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DRAFT FEASIBILITY STUDY FOR OPERABLE UNIT 16 (OU16) SITE 41 WETLANDS NAS PENSACOLA FL
12/29/2010
TETRA TECH INC

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

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Feasibility Study for Operable Unit (OU) 16, Site 41 Wetlands

Naval Air Station Pensacola
Pensacola, Florida

Contract Task Order 0030

December 2010

NAVFAC
Southeast
NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

Rev. 1
12/29/10

FEASIBILITY STUDY REPORT

OPERABLE UNIT (OU) 16, SITE 41 WETLANDS

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Southeast
Building 903, NAS Jacksonville
Jacksonville, Florida 32212-0030

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TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criterion
BEHP	bis(2-Ethylhexyl) phthalate
bgs	below ground surface
BHC	hexachlorocyclohexane
BSAF	Biota Sediment Accumulation Factor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CKD	Cement kiln dust
CLEAN	Comprehensive Long-Term Environmental Action Navy
CO_2	Carbon Dioxide
COC	Chemical of concern
COPC	Contaminant of potential concern
CSF	Cancer Slope Factor
CTO	Contract Task Order
CWA	Clean Water Act
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DGPS	Digital global positioning system
DoD	Department of Defense
DOT	Department of Transportation
EC	Engineering Controls
EEC	Extreme Effects Concentration
EqP	Equilibrium Partitioning Quotient
ERA	Ecological Risk Assessment
ERM	Effects Range Mean
ESA	Endangered Species Act
F.A.C	Florida Administrative Code
FCM	Food-Chain Model
FDEP	Florida Department of Environmental Protection
FL-PRO	Florida Residual Petroleum Organic Method

ACRONYMS AND ABBREVIATIONS (CONTINUED)

FS	Feasibility Study
GAC	Granular activated carbon
GCTL	Groundwater Cleanup Target Level
GHG	Greenhouse Gas
GRA	General Response Action
HQ	Hazard Quotient
HHRA	Human Health Risk Assessment
IC	Institutional Controls
IR	Installation Restoration
IWTP	Industrial waste water treatment plant
LDR	Land disposal restriction
LOAEL	Lowest observed adverse effects level
LUC	Land Use Control
LUCIP	Land Use Control Implementation Plan
mg/kg	Milligram per kilogram
MMBTU	One thousand British Thermal Units
msl	mean sea level
NA	Not Applicable
NACIP	Navy Assessment and Control of Installation Pollutants
NADEP	Naval Aviation Depot
NAS	Naval Air Station
NATTC	Naval Air Technical Training Center
NAVFAC SE	Naval Facilities Engineering Command Southeast
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEESA	Navy Energy and Environmental Support Activity
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAEL	No observed adverse effects level
NOEC	No Observable Effects Concentration
Nox	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PCB	Polychlorinated biphenyl
PDI	Pre-Design Investigation
PM_{10}	Particles measuring 10 microns or less
PP	Proposed Plan
PPE	Personal protection equipment
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RBC	Risk-based Criterion
RCM	Reactive core mat
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
Sox	Sulfur Oxide
SQG	Sediment Quality Guideline
SVOC	semi-volatile organic compounds
SWPPP	Storm Water Pollution Prevention Program
TAL	Target Analyte List
TBC	To Be Considered
TCE	1,1,1-trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TEC	Threshold Effects Concentration
Tetra Tech	Tetra Tech NUS, Inc
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TSDF	Treatment, storage, and disposal facility
ug/kg	Micrograms per Kilogram
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile organic compound

EXECUTIVE SUMMARY

E.1 PURPOSE OF THE REPORT

The purpose of this Feasibility Study (FS) Report is to develop and evaluate potential remedial options for the contaminated sediment at Operable Unit (OU) 16 Site 41 – Combined Wetlands (Wetlands 3, 5A, 15, 18A, 18B, 48, and 64) at Naval Air Station (NAS) Pensacola, Florida.

E.2 SITE DESCRIPTION AND HISTORY

The United States Navy has maintained a presence in the Pensacola area since 1825 when a Navy yard was established on Pensacola Bay. Between 1828 and 1835, the Navy acquired approximately 2,300 acres as operations expanded. Several natural disasters in the early 1900's destroyed the yard and forced it into maintenance status in 1911. Three years later, the Navy's first permanent air station was established on the site of the old Navy yard. The air station has been the primary training base for naval aviators since that time and the base continues to expand.

For the purpose of organization within this FS, the wetlands within OU 16 have been grouped based on geographic location. Wetlands 3, 15, 18A, and 18B are all located within the vicinity of NAS Pensacