal trade with Spanish Louisiana and Mexico also continued via the port at Pensacola. When the Spanish regained control in the early 18th century, timber and turpentine also became popular exports and remained in high demand among Europeans until years after Florida was granted statehood (Smith et. al 1997:21).

Once the United States gained control of Florida, many changes occurred in Florida's maritime activity. Jacksonville replaced St. Augustine as the State's most important port. Ports along the west coast such as St. Marks, St. Joseph, and Apalachicola became major centers for cotton export. Tampa also developed into a strong port, becoming especially important during the Seminole Wars. Improved transportation between ports became a necessity with the increase in commercial trade. As a result, railroads sprang up along the coast, connecting ports to the interior (Smith et. al 1997:21).

During the Civil War, Florida's ports took on a new role. Ports at Cedar Key, Tampa, St. Marks, St. Augustine and Fernandina were important to blockade-runners. These ships exchanged cotton, tobacco, and turpentine for medical supplies, weapons, ammunition, and other goods needed in the South (Smith et. al 1997:21).

During the period of expansion and reconstruction following the Civil War, Florida's ports and waterways were crowded with ships filled with cargo as well as tourists eager to explore this booming area. Tampa, now connected to both Jacksonville and St. Augustine via railway, had developed into a leading exporter of phosphate by the 1880s. Also important during this period was the invention of ice machinery, which allowed for large scale shipping of seafood (Smith et. al 1997:12).

Types of Maritime Activity

Wrecking, smuggling, fishing, sponging, as well as a variety of recreational activities have all played an integral role in Florida's historical development.

Wrecking

Wrecking or the "salvaging of ship's cargos" first became popular among the Calusa Indians (Smith et. al 1997:16). After the Calusa were sent to Havana by Great Britain in 1763, Bahaman merchants took their place on the salvage market, settling in the Keys near the shallow reefs that sank numerous cargo ships (Smith et. al 1997:16).

Soon after the US acquired Florida, Key West was established as an important port for trade between Mexico, the Caribbean, and the U.S. However, as Bahamans had already discovered, the dangerous reefs surrounding the Florida Keys were difficult for ships to avoid, causing hundreds to be lost or destroyed. Wrecking, therefore, gained popularity and the lucrative practice became common along Florida's coastline. In 1828, the U.S. government instituted certain regulations restricting such looting practices. Key West was declared by the superior court the supreme authority over all ships salvaged between Port Charlotte and the Indian River. Within twenty years, the Florida government established a District Court to regulate the activity of wrecking with strict legal limits (Smith et. al 1997:16).

Vessels used by looters to confiscate goods found in these wrecked ships were "fast, shallow-draft sloops and schooners, ranging from 10 to 100 tons in burden" (Smith et. al 1997:17). Although now government regulated, the wrecking industry flourished into the 1850s. By the late 50s, coastal surveys around Florida reefs as well as lighthouse construction made Florida's coast safer and easier to navigate, and as a result, the wrecking industry began to die out in the late 50s. Finally, in 1921, Florida closed the District Court register, ending a century of regulated wrecking (Smith et. al 1997:17).

Smuggling

Because of Florida's proximity to countries such as Cuba and Jamaica, the smuggling of illegal goods has always played a role in the area's maritime history.

Soon after the U.S. instituted the National Prohibition Act of 1919 the infamous "Rum Row", using "old schooners, tramp steamers, former gunboats, and onetime luxury yachts flying many flags" transported liquor from various islands on the outskirts of Florida's coast (Smith et. al 1997:17). Mostly Cuban and Jamaican, these smugglers would let Florida merchants come to them. Boats known as the "sunset fleet", left Florida ports in the middle of the night to rendezvous with vessels offshore and carry the smuggled goods back to shore. Cargo trucks would then secretly haul the products inland to bootleggers in metropolitan areas (Smith et. al 1997:17).

In 1924 after many unsuccessful attempts to put a stop to the sunset fleet, picket boats "designed for stealth and speed" were used by the Coast Guard to target illegal trade. Eventually, the Prohibition Act was repealed, and this clandestine liquor smuggling off the coast of Florida came to an end (Smith et. al 1997:17).

Drug smugglers later took the place of these notorious rumrunners. In the 1970s and 80s, drugs such as cocaine from Colombia and marijuana from Jamaica were smuggled into the area in small nondescript boats. Finally, in 1982, State and Federal governments joined forces hoping to put a stop to narcotic transport. High-speed cutters and offshore racing boats were supplied to track down drug smugglers. The Federal government would eventually spend millions of dollars and imprison hundreds in effort to diminish the drug industry. The industry itself, though, has been largely unaffected, and still flourishes in Florida today (Smith et. al 1997:17).

Fishing

Fishing was a means of survival for the first Floridians. In most cases, marine life was the primary food source for coastal inhabitants. During the Spanish and British occupation, Europeans were less interested in marine resources. Indians and Bahamans though, continued to fish off the coast of Florida, often selling their catches at small markets locally or in Havana, where dried fish was a commodity (Smith et. al 1997:20).

Fishing became important economically with the establishment of the railway system in the late 19th century. Markets along the coast could now supply fish to the inland areas via railroads. Large schooners, (50 to 60 ton) called smacks, were the primary vessels used at sea. Smaller vessels (5 to 20 ton) known as chings were also used along the coast, especially around the Tampa area (Smith et. al 1997:20).

The invention of ice machinery allowed Florida's fishing industry to explode. Red Snapper was transported in railroad cars by the hundreds from Pensacola to New Orleans, while mullet became a popular export at Tampa Bay and Charlotte Harbor. Oysters and sponges were also in high demand throughout the area. At the turn of the century, shrimping began to develop along the east coast, and today comprises 40% of the fishing industry's sales (Smith et. al 1997:20).

Today, the majority of commercial fishing is focused on the west coast near Tampa and Apalachicola Bays. Oysters, scallops, finfish, blue crab, grouper, and red snapper are among the most important exports (Smith et. al 1997:20).

Sponging

Before introduction to Florida's Pinellas region, Greeks sponged almost exclusively in the Aegean Sea. The sponge market was first introduced to Florida in 1849 in Key West. During the next twenty-five years, other sponging sites were discovered, including the area north of St. Petersburg to St. Marks (Fernald and Purdum 1992:109).

After depleting their own resources, a large number of Greeks immigrated to Florida. These immigrants helped to revolutionize the industry in Florida by using vessels equipped with air pumps and hoses that supported divers equipped with "copper-helmeted diving suits allowing them to sponge in deeper waters" (Fernald and Purdum 1992:109).

Sponging, concentrated in Pinellas County, eventually became a multi-million dollar industry. The industry flourished well into the middle of the 20th century, only to end with the invention of synthetic sponges (Fernald and Purdum 1992:109).

Recreation

With the increase in air and railway travel, shipping is no longer considered Florida's primary source of importing and exporting. Recreational activities now characterize Florida's waterways. The majority of boats cruising the coast today are pleasure boats such as speedboats, large yachts, windsurfing boards, and jet skis (Smith et. al 1997:14).

Florida's temperate climate and its coastal location have attracted settlers and tourists alike for decades. In the late 1800s, recreational hunting and fishing became popular. Men traveled by steamboat along Florida's inland waterways to find hidden recreational sites. With the growth of luxury hotels, as well as large-scale development and expansion, beginning in the early 20th century, activities such as yachting, fine dining, touring, and adventure sports became popular (Smith et. al 1997:19).

With "1,200 miles of coastline, 7,700 lakes over ten acres in size, nearly 300 springs, and 4,500 islands of at least ten acres", Florida attracts millions of tourists each year. Many tourists charter fishing boats in search of the record size sailfish and marlin that are found on the Southeastern coast. Scuba divers and snorkelers flock to the reefs that surround the Florida Keys. Canoeing in streams and rivers, sailing and water-skiing across quiet lakes, and site seeing from pleasure boats along the coastline are also very popular activities (Smith et. al 1997:19).

Maritime Technology
By the turn of the 20th century, Florida's maritime industry was important to markets worldwide. However, dangerous weather patterns such as hurricanes, treacherous inlets, and poor navigation equipment were major liabilities to the industry. Ships and their cargo were lost every year to storms or because of poor navigation.

The development of the wireless telegraph in the late-19th century greatly improved communication from ship to shore and from ship to ship. Subsequently, many losses to various near shore hazards were avoided. In addition, radio broadcasts allowed ships to receive accurate weather conditions (Smith et. al 1997:14).

Shipbuilding also became more advanced. Steel was used, rather than iron to construct larger ships. This method was not only more cost efficient, but also proved to expedite the building process. Oil replaced coal as the ship's fuel source, providing a cleaner and more efficient supply of power (Smith et. al 1997:14). Technological advancements throughout the 20th century helped to improve Florida's maritime industry and to significantly reduce the number of ships and amount of cargo lost.

Modern Florida
Despite the development of air travel and its popularity in the shipping industry, cargo vessels continue to frequent Florida's ports, which are still considered the most "sophisticated and cost effective" ports in the world. Again, due to Florida's climate, as well as the abundance of deep-water ports, Florida is able to handle any and every type of shipping need throughout the year (Smith et. al 1997:23).

Florida's major ports today are some of the very same ports used by the Spanish and the British centuries ago. Pensacola in the panhandle, Tampa on the west coast, Port Manatee in Tampa Bay, Jacksonville in the upper east coast, and Palm Beach, Port Everglades and Miami along the lower east coast are all important shipping centers. Major exports include citrus fruits, vegetables, juice products, fish, lumber, paper products, clay, insecticides, poultry, sand, scrap metal, and tallow. Imported goods are steel, lumber, motor vehicles, machinery, marble, meat, olives, alcoholic beverages, and bananas. Florida's main chemical and mineral exports are phosphate and other fertilizers while primary imports are petroleum, coal, and cement (Smith et. al 1997:22-23).

Shipwrecks

Because of natural hazards such as hurricanes and reefs, a large number of vessels have been lost or wrecked off the coast of Florida.

Before the advent of modern technology, ship captains were at the mercy of nature. Without warning, storms would destroy entire fleets of ships. Hurricanes have been responsible for most of Florida's maritime disasters, and have in the past wiped out entire ports. Hurricanes occur most frequently in the months from June through November with the strongest storms occurring in September and October (Smith et. al 1997:30).

Dangerous reefs off the coast of Florida's Keys have also caused numerous shipwrecks. These reefs constitute over two hundred miles of submerged coral that are either exposed or covered by shallow water. With little knowledge of the area, many early explorers and traders fell victim to the strong currents that pulled them toward these reefs, and ultimately destroyed their vessels. Today, even with improved maps, technologies, and communication devices, many ships are wrecked on reefs (Smith et. al 1997:31).

Pinellas County

Hisorical Background

The first permanent white resident on the Pinellas peninsula was Odet Philippe who established a settlement at what is now Safety Harbor around 1836. He farmed and fished to provide for he and his family and has been credited as the first local person to grow citrus. Citrus would later become the area's leading agricultural export. Phillipe's daughter, Melanie, married Richard Booth and gave birth to a son, also named Odet, in 1852. Odet Booth is thought to have been the first white child to be born in Pinellas (Piper Archaeological Research, Inc. 1995:17; Arsenault 1988:39).

In 1842, Congress attempted to encourage settlement in South Florida through legislation of The Armed Occupation Act (AOA). The AOA offered 160 acres to any "head of family or single man over eighteen" that would cultivate five acres and agree to live on the property for at least five years. Still, few pioneers settled on the isolated peninsula until 1880. There were only 50 families inhabiting the area when Civil War was declared in 1861. Their livelihood depended mostly on farming and fishing (Piper Archaeological Research, Inc. 1995:17).

In his *History of Pinellas County, Florida*, W. L. Straub notes that early settlement spread slowly in a fan-like form. Settlers spread north and west of the site of Ozona, south and west of Indian Rocks, and to a point at what is now St. Petersburg (1929:12). A post office was first established in 1859 at Clearwater. Soon after, Dunedin developed as a trading post. Both communities, however, were still frontier settlements with few amenities. Cedar Key, 100 miles to the north served as the major supply center for the region. Coastal schooners and steamers from Cedar Key transported mail and supplies to Pinellas communities. Pinellas, being an important agricultural area, also supplied Cedar Key with various necessities, such as cotton, citrus, and vegetables (Piper Archaeological Research, Inc. 1995:17).

On January 10, 1861 at a convention in Tallahassee, Florida delegates voted to withdraw from the United States. Florida then joined the Confederacy and moves were taken to strengthen the state from Union attack. Confederate ships known as Blockade Runners snuck from Florida's coast across to Cuba to retrieve much needed supplies and provisions. Then, by way of Florida's guarded southwestern inlets, they would attempt to deliver the goods to confederate soldiers. Many of these ships managed to escape the blockades set up by the Federal government at strategic points along the Gulf Coast; however, many also perished (Covington 1957 Vol. I: 140-141).

The federal fleet kept a close watch on the activities around Tampa Bay. Naval stations were established on Mullet and Egmont Keys. From these points Union blockading vessels patrolled for Confederate blockade-runners and sent raiding parties out along the coast. Significant actions include the Federal bombardment of Confederate Fort Brooke on April 13, 1862, as well as the shelling of Tampa on June 30-31, 1862, March 27, 1863 and again on October 17, 1863. On October 20, 1863 the schooner, *Anne of Nassau* and a sloop (unnamed), carrying cotton, were captured by Union troops at Bayport. That same month, a landing party burned the cotton laden *Scottish Chief* and *Kate Dale* in the Hillsborough River. Another raiding party destroyed salt works on the shore of Old Tampa Bay. On May 6, 1864 Fort Brooke was captured and Tampa was pillaged soon thereafter. On July 11, 1864 Bayport was raided and supplies of cotton burned. Having devastated much of the region, the Federals turned their attention to the Fort Myers area further south (Covington 1957 Vol. I: 142-145).

Pinellas peninsula citizens were only indirectly affected by the war. In February 1862, Union sailors attacked Abel Miranda's home. Produce and food supplies were taken and the home, livestock, and citrus groves destroyed. Other residents, though, were mostly affected by inflation and a decline in imports, both of which plagued much of the South as the war dragged on (Covington, 1957 Vol. I: 143-144).

Despite the interruption of the Civil War, Pinellas peninsula grew slowly but steadily in the mid to late-19th century. Agriculture and livestock provided an economic foundation with cattle, cotton, and oranges as the main exports (Piper Archaeological Research, Inc. 1995:17-19). The famous Leonardi grapefruit was introduced to the area during this period; Abel Miranda became the leading cattleman, with more than 1,000 head; and commercial fishing became increasingly important, especially the Cuban mullet trade. By 1876, approximately twenty-five pioneers had settled in the area now known as St. Petersburg (Straub 1929:33).

The lack of efficient transportation stalled growth in the area. Because the interior of Pinellas was nothing more than rugged wilderness, Tampa, the Hillsborough county seat, was only accessible by boat. Settlers had to sail to Tampa just to retrieve their mail; therefore, most residents inhabited the area nearest St. Petersburg, which accessed the fastest route to Tampa (Straub 1929:38).

Although early roads did in fact exist, they were little more than rough trails, and did not venture inland. Even after Hillsborough County was established, modern road systems were not seen in Pinellas for another 30 years. Although the Old Tampa Road ran close to the eastern edge of the bay through bayside settlements, it bypassed Gulf Coast settlements. Therefore, waterways continued to provide the best transportation to Tampa from St. Petersburg, even until the late 1880s (Piper Archaeological Research, Inc. 1995:19). Pinellas Point residents continued to travel to Old Tampa by boat to access needed supplies or to attend schools, churches, and political or social functions, particularly after the war (Bethell 1962:88).

As in the rest of Florida, the development of railroad systems proved to be the key to Pinellas County's success (Covington 1957, Vol. I: 190). The arrival of the Orange Belt Railroad in 1887 signaled the beginning of prosperity and growth in Pinellas. Organized by Peter Demens, the railroad ran southwest from Sanford through central Florida and by mid-1888 continued to St. Petersburg. Financial support came from H.O. Armour, the Chicago meatpacker, and A.J. Drexel, the furniture manufacturer (Bethell 1962:8).

The construction of the Orange Belt railroad was the result of a deal made between Demens and John C. Williams, a wealthy Detroit merchant who wanted to develop property he owned in southern Pinellas County. In order to connect the rail line to the waterfront, Demens needed to obtain access to the surrounding property. Williams offered to donate a portion of his property to the railroad if Demens would complete the line to the coastal edge of the property and erect a wharf on Tampa Bay. Demens agreed, and eventually constructed a railroad pier half-a-mile long. This allowed steamers such as the *H. B. Plant*, the *Margaret* and other vessels to transfer cargo as well as passengers directly to the train (Piper Archaeological Research, Inc. 1995:22).

The region grew rapidly on the heels of the new railroad system. Numerous new communities sprang up along the rail line with St. Petersburg becoming the major city on the peninsula. Shortly after the introduction of the railroad, the population of the peninsula rapidly increased. The area's main attraction proved to be its temperate climate, and with the help of Dr. W.C. Van Bibber, of Baltimore, in 1885, the Pinellas peninsula became known as the healthiest spot on earth. Because of such publicity, tourists and potential residents alike poured into the region, prompting the development and construction of hotels, and other tourist-related industries and attractions. Henry Plant in Belle-Air opened the world's largest wood-frame structure, the Belleview Biltmore Hotel, in 1895. This hotel alone contributed greatly to tourism by attracting a class of wealthy industrialists and socialites who came to enjoy such amenities as one of the state's first golf courses (Piper Archaeological Research, Inc. 1995:22,24; Sanders 1983:27).

Farming, citrus, and fishing industries exploded with the advent of the railroad system. This new form of transportation allowed farmers to send crops to market in record time thereby reducing spoilage. Fishing became economically important to the area, both as an industry and as a sport. Tourists flocked to local beaches and waterways in pursuit of sheep-head, trout, snook, mackerel, and tarpon, while many new immigrants became involved in the fishing industry. Fish, oysters, clams, scallops, turtles, and shrimp were exported by the thousands to local and national markets (Covington 1957, Vol. I: 190-192).

The sponge industry also developed during the last decades of the nineteenth century at Tarpon Springs. In 1873 a group of Key West turtle fishermen discovered the sponge field, and soon other boats were arriving to harvest the sponges and return to Key West. As the industry became established the fishermen began to move, and by the turn of the 20th century, 35 of the 120 vessels collecting sponges were based in Tarpon Springs (Figure 2) (Piper Archaeological Research, Inc. 1995:24).

The Spanish-American War also added to the growth of Southwestern Florida and Pinellas County. In 1898, 33,000 troops were stationed at Tampa, which became a supply base and embarkation point for the army. Fort DeSoto, constructed at Mullet Key, served to protect central Florida from the Spanish navy. The soldiers stationed there and in surrounding communities would later help to advertise the region's advantages when they returned to their homes (Covington 1957 Vol. I: 200-201).

Because of the population growth stimulated by these influences, large capital investments in transport, communications, and utilities were needed by the turn of the century. Newcomers who came by the new railroad brought their wealth and a demand for such modern conveniences as electricity, telephones, automotive transportation, and modern utilities. Corporate change was also part of this restructuring. In 1902, Henry Plant's Sanford and St. Petersburg Railroad

Figure 2. Sponge Boat *Elizabeth M* (Ricthie 1953:263).

were absorbed by the Atlantic Coast Line railway system. A second railroad was added to the peninsula's transportation system in 1914, connecting Clearwater, Largo, and St. Petersburg with Tampa. Then called the Tampa and Gulf Coast Railroad, the line was later acquired by the Seaboard Airline Railroad Company. Eventually the railroad became the Seaboard Coastline Railroad (Piper Archaeological Research, Inc. 1995:28).

Within 20 years electricity, telephones, as well as automobiles were introduced to Pinellas Point. The most significant development of the first decade of the twentieth century in Pinellas was the invention of the automobile. Road construction quickly became of primary importance to the Pinellas peninsula. (Piper Archaeological Research, Inc. 1995:28)

According to historian Karl H. Grismer:

> "As a result of the lack of worthwhile improvements, the people of the lower end of the peninsula found it almost impossible to drive to Tampa, either with teams or automobiles. They had to follow a trail that zigzagged around swamps and swales and through the pinelands. In places the sand was deep; in other places wheels sank hub deep in mud. During the rainy season, the travel was often impossible for months at a time. In January 1907, a party of motorists left Tampa for St. Petersburg. They were three and one-half days on the road."
>
> (Grismer 1948:115)

Hillsborough County officials failed to address transportation needs and other public concerns of Pinellas residents, and dissatisfaction led to calls for secession. On January 1, 1912, the area of Pinellas peninsula officially became Pinellas County. Once Pinellas became a separate county, Clearwater – with some controversy – was established as the county seat. Communities within the new county were small and largely undeveloped. The incorporated communities included Tarpon Springs (1887), Clearwater (1891), St. Petersburg (1892), Dunedin (1899), Largo (1905), Gulfport (1910), Pass-a-Grille (1911), Pinellas Park (1913, and Safety Harbor (1917). Other areas were settled but not yet incorporated. These included: Oldsmar, Sutherland (Palm Harbor), Ozona, Crystal Beach-Wall Springs, Seminole-Oakhurst, Indian Rocks (on the mainland), Harbor Bluffs, and Anclote. The opening decades of the twentieth century saw rapid and steady growth in these areas (Piper Archaeological Research, Inc. 1995:30-32).

Once the new county was created, officials began to address its transportation problems. The county's first paved road system was completed in 1917. A bridge from Clearwater to Clearwater Beach was also finished that same year and in 1919 the first bridge to Pass-a-Grille was opened. The Pinellas County beach communities began to develop shortly thereafter (Piper Archaeological Research, Inc. 1995:33-34).

World War I only briefly slowed the pace of development in Pinellas. When the conflict ended in 1918, thousands of tourists and potential residents flocked to Florida lured by its desirable climate, undeveloped land, and the potential for investment. This was the start of a period of rapid real estate speculation and development. Expensive hotels and multi-million dollar developments popped up along the coast. This "boom" which peaked in 1925 attracted mostly the wealthy; however, people of moderate means also frequented the area. Construction projects included homes, offices, churches, and apartments as well as smaller hotels to accommodate the growing tourist industry (Piper Archaeological Research, Inc. 1995:42).

Transportation developments continued in effort to keep up with public demand. One of the most famous developments was the Gandy Bridge. Built by George S. Gandy and opened in 1924, the bridge shortened the travel distance between St Petersburg and Tampa from 43 to 19 miles, and was said to be the longest automobile toll bridge in the world. Also, in 1924 a ferry service to carry passengers and automobiles between the southern tip of Pinellas County and Manatee County began operations. In 1926, municipal bus service was inaugurated in St. Petersburg (Piper Archaeological Research, Inc. 1991:33; Piper Archaeological Research, Inc. 1995:47).

The completion of the Davis Causeway on June 28, 1934 connected Clearwater with Tampa. Captain Ben T. Davis constructed the bridge over a seven-year period. Both Davis and the Gandy Bridge provided easy access to the Gulf Beaches. The Davis Bridge was also a toll facility but during World War II, the Federal government purchased the bridges from Gandy and Davis and tolls were eliminated (Dunn 1972:22; Piper Archaeological Research, Inc. 1995:50).

The Florida land-boom ended in 1926 shaking the local economy. This was but a foreshadowing of the Great Depression, which would devastate the nation for years. In the 1930s the federal government attempted to spur local economies with an infusion of federal money for job programs and other county needs. These federal programs enabled the construction of a new water system, which reached to the county's coastal areas, making the property more valuable as well as more desirable. Also, the Treasure Island Causeway was built to link St. Petersburg with the city of Treasure Island (Piper Archaeological Research, Inc. 1995:51).

During the twenty years preceding 1940, Pinellas County residents witnessed important demographic and economic changes. In 1920, the county's population was evenly divided between urban and rural. Later, with the influx of tourists, which brought investors and developers by the hundreds, the county became increasingly more urban. St. Petersburg and Clearwater emerged as the major urban centers, but their percentage of the overall population has declined as other areas have developed. Tourism, which has fueled the economy since the early 1900's, rapidly increased in importance in the years before WWII. Citrus was the primary agricultural export; however, only 8 percent of the population was engaged in agriculture in 1930. In 1940 this had dropped to 6 percent and continued to decline as the county became increasingly urbanized (Piper Archaeological Research, Inc. 1995:52).

Pinellas County's economy was slowly recovering from the years of the Depression when World War II broke out in 1941. With the onset of war, the rate of growth decreased. Potential immigrants as well as some Pinellas County residents sought jobs in Northern and Midwestern industrial centers, away from the wartime dangers that loomed over coastal regions. The U.S. military eased the potential economic blow by establishing an Army Air Corps training center at

St. Petersburg. The city's hotels were soon filled to capacity and tent camps were created to house additional troops. One report indicates that over 119,000 military personnel passed through the training center during the war (Piper Archaeological Research, Inc. 1995:60).

Soon after the war ended in 1945, Pinellas experienced another burst in population and economic growth. Restrictions on travel were lifted and social security payments, wartime savings, and retirement pensions provided opportunities for vacations and investments. As a result, immigration resumed, stimulating another boom in the tourist and construction industry (Piper Archaeological Research, Inc. 1995:62).

As the population increased so did the demand for property. Developers in Pinellas County soon encountered a shortage of waterfront property and so began dredging sand to turn shallow shorelines into foundations suitable for building. During the 1950s many barrier islands increased in size. Approximately 4,800 acres, mostly in the vicinity of Boca Ciega and Clearwater Bays, were added to the county by 1970 (Piper Archaeological Research, Inc. 1995:63).

The post war land boom also affected the area's beaches from Pass-a-Grille to Indian Rocks. This growth had actually been increasing since 1927 when Johns Pass Bridge, Corey Causeway and the highway to Key West had been completed. Old locations received new names as municipalities were formed. Boca Ciega, Mitchell's Beach, Redington Beach, Sunset Beach, Madeira Beach, Bennett Beach, Belle Vista Beach, and Treasure Island are among the beaches that evolved as a result (Piper Archaeological Research, Inc. 1995:62-63).

The development of the Pinellas Peninsula closely paralleled the rest of Florida and to some extent the entire coastal region of the southeastern United States. Initial settlers and pioneers depended heavily on waterborne transportation for all their needs. Even after the development of early roads, most settlers preferred to travel and trade by boat and ships. Only the railroad and later the automobile brought significant changes to the way of life of early Pinellas County inhabitants. The coming of the railroad marks the beginning of a strong tourist economy that has continued to this day.

Clearwater

The first establishment in "Clear Water" came with the Seminole Wars. In 1841, Fort Harrison was built to provide a "high and dry and healthy place" for the sick and wounded. The fort was abandoned in November of the same year and the war ended in 1842 (Cadwell 1977:59).

The Armed Occupation Act was passed and land grants received by the Stephens family as a result of the legislation were sold to the Taylor family who arrived in Clearwater from Brookville in 1842. Gradually, the area began to grow (Cadwell 1977:59).

When the first settlers inhabited the area, the land was rich with food sources. Corn, sweet potatoes, venison, wild turkey, and fish were plentiful. Sea cotton and oranges were also popular commodities. Because the town was small, mail was delivered from nearby Cedar Key, shipped by packet steamer once a week (Cadwell 1977:60). The town developed slowly without any problems until the onset of the Civil War.

During the war, Clearwater was bombarded with Union soldiers and had little defense against them. Union boats raided the area, stealing provisions and supplies. They also succeeded in blocking all contact between Clearwater and other areas of Florida such as Tampa and Cedar Key. After the war, Clearwater bounced back rather quickly. An influx of tourists, attracted by Clearwater's location and climate, brought intense commercial growth. M.C. Dwight built the first hotel, the Orange Bluff Hotel, in 1880, and soon after Theodore Kamensky, a Russian immigrant constructed the Sea View Hotel. Due to these and other residential and business developments as well as the immigrants that they attracted, the city became incorporated in 1891, and the first mayor, James Crane was elected. The telephone system was introduced to Clearwater in 1903, and an electric light franchise was granted to J.N. McClung in 1905. Also, the Board of Trade formed in 1913 (Cadwell 1977:62-63).

In addition to these technologies, the railroad came to Clearwater. Henry Plant developed the railway along the west coast, connecting Clearwater to Tampa. He also established hotels and hospitals in the area, near the established railroads (Cadwell 1977:63).

Clearwater's success over the years spread to the areas surrounding it. Sites such as Dunedin, and Stevenson Creek have benefited from the gradual yet consistent growth that continues today in Clearwater.

Pinellas and Hillsborough County Shipwrecks

Over the years, several ships have been lost or destroyed along the coasts of Pinellas County and Hillsborough County (Tampa Bay). For reasons such as severe storms, war, and collisions, these known shipwrecks now lie in coastal areas of the counties.

The first recorded shipwreck of the area is believed to be part of a Spanish fleet. Juan Munoz was found in 1549 near a bay, named the Bay of the Holy Spirit (Espirito Santa) by Hernando de Soto. Most researchers believe this area was Tampa Bay. Munoz was thought to have been one of de Soto's soldiers or a shipwreck survivor that wrecked along the coast fourteen years earlier (Singer 1998: 49).

Before the Civil War at least two ships are known to have wrecked in the vicinity of Pinellas County, the *Exchange* and the *Isis*. The *Exchange*, a schooner of Frankfort Maine, went ashore in Tampa Bay following a storm on 31 January 1836. The *Isis* was a side-wheel steamer built in 1837 in New York. This vessel burned at Tampa on 5 January 1842 (Singer 1992:50).

During the Civil War the Union vessel *Ethan Allen* under the command of Captain Eaton sank the Confederate sloop *Caroline and the schooner Spitfire* in Clearwater Harbor in February 1862 (Singer 1992:238). Also, the *Mary Jane*, a British schooner was chased ashore and destroyed by the Union steamer *Tahoma* under the command of Lieutenant A.A. Semmes on 18 June 1863 at Clearwater (Singer 1992:239-240).

The *Evening Star* wrecked at Clearwater in August 1872 (Singer 1992:51). The next disaster did not occur until 8 September 1927, when the gas vessel the *Javelin* burned at Dunedin. On 30 March 1930, the *Silver City*, a gas towing vessel, burned in Clearwater Bay (Singer 1992:59).z

Three ships were destroyed in Tampa Bay. The *Idonia*, the *Flying Fish*, and the *Rosa* were schooners lost in December 1869 (Singer 1992: 51).

The late 1800s witnessed ship disasters in the harbor of Tampa Bay. The *Millie Wales*, a steamer of Pensacola, caught fire while fishing in the Bay on 4 June 1885, resulting in a total loss. The *City of Athens*, a stern-wheel steamer commanded by Captain Gilbert, burned on 30 January 1893. Also, the schooner the *Silver Spray* burned while at port on 16 August 1893, and the *Rambler*, a schooner under the command of Captain Fogarty, sank at the dock on 15 December 1894, resulting in a total loss (Singer 1992:53).

The 1900s are filled with ship disasters along the Coast of Pinellas County. First, the *Caroline Kage*, a schooner built in 1875 at Pensacola, was stranded in Tampa Bay in Jauary 1902. Also, the *Sammy Lee*, a schooner of Tampa, collided with the dock at St. Petersburg on 24 February 1902, resulting in a total loss (Singer 1992:54).

The *Addie F. Cole*, a schooner of Tampa under Captain Tsolinas, foundered near the middle buoy of North Anclote Channel on15 April 1908. The vessel was from Tampa, bound for Tarpon Springs and had no cargo. Also in 1908, the schooner *Wave* burned at Tampa on 3 November. In 1909, the *Jimmie* and the *Ellen M. Adams* were destroyed in Pinellas County. The *Jimmie*, a schooner under the command of Captain Knowles bound for Tampa carrying oil, gas, and turpentine, exploded at Tampa on 10 July 1909. The *Ellen M. Adams*, a schooner commanded by Captain Johnson foundered while on a sponging trip on 20 December 1909 in North Anclote Channel. Another ship lost on a sponging expedition was the *Gertrude Summers*. The schooner from Tarpon Springs foundered during a storm at midnight on 8 June 1912 eighty miles west by north of Anclote Light (Singer 1992:56).

Many ships were lost during this time due to fires and explosions. The *Lola*, a steam tug from Tampa under the command of Captain Lache, caught fire and sank in Tampa Bay on 6 July 1912. The *Vaudalia*, a gas vessel of Tampa bound for St. Petersburg carrying general merchandise, caught fire because of a gallery lantern explosion. The ship was destroyed on 27 January 1913 in St. Petersburg wharf. Finally, the gas vessel the *Mary B. Franklin* burned in Tampa Bay on 2 August 1913 (Singer 1992:57).

On 27 March 1915, the iron steamer the *Theodore Weems* (formerly the *East Side*) collided with the *S.S. Heridia* in Tampa Bay. Also, the *Mylu*, a gas yacht, burned in Tampa Bay on 29 August 1918, and the schooner *Pride* was stranded off Anclote Light in September of that year (Singer 1992:57). In 1919, the *Shamrock* and the *City of Sarasota* were lost off of Pinellas County. The *Shamrock*, a schooner built in 1887 in Mississippi, burned at Tarpon Springs on 7 October 1919. The *City of Sarasota*, a steamer built in 1911 at Tampa, foundered near Tampa on 5 November 1919 (Singer 1992:58).

Many ships fell victim to disaster in the waters of Pinellas County during the 1920s. The *Thomas B. Garland*, a three-masted schooner, was stranded at Tampa on 27 October 1921. The *Iris*, a gas yacht (formerly a schooner), burned in Tampa Bay on 22 January 1922. The *Sunoco Jr*, a gas vessel, also burned at Tampa on 23 September 1925, and the *Stranger* (formerly *Hilda M. Stark*) burned in Tampa on 15 September 1927 (Singer 1992:58-59).

On 21 October 1927, the *Josephine* foundered at St. Petersburg, and the *Wallace A. McDonald* foundered in Tampa Bay on 17 September 1928. The schooner barge, the *Belmont*, foundered at the entrance to Tampa Bay in January 1940 with four lives lost (Singer 1992:59-60).

The only disaster recorded during WWII in Pinellas County's waters occurred eighteen miles off of Clearwater. The steel dredge *Gulfport* foundered on 13 or 14 February 1943 and was still visible in 1983 (Singer 1992:253).

No. B-29, a steel barge, foundered in Tampa Bay on 18 September 1955, and the *Dania* foundered approximately 1,500 feet east of Cut "F" in the channel of Tampa Bay on 15 February 1958 (Singer 1992:61).

Several wrecks occurred in the 1960s in the waters of Pinellas County. First, *Miss Powerama* was stranded on 31 January 1962 off Passage Key in Tampa Bay. The *Independence* burned approximately 17 miles west of Tarpon Springs on 10 December 1964. The *Leslie Ann*, built in 1959 at Tarpon Springs, foundered off St. Petersburg on 14 October 1965, and the *Go Go Girl* burned approximately six miles west of Tarpon Springs on 17 May 1969 (Singer 1992:62-63).

The *Candice* foundered in Clearwater Pass on 29 September 1966, and the *Sandy Belle* foundered approximately three miles west of Clearwater on 19 June 1972 (Singer 1992:62-63). Three wrecks have been recorded during the 1970s in the waters of Pinellas County. The barge *118* foundered sixty mile west of St. Petersburg on 18 August 1970. The pile driver *YSD 71*, a Navy seaplane wrecking derrick in WWII, foundered in 1973 off of St. Petersburg. Finally, the *Broward II*, a dredge of 358 tons, burned off Gadsen Point in Tampa Bay on 26 July 1974 (Singer 1992:63-64). The Coast Guard cutter *Blackthorn*, built in 1944, scuttled off Tampa in 1980 after a collision. This area is now a popular dive site.

(See Appendix A)

Stevenson Creek

Little maritime history of Stevenson Creek is documented and no known shipwrecks have been recorded within the creek (Florida Master Site Files 1999). However, a local resident did report the remains of some type of vessel visible during periods of low water in the lower end of the creek.

Description of Work

Historical Research

M-AT/ER conducted a literature search as part of the investigative effort at Stevenson Creek. This research helped document man's activities in Florida and the immediate vicinity, thereby providing an understanding of local resource use and the probability of cultural remains near Stevenson Creek. Also, the search helped determine the extent and type of commercial and maritime activity in the vicinity, which helped in the assessment of target identified during field investigations. This research focused on primary and secondary materials as compiled by environmental and archeological agencies responsible for managing the States cultural resources and depositories such as libraries and museums. In addition, research included interviews with local historians. Resources used are as follows:

- Clearwater Florida Main Library, Clearwater Florida
    - MAT/ER searched the main library and found many useful books, especially a book dedicated to Florida maritime history.

- Pinellas County Historical Society, Largo, Florida
    - MAT/ER met with Jay Dobkin a volunteer with the special collections and museum archives and found useful information concerning the area of Stevenson Creek.

- University of Southern Florida, Main Library, Tampa, Florida
    - MAT/ER searched the main library with the help of Paul Camp in the Special Collections section.

- Bureau of Archaeological Research, Division of Historical Resources, Tallahassee, Florida
    - MAT/ER reviewed Florida Master Site Files.
        - No recorded submerged sites in immediate vicinity.
        -

- Office of the Historian, U.S. Coast Guard
    - MAT/ER telephone call to review potential shipwrecks in the vicinity of Stevenson Creek.

- Marine Casualty Branch, U.S. Coast Guard
    - MAT/ER telephone call to review potential shipwrecks in the vicinity of Srevenson Creek.

- Maritime Historian, Sanctuaries and Reserves Division, National Oceanic and Atmospheric Administration
    - MAT/ER telephone call to review potential shipwrecks in the vicinity of Stevenson Creek.

Preliminary secondary sources reviewed are as follows:

- The Encyclopedia of American Shipwrecks
- Merchant Steam Vessels of the United States 1807 - 1868
- Shipwrecks of the Western Hemisphere
- Shipwrecks of the Civil War
- Official Records of the Union and Confederate Navies in the War of the Rebellion
- Automated Wreck and Obstruction Information System of the National Oceanic and Atmospheric Administration
    - Web Site Review http://anchor.ncd.noaa.gov/awois/search.cfm

Researchers reviewed source materials at each institution, and conducted interviews with librarians to determine the best potential sources for background information on Stevenson Creek and potential shipwrecks in the region.

Remote Sensing Survey

M-AT/ER's underwater archaeology team conducted the remote sensing survey from a rented shallow draft survey vessel. Two remote sensing devices were used: 1) a Geometrics 881 cesium marine magnetometer, 2) a Marine Sonic 600 kHz digital, side-scan sonar. Because of very shallow water in portions of the survey area the magnetometer was suspended off the bow of the survey vessel. Because of shallow waters in the creek, the side scan sonar was of limited use except in the central portion of the lower creek. Each instrument was interfaced with a Starlink Differential Global Positioning System.

Data was collected along parallel lines spaced at 50-foot intervals. Magnetic data, along with corresponding positioning data, was recorded at one-second intervals (or approximately every 6 feet along a track line at 6 knots) using MAGSEA™ and HYPACK™ data acquisition software. Sonar data, with corresponding positioning data, was recorded continuously and stored on read/write cdrom disks. Hydrographic data was not recorded due to the small size of the boat necessary to conduct the survey. Water depths were generally shallow (0 to 14 feet).

Acoustic data was recorded with Marine Sonic Sea Scan® acoustic data acquisition software using an onboard PC computer system. At the end of the day, acoustic data was stored on 700 mb CD's. The side-scan sonar fish was maintained at an altitude above the bottom that provided the most detailed records, just below the surface in the case of Stevenson Creek.

Data Analysis

During field investigations, data being produced by the magnetometer and side-scan sonar and were closely monitored. Targets (magnetic or acoustic) were identified and recorded as they were generated. Also noted on field records was information about the local environment, which included man-made features such as pipelines, channel markers, crab traps, and conditions that could influence magnetic or acoustic data.

After a survey area had been completed, archaeologists edited the magnetic data for detailed analysis and comparison to acoustic data. Editing was performed in three phases. The initial phase consisted of using HYPACK's single-beam editing program to review raw data (of individual survey lines) and to delete any artificially induced noise or data spikes. While editing survey lines, a preliminary target table was developed that included individual target coordinates, signature characteristics, intensity, and duration. Once all survey lines for an area were edited, the edited data was converted to an XYZ file (Easting and Northing State Plane Coordinates, and magnetometer data – measured in gamma), also using HYPACK. Next, the XYZ files were imported into a Triangular Irregular Network (TIN) modeling program (HYPACK) that was used to contour the data in 5-nanotesla intervals. Once the data was contoured, the contour graphic was converted to a DXF file and imported into AutoCAD in order to clearly view individual magnetic anomalies and their association with acoustic target signatures. Once in AutoCAD, additional editing of the total magnetic intensity was performed without effecting individual magnetic anomalies. For example, dramatic or pronounced diurnal changes that will frequently create a "striped," "zigzag," or "herring bone" pattern in the contour lines can be edited out and averaged across a survey area to create a more realistic and accurate contour map.

A second major analytical technique employed included the subtraction of general background from each successive data sample to develop the actual field gradient. The gradient is the vertical difference (z) between samples. By subtracting successive data samples one from the other the effects of diurnal change is eliminated. The resulting data represents only the localized changes in the magnetic background created by ferrous object(s) (i.e. anomalies). When graphically represented by contouring (using the same method described above), only the intensity of variation is represented.

During the analysis process, magnetic anomalies were categorized using the anomaly intensity, duration and/or extent, and signature characteristics. In addition, the anomaly's geographic location was taken into consideration, as well as its association with acoustic target signatures.

After magnetic data was developed into a target list, acoustic data was examined using SeaScan™ acoustic data review software to identify any unnatural or man-made features in the records. Once identified, acoustic features were described using visible length, width, and height from the bottom surface. The coordinates of the acoustic features also were recorded and compared to those of the magnetic anomalies.

Data Assessment

Target signatures were evaluated using the National Register of Historic Places criteria[4] as a basis for the assessment. For example, although an historic object might produce a remote sensing target signature, it is unlikely that a single object (such as a cannon ball) has the potential to meet the criteria for nomination to the National Register of Historic Places.

Target assessment was based primarily on the nature and characteristics of the acoustic and magnetic signatures. Shipwrecks – large or small – often have distinctive acoustic signatures, which are characterized by geometrical features typically found only in a floating craft. Most geometrical features identified on the bottom (in open water) are manmade objects. Often an acoustic signature will have an associated magnetic signature. Generally, if the acoustic signature demonstrates geometric forms or intersecting lines with some relief above the bottom surface and has a magnetic signature of any sort, it can be categorized as a potentially significant target. Often, modern debris near docks, bridges, or an anchorage is easily identified solely based on the characteristics of its acoustic signature. However, it is more common to find material partially exposed. Frequently, these objects produce a record that obviously indicates a man-made object, but the object is impossible to identify or date. In making an archaeological assessment of any sonogram record, the history and modern use of the waterway must be taken into consideration. Naturally, historically active

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[4] To qualify for the National Register, a historic shipwreck must "meet one or more of the National Register criteria A, B, C, and D. Determining the significance of a historic vessel depends on establishing whether the vessel is 1) the sole, best, or a good representative of a specific vessel type; 2) is associated with a significant designer or builder; or 3) was involved in important maritime trade, naval, recreational, government, or commercial activities" The criteria is described thusly:

A. [B]e associated with events that have made a significant contribution to the broad patterns of our history; or

B. be associated with the lives of persons significant in our past;

C. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. have yielded, or may be likely to yield, information important in prehistory or history (National Register Bulletin, U.S. Department of the Interior, National Park Service, Interagency Resources Division).

archaeological assessment of any sonogram record, the history and modern use of the waterway must be taken into consideration. Naturally, historically active areas tend to have greater potential for submerged cultural resources. The assessment process prioritizes targets that require further underwater archaeological investigations.

Magnetic target signatures alone are more difficult to assess. Without any supporting sonogram record, the nature of the bottom sediments and the water currents become more important to the assessment process. A small, single-source magnetic signature has the least potential to be a significant cultural resource. Although it might represent a cannon ball or historic anchor, this type of signature has little potential to meet National Register criteria.

A more complex magnetic anomaly, represented by a broad monopolar or dipolar type signature, has a greater potential to be a significant cultural resource, depending on bottom type. Shipwrecks that occur in regions with hard bottoms, with little migrating sand, tend to remain exposed and are often visible on sonogram records. A magnetic anomaly that is identified in a hard bottom area and has no associated acoustic signature frequently can be discounted as being a historic shipwreck. Most likely, such an anomaly is modern debris, such as wire rope, chain, or other ferrous material.

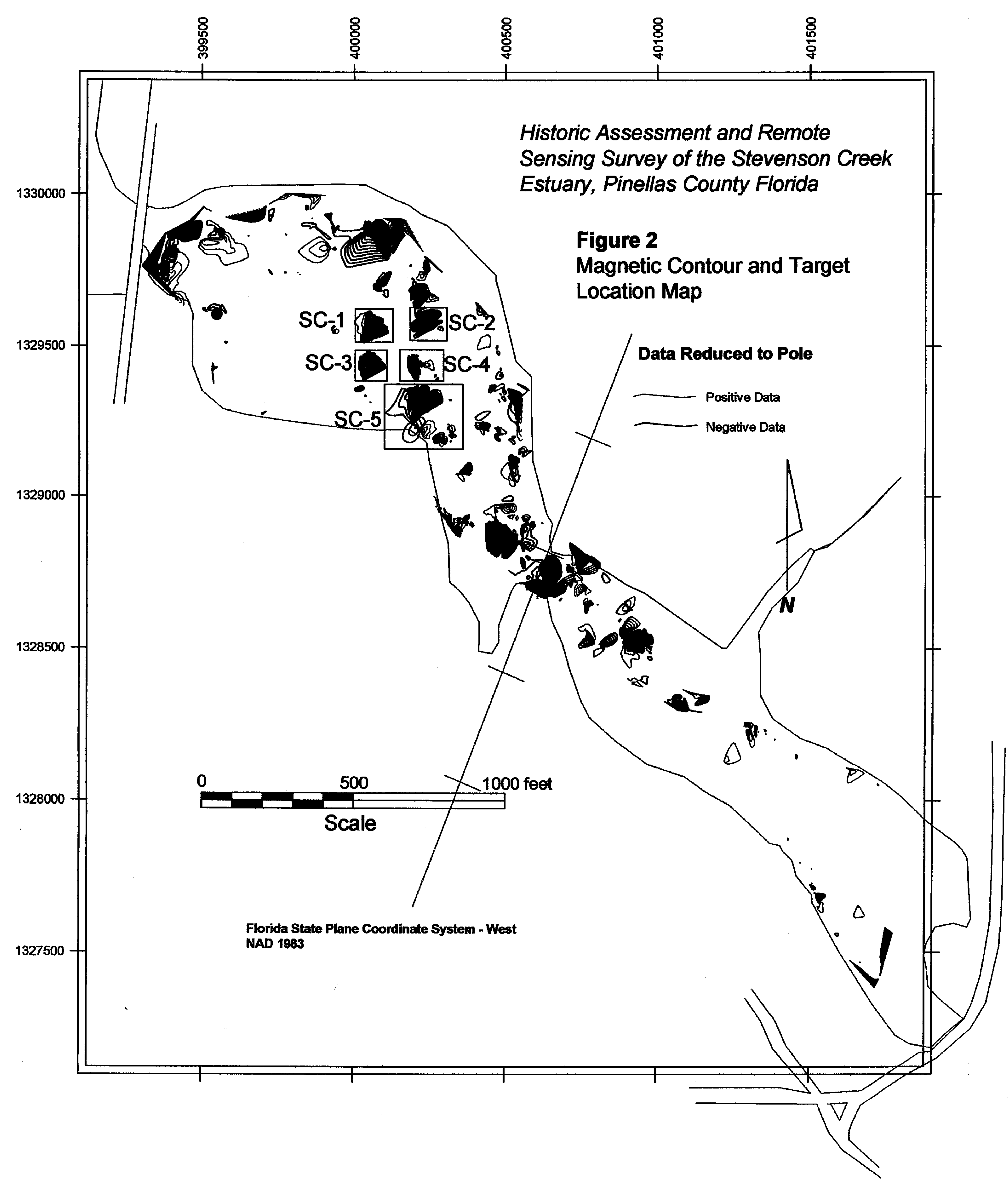
The types of magnetic signatures that a boat or ship might produce are infinite, because of the large number of variables including location, position, chemical environment, other metals, vessel type, cargo, sea state, etc. These variables are what determine the characteristics of every magnetic target signature. Since shipwrecks occur in a dynamic environment, many of the variables are subject to constant change. Soft migrating sand or mud can bury large wrecks, leaving little or no indication of their presence on the bottom surface. Thus investigators must keep all these factors in mind while making an assessment of a magnetic anomaly's potential to represent a significant cultural resource and be circumspect in their predictions.

Broad, multi-component signatures (again, depending on bottom characteristics and other factors) often have the greatest potential to represent a shipwreck. On the other hand, high-intensity, multi-component, magnetic signatures (without an accompanying acoustic signature) in areas of relatively high velocity currents can be discounted as a historic resource. Eddies created by the high-velocity currents usually keep some portion of a wreck exposed. Generally, wire rope or some other low-profile ferrous debris produces this type of signature in these circumstances. Many types of magnetic anomalies display characteristics that are not easily interpreted. The only definitive method of determining the nature of the object creating these anomalies is by physical examination.

Description of Findings and Recommendations

There were numerous magnetic and acoustic target signatures in Stevenson Creek. The majority was associated with bridge crossings, private docks, outfall pipe, shoreline debris, and ferrous debris (identified exposed above the water). Five targets were not readily identified with visible debris or structures (Figure 3). A local resident also reported that some type of wooden vessel was located in the vicinity of these targets probably SC-5. Although the majority (if not all) of the targets are most likely associated with modern debris, archaeological investigations to identify and assess at least 2 (two) of the targets (SC-4 and SC-5) are recommended. Avoidance of these targets during dredging activities would be difficult given the confines of the creek and shallow waters.

Table 1 and Figure 3 reflect the location, nature and recommendations for the identified magnetic anomalies. All the target coordinates are in Florida State Plane West– NAD 1983 and Universal Transerve Mercator (UTM) WGS 1984.



Historic Assessment and Remote Sensing Survey of the Stevenson Creek Estuary, Pinellas County Florida

Figure 2
Magnetic Contour and Target Location Map

Historic Assessment and Remote Sensing Survey of the Stevenson Creek Estuary, Pinellas County, Florida								
TARGET LIST:								
Target ID	**Easting (X) UTM E (m)**	**Northing (Y) UTM N (m)**	**Area of Influence (feet)**	**nT (max.)**	**Magnetic Signature Type**	Acoustic Signature Type	Acoustic Target Description	Notes
SC-1	400073 323621	1329577 3097291	70 x 95	315	dipolar	none	N/A	2
SC-2	400242 323673	1329579 3097291	72 x 105	205	dipolar	none	N/A	2
SC-3	400041 323612	1329459 3097255	85 x 87	220	dipolar	none	N/A	2
SC-4	400193 323658	1329447 3097251	80 x 85	80	multi	linear	10 feet long	1
SC-5	400200 323660	1329300 3097206	108 x 110	555	multi	structure	Object angular shape	1

1 – Additional underwater archaeological investigations are recommended.
2 – No further archaeological investigations are recommended.

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Appendix A: Shipwrecks Recorded in the Vicinity of Pinellas & Hillsborough Co.

NAME	TYPE	DATE LOST	WHERE LOST
Unknown	unknown	1535	Juan Munoz found in Tampa Bay in 1549 thought to be survivor of Spanish wreck 14 years earlier.
Unknown	unknown	1567	Spaniards exploring Tampa Bay found a Portuguese trader who was a survivor of a shipwreck near there.
Exchange	schooner	1836	Ashore at Tampa Bay.
Isis	130 ton sidewheel steamer	1842	Burned at Tampa.
Carolina	sloop - Confederate	1862	Sunk by Union vessel *Ethan Allen* in Clearwater Harbor.
Spitfire	schooner - Confederate	1862	Sunk by Union vessel *Ethan Allen* in Clearwater Harbor.
Mary Jane	schooner - British	1863	Chased ashore at Clearwater by Union steamer *Tahoma*.
Idonia	schooner	1869	Wrecked in Tampa Bay.
Flying Fish	schooner	1869	Wrecked in Tampa Bay.
Rosa	schooner	1869	Wrecked in Tampa Bay.
Evening Star	schooner	1872	Wrecked at Clearwater.
Antarctic	61 ton - sloop	1877	Stranded-Perico Shoal/Tampa Bay.
Millie Wales	85 ton – steamer	1885	Burned in Tampa Bay.
Carolina Kage	20 ton - schooner	1902	Stranded at Tampa Bay.
Sammy Lee	20 ton - schooner	1902	Collided with dock St. Petersburg.
Ardell	50 ton - schooner	1906	Capsized south of Pinellas Point

Wave	67 ton - schooner	1908	Burned at Tampa.
NAME	**TYPE**	**DATE LOST**	**WHERE LOST**
Davy Crockett	85 ton - schooner	1909	Stranded at South Pass, Tampa Bay
Jimmie	18 ton - schooner	1909	Exploded at Tampa
Lily White	55 ton - schooner	1910	Burned at Tampa
Iola	72 ton – steam vessel	1908	Burned in Tampa Bay
Vaudalia	109 ton – gas vessel	1913	Burned at St. Petersburg
Mary B. Williams	25 ton - gas vessel	1913	Burned in Tampa Bay
Theodore Weems	926 ton - steamer	1915	Collided with SS *Herodia*
City of Sarasota	125 ton - steamer	1919	Foundered near Tampa
Thomas B. Garland	348 ton three-masted schooner	1921	Stranded at Tampa
Iris	32 ton - gas yacht	1922	Burned in Tampa Bay
Sunoco Jr.	29 ton - gas vessel	1925	Burned at Tampa
Stranger	596 ton - schooner	1927	Burned at Tampa
Josephine	32 ton - yacht	1927	Foundered at St. Petersburg.
Wallace McDonald	20 ton - gas vessel	1928	Foundered in Tampa Bay
Belmont	1,491 ton-scow schooner/steel	1940	Foundered at entrance to Tampa Bay
Amazone	1,294 ton - tanker	1942	Torpedoed at Lat.27º 23' 39" / Long 80º 08' by German sub U333
Halsey	7,088 ton - tanker	1942	Torpedoed at Lat.27º 33' / Long 80º 03' 08" by German sub U-333

NAME	TYPE	DATE LOST	WHERE LOST
Gulfland	5,277 ton - tanker	1943	Burned/grounded off Hobe Sound.
Blackthorn	180' Coast Guard /buoy tender 936 tons	1980	Scuttled off Tampa after a collision
No. B-29	Steel barge	1955	Foundered in Tampa Bay
Mary E	25 ton - gas vessel	1961	Stranded at John's Pass, Maderia Beach
Miss Powerama	64 ton - fishing vessel	1962	Stranded off Passage Key/Tampa Bay
Leslie Ann	38 ton - fishing vessel	1965	Foundered off St. Petersburg.
Candice	Motor Vessel	1969	Foundered off Clearwater Pass
Mary E. Singleton -	Oil fired steamer	1967	Burned off Egmont Key
Sandy Belle	79 ton - fishing vessel	1972	Foundered 3 mi. off Clearwater
YSD 71	138 ton - Pile Driver/derrick	1972	Foundered off St. Petersburg

Targeted Brownfields Assessment (TBA) Phase II Report

for the

Wolfe Property Site
Clearwater,
Pinellas County, Florida

BUREAU OF WASTE CLEANUP

JAN 2 4 2003

TECHNICAL REVIEW SECTION

January 2003

Prepared for:

Florida Department of Environmental Protection
Site Screening Superfund Subsection
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Prepared by:

PBS&J
3230 Commerce Place, Suite A
West Palm Beach, Florida 33407

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 EXECUTIVE SUMMARY

PBS&J performed a Phase II Targeted Brownfields Assessment (TBA) at the Wolf Property for the Florida Department of Environmental Protection (FDEP) under FDEP contract HW-364. The U.S. Environmental Protection Agency provided the funding for the Phase II TBA in order to assist the City of Clearwater in evaluating environmental conditions of this property.

The objectives of this Phase II TBA were to evaluate site conditions by researching available historical files and by conducting field-sampling activities to determine whether or not the site has been impacted by past use of the property. The monitoring well installation and sampling for the Phase II TBA were conducted during the week of March 6 through 8, and follow-up sampling was conducted at the site on July 23, 2002.

PBS&J performed this Phase II TBA in conformance with the scope and limitations of the American Society of Testing and Material (ASTM) Standard E 1903-97 (Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process).

The analyses of samples collected during the Phase II TBA revealed the presence of arsenic in soil and groundwater above screening criteria. Arsenic was detected at WP-SS-04 at 4.7 mg/kg, which exceeds both residential and industrial Soil Cleanup Target Levels (SCTLs) stipulated in Chapter 62-777, F.A.C. Volatile Organics detected in a sediment sample collected from a storm drainage ditch (up-gradient) exceeded Sediment Quality Assessment Guidelines (SQAGs) for both TEL (Toxic Effects Levels) and Probable Effects Levels (PEL). However, the levels were below SCTLs in Chapter 62-777 and were not detected in downgradient sediment samples collected near the wetland and Stevenson Creek.

Based on the findings of the Phase II TBA, further assessment is recommended to better understand the potential environmental risks associated with the contamination detected at the Wolfe property.

2.0 SCOPE

The scope of this Phase II TBA included the following:

- Collection of sediment samples from the drainage ditch near the entrance to the property, the interior of the property, and near the confluence with the wetlands;

- Collection of composite soil samples from two suspected dredge spoil piles located along the eastern side of the property and the collection of six surface and two subsurface soil samples from other areas of the property;

- Installation of five permanent monitoring wells and collection of groundwater samples.

EPA/FDEP Standard Operating Procedures were observed to ensure that data quality objectives were achieved for the Wolfe Property Site.

3.0 SITE BACKGROUND

3.1 Site Description

The Wolfe Property site consists of approximately eight acres of undeveloped wooded uplands and wetlands near the southwest corner of Overbrook Drive and unimproved Pineland Drive in Clearwater, Florida. The approximate coordinates of the site are 27°59'02" (27.9839) North Latitude and 82°47'11" (82.7864) West Longitude [1]. The City of Clearwater purchased this property in April 2002, and is considering using the property to stage dredge spoils for the proposed Stevenson Creek Restoration project. The City also is planning to construct a city park and recreation area at the site following the completion of the Creek Restoration project.

The TBA was conducted on approximately four acres of wooded property located northeast of Stevenson Creek in Clearwater, Pinellas County. The wooded portion of the property is heavily vegetated by trees and underbrush and gently slopes toward the wetlands located on the southwestern side of the property. Several large mounds of soil (up to 15 feet in height) and minor amounts of solid waste, including discarded carpet, household garbage, white goods, and concrete debris, were observed on the wooded portion of the property. An auto salvage yard is located east of the property across from the unimproved Pinelands Drive. Photographs depicting the subject property are provided as Appendix A.

The location of the property is shown in Figure 1, a USGS 7.5-minute topographical map is provided as Figure 2, and a site plan is provided as Figure 3.

3.2 Site History

The Wolfe Property has historically remained undeveloped; however, dewatering of dredge material from Stevenson Creek was reported to have occurred on the property during the 1980's [2]. Aerial photographs from 1954 through 1996 indicated the presence of the auto salvage yard located east of the property. The salvage yard appeared to have encroached onto a portion of the eastern boundary of the subject property in the 1979 and 1984 photograph but was not observed on the subject property in the 1996 photograph. Copies of the aerial photographs are provided as Appendix B.

3.3 Environmental Conditions

Information provided by the City of Clearwater [2,3] and observations during the Phase II TBA[4], revealed several environmental conditions noted below.

1) Hydrocarbon odors emanating from an excavation (test pit) at the adjacent salvage yard property were detected while conducting the TBA. The test pit, located less than 100 feet east of the property line, was being dug by a consultant working for the owners of the auto salvage yard. No sampling data was available to evaluate contaminant migration concerns associated with this offsite area prior to the field sampling for this Phase II assessment.

2) Several large mounds of soils that were dredged from Stevenson Creek have been deposited throughout the property. A previous water and sediment quality study of the nearby Stevenson Creek found trace amounts of arsenic, barium, cadmium, chromium, nickel, selenium, and zinc, and elevated levels of lead, copper, iron, and mercury [3]. However, neither pesticides nor Polynuclear Aromatic Hydrocarbons (PAHs) were detected in the samples collected from the creek [3].

3) The Wolfe property receives storm water run-off from a drainage ditch that runs along Overbrook Drive through the site to the adjacent wetland.

4) Review of historical aerial photographs revealed that vehicular storage and other unknown operations associated with the adjacent salvage yard occurred on the east side of the Wolfe property during the 1970's and 1980's.

5) A small amount of debris believed to be associated with miscellaneous dumping was observed at the property during the Phase II TBA.

4.0 SITE ENVIRONMENTAL SETTING

4.1 Climatology

The climate of Pinellas County consists of hot, humid summers and very mild winters with occasional frost and freezing temperatures. Rainfall averages between 50 and 55 inches per year. Although some rainfall normally occurs every month, there is a distinct rainy season extending from May through September and a low rainfall season from October through April. Approximately 60 to 65 percent of the annual rainfall occurs during the late spring-summer rainy season. Evapotranspiration within the district has been estimated at approximately 39 inches per year. Approximately 60 percent of this total occurs in the six-month period from May to October [5].

4.2 Site Topography and Surface Water Drainage

As shown on the U.S. Geological Survey 7.5-Minute Topographic Map for the Clearwater Quadrangle (Figure 2), the elevation of the Wolfe Property site ranges from Mean Sea Level (MSL) to approximately 15 feet above MSL. Site topography slopes toward the southwest.

4.3 Geology/Hydrogeology

4.3.1 Regional Geology and Hydrogeology

The Wolfe Property site is located within the Gulf Coastal Lowlands Geomorphologic Feature of the Central Geomorphologic Province of Florida. This area also comprises various karst terrain features, such as: sinkholes (predominantly cover-collapse) and sinkhole lakes. Three hydrostratigraphic units, the surficial aquifer system, intermediate aquifer system/confining unit and the Floridan aquifer system, exist in the site area [6-10].

The surficial aquifer system generally consists of fine to medium grained quartz sand and shelly sand. These deposits grade downward to sandy clay, marl and some interbedded clay. These sediments are Pleistocene to possibly Pliocene age. Organic material and silt commonly form a hardpan layer five to ten feet below land surface (bls). This hardpan acts as a semi-confining bed that restricts the vertical movement of water. A gray to white, tan, phosphatic limestone forms the base of the aquifer in some portions of Pinellas County. In the Clearwater-Dunedin area, an organic rich, dark-brown to black, very fine-grained sand occurs near the base of the aquifer system [6,7,11,12].

The surficial aquifer exists under unconfined conditions and the water-table is found generally less than five feet BLS in Pinellas County. The water table may be more than six feet BLS in topographically high, well-drained areas. The saturated thickness of the surficial aquifer averages about 30 feet throughout most of the County. The aquifer ranges in thickness from approximately 40 feet along the Pinellas Ridge to more than 80 feet in the western part of St. Petersburg. Recharge to the surficial aquifer is primarily derived from local rainfall [6,7,11,12].

The surficial aquifer is used primarily for lawn irrigation and is of limited use in domestic applications. Small diameter wells, open to the aquifer, yield between 5 to 30 gallons per minute. The water from this aquifer generally contains high levels of iron, which results in staining of fixtures and utensils [6,7,11,12].

Underlying the surficial aquifer system are the Middle and Upper Miocene Deposits, the lower Miocene-age Arcadia Formation (Fm) and the Tampa Member of the Arcadia Fm. The Arcadia Fm and the Tampa Member comprise the Hawthorn Group in Pinellas County. These Miocene-age deposits jointly form the intermediate aquifer system/confining unit in Pinellas County. Low permeability portions of the upper Tampa Member of the Arcadia Fm. form the base of the intermediate aquifer system/confining unit [6-8,11,12].

The Middle and Upper Miocene Deposits, also referred to as the Alachua Fm, predominantly consist of blue to gray clay, fine-grained sandstone and weathered lumps of limestone. These deposits are generally less than 50 feet thick. This unit is limited in lateral extent being present only between Clearwater and Palm Harbor. These deposits do not yield significant quantities of water due to their large clay content. The Arcadia Fm is composed predominantly of limestone and dolostone with various amounts of sand, clay and phosphate grains. Thin beds of quartz sand and clay are dispersed throughout the Arcadia Fm. The Arcadia Fm is generally present in the southern part of the county and thins to the north. The Arcadia Fm pinches out north of Coachman and is absent in northern Pinellas County. The top of the Arcadia Fm is found at sea level in the north-central part of the County to 50 feet below sea level in the St. Petersburg area. Thin beds of sand within the Hawthorn Group may yield water to domestic wells. However, these sands have low permeability and are discontinuous making them a poor water producer. The intermediate aquifer system thins to the north and is absent in central and northern Pinellas County. Low permeability beds within the Middle and Upper Miocene Deposits and/or Hawthorn Group restricts the vertical movement of water to and from the overlying surficial aquifer and underlying Floridan aquifer systems [6-8,11,12].

The Floridan aquifer system is the major source of potable groundwater in the area. The system consists of a series of limestones of Eocene to early Miocene age, which collectively function as a single hydrologic unit. The aquifer ranges in thickness from 1,000 feet (north Pinellas County) to 1,200 feet (southern Pinellas County) throughout the county [6,11].

The Floridan aquifer system includes, in ascending order, the Ocala Limestone, Suwannee Limestone and permeable limestone beds (Tampa Limestone) of the Tampa Member of the Arcadia Fm. The Ocala Limestone is not an important component of the Floridan aquifer system in Pinellas County due to its depth and the productiveness of the Suwannee and Tampa Limestones. The Tampa Limestone, an early Miocene-age deposit, consisting of white to light tan, sandy, fossiliferous limestone with chert fragments, forms the upper layer of the Floridan aquifer. The top of the Tampa Limestone, the top of which is highly variable, is first encountered at sea level in the Tarpon Springs area to 120 feet below sea level in the St. Petersburg area. This variability of depth reflects the irregular surface of the Tampa Member caused by numerous pinnacles and sinkholes. The Tampa Limestone contains numerous solution channels. The Tampa Member is underlined by predominantly white to cream-colored, hard, fossiliferous limestone of the Suwannee Limestone [6].

Water in the Floridan aquifer system exists under water-table conditions north of Palm Harbor and west of Lake Tarpon. An 8-inch diameter well open to the Upper Floridan aquifer system can yield several hundred gallons per minute (gpm) of water. Water from the Floridan aquifer is generally hard, particularly water from the Suwannee Limestone [6]. Recharge to the Floridan aquifer system varies from none to very low in southern Pinellas County and from low to moderate in north Pinellas County [6,7,11-14].

4.3.2 Site-Specific Geology and Hydrogeology

Surface deposits at the site consist of several inches to one-foot of organic soils. Underlying the organic surface deposits are inter-fingering layers of fine sand, clayey sand, sandy clay, and clay to a depth of 15 feet BLS. Lithologic descriptions from the site are provided with the drilling logs in Appendix C.

The site-specific water table is located between 5 and 10 feet BLS and is expected to vary with seasonal rainfall. Based on the topography, the groundwater likely flows towards the southwest in the direction of the wetlands and Stevenson Creek.

4.4 Groundwater Usage

There are no public water supply wells (PWS) located within a one-mile radius of the site [15]. Six PWS wells are located within one to two miles, thirteen PWS wells are located between two to three miles, and twenty-one PWS wells are located between three to four miles of the site. These wells extract water from the Floridian aquifer at depths ranging from 124 to 340 feet BLS.

5.0 FIELD METHODOLOGY

5.1 Sediment Samples

In March 2002, three sediment samples were collected from a drainage ditch that runs along the south ROW of Overbrook Drive and through the subject property. Sediment sample WP-SD-01 was collected at the entrance of the property, sample WP-SD-02 was collected downstream on the interior of the property, and sample WP-SD-03 was collected on the west side of the wooded portion of the property immediately adjacent to the wetlands. Sediment sample locations are shown in Figure 4, and the rational for the sample locations is summarized in Table 1. The sediment samples were collected from the ditch bottom at the selected locations utilizing a stainless steel hand auger. The VOC fraction was collected prior to mixing the sample in a stainless steel pan with a stainless steel spoon.

Sediment samples were analyzed for Volatile Organic Compounds (EPA Method 8260), Semi-Volatile Organic Compounds (EPA Method 8270), Metals (EPA Method 6010) and Mercury (EPA Method 245.5).

5.2 Soil Samples

Six soil samples were collected from the Wolfe Property site at the locations shown on Figure 4 in March 2002. One composite soil sample was collected from each of the two mounds of soil suspected to be dredge spoil located on the eastern side of the property (WP-SS-01 and WP-SS-02). Soil samples were also collected from two other areas of the property. Samples WP-SS-03 and WP-SS-04 were collected from the surface to 2-feet BLS, and WP-SB-03 and WP-SB-04 were collected from 2 to 4 feet BLS. The rational for the sample locations is summarized in Table 1.

On July 23, 2002 PBS&J returned to the site to collect four additional soil samples (WP-SS-4A through WP-SS-4D) from the locations shown in Figure 8. These samples were collected from the surface to 2-feet BLS in order to further delineate arsenic levels detected in WP-SS-04. The soil samples were collected utilizing a stainless steel hand auger and composited in plastic bags. Soil samples were analyzed for Metals (EPA Method 6010) and Mercury (EPA Method 245.5).

5.3 Groundwater Monitoring Well Installation

Monitoring wells (WP-MW-01 and WP-MW-02) were installed on the east side of the property, adjacent to the salvage yard. Monitoring wells (WP-MW-03, WP-MW-04, WP-MW-05) were also installed on the south, north and central interior portions of the property. The locations are shown in Figure 4. The wells were installed by a hollow-stem auger rig to a maximum depth of 16 feet, with 10 feet of 0.006-inch slotted well screen, set to intercept the water table surface. The monitoring wells were constructed of two-inch diameter Schedule 40 polyvinyl chloride (PVC) with protective aboveground casings. A silica sand filter pack was installed surrounding the well screens followed by a bentonite seal and cement grouted to the surface. The monitoring wells were developed with a centrifugal pump to remove fine-grained sediment ensuring a good hydraulic connection with the underlying aquifer. The monitoring wells were installed by a

Florida-licensed water well driller. Monitoring well drilling logs and construction details are provided as Appendix C.

5.4 Groundwater Samples

Groundwater samples were collected from the five monitoring wells (WP-MW-01 through WP-MW-05) in March 2002 and again from WP-MW-03 on July 23, 2002. The depth to water, conductivity, pH, temperature, turbidity, and dissolved oxygen were measured and recorded in the field during purging. Purging was conducted utilizing a low flow peristaltic pump to minimize, to the extent possible, the introduction of particulate matter into the well. Samples for VOCs were collected by filling the Teflon tubing and allowing the sample to drain into the sample vials.

Groundwater samples were analyzed for Volatile Organic Compounds (EPA Method 624), Semi-Volatile Organic Compounds (EPA Method 625), Metals (EPA Method 200.7), and Mercury (EPA Method 245.2). Arsenic samples collected from WP-MP-03 in July 2002 were analyzed for arsenic (EPA Method 3010/6010) only.

5.5 Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) samples collected from the Wolfe Property site included duplicates, sediment and groundwater sampling equipment rinsate blanks, and trip blanks. One duplicate soil sample WP-SS-02 DUP and one duplicate groundwater sample WP-MW-05 DUP were collected and analyzed for metals, volatile, and semi-volatile organic compounds.

5.6 Laboratory Analyses

All samples were analyzed by US Biosystems Laboratory in accordance with procedures established in CompQAP No. 980126.

5.7 Investigative Derived Waste

Background information from the Wolfe Property site did not indicate the likely presence of contaminants at concentrations that would require off-site disposal of investigation derived wastes. Soil cuttings and groundwater development and purge water were disposed to the ground surface near the monitoring well and soil sample locations.

6.0 ASSESSMENT RESULTS

Results from the Wolfe Property TBA are presented in Tables 2 through 5. Analytical results were compared to federal and state standards and guidelines. Laboratory analytical reports are provided in Appendix D.

6.1 Sediment Data

Analytical results of the sediment samples collected from the drainage ditch indicated that FDEP Sediment Quality Assessment Guidelines (SQAGs) were exceeded for several Polynuclear Aromatic Hydrocarbons (PAHs). These included Benzo(A) anthracene (0.22 mg/kg), Benzo(a) pyrene (0.22 mg/kg), Chrysene (0.26 mg/kg), Fluoranthene (0.5 mg/kg), and Pyrene (0.41 mg/kg). The SQAGs were established in order to identify the probability of adverse effects on aquatic organisms.

In sample WP-SD-01, collected from the ditch at the entrance to the property, toxic effects levels (TEL) were exceeded for Benzo(a) anthracene, Benzo(a) pyrene, Chrysene, Fluoranthene, and Pyrene; however, these levels did not exceed probable effect levels (PEL). Concentrations of these compounds also did not exceed FDEP Direct Exposure soil cleanup target levels (SCTLs) for commercial/industrial sites.

Table 2 lists the parameters that were detected in at least one sample, the screening criteria, and the analytical results of detected constituents. Analytical results of the detected constituents are also presented in Figure 5.

6.2 Soil Data

In soil sample WP-SS-04 collected from the southern portion of the property arsenic was detected at 4.7 mg/kg. This concentration exceeded FDEP residential and industrial direct exposure criteria and USEPA residential but not industrial risk based criteria. Soil screening criteria were not exceeded for any other analyzed constituent in any of the collected samples. Supplemental soils samples collected in the vicinity of WP-SS-04 did not exceed FDEP direct exposure criteria or USEPA risk based criteria for arsenic.

Table 3 lists the parameters that were detected in at least one sample, the screening criteria, and the analytical results of the detected constituents. Analytical results of detected constituents in the 0- to 2-foot BLS interval are presented in Figure 6, and the 2- to 4-foot BLS interval is are presented in Figure 7.

6.3 Groundwater Data

6.3.1 Groundwater Field Parameters

At the Wolfe Property site, groundwater field parameters were measured in the field during purging of the groundwater monitoring wells prior to collection of samples for laboratory analyses. Table 4 includes the results of the field measurements for pH, specific conductance, temperature, dissolved oxygen and turbidity.

6.3.2 Groundwater Analytical Results

Analytical results indicated that groundwater concentrations of aluminum, arsenic, iron, and manganese exceeded groundwater cleanup target levels (GCTLs) in groundwater samples collected from the facility. Federal and state levels were exceeded for aluminum in samples collected from WP-MW-01(0.35 mg/l), WP-MW-02 (0.47 mg/l), and WP-MW-04 (2.9 mg/l); for iron in samples collected from WP-MW-01 (1.0 mg/l), WP-MW-03 (1.3 mg/l), WP-MW-04 (0.61 mg/l) and WP-MW-05 (0.33 mg/l); and for manganese in samples collected from WP-MW-04 (0.063 mg/l), and WP-MW-05 (0.076 mg/l).

Arsenic was detected in the sample collected from WP-MW-03 at 0.019 mg/l in March 2002 and 0.021 mg/l in July 2002. These levels slightly exceed the newly established EPA drinking water Maximum Contaminant Level of 0.01 mg/l; however, the observed concentration is below the FDEP GCTL of 0.05 mg/l.

The analytical results of the detected parameters are summarized on Table 5 and shown on Figure 8.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Analysis of samples collected at the Wolfe Property site indicated that impacts to sediment, soil, and groundwater appear to be minimal. FDEP threshold effects levels were exceeded for several PAHs in the sediment sample collected from the drainage ditch at the entrance to the property; however, these concentrations did not exceed probable effects levels established for sediment or commercial/industrial direct exposure target cleanup levels established for soil. Elevated levels of PAHs in this sample are likely due to stormwater runoff from adjacent commercial/industrial business operations.

Arsenic levels detected in the soil sample collected from the southern portion of the property exceeded FDEP residential and industrial direct exposure criteria and USEPA residential but not industrial risk based criteria. Supplemental soil assessment conducted in this area defined the extent of arsenic exceedances.

Arsenic levels also were elevated in the groundwater sample collected in this area; however, concentrations did not exceed FDEP target cleanup levels. Aluminum, iron, and manganese concentrations exceeded groundwater target levels based on secondary drinking water standards; however, these levels may be due to elevated background concentrations.

Based on the findings of the Phase II TBA, further assessment of the Wolfe property is recommended to better understand the potential risk associated with the contamination detected during the Phase II TBA.

INDEX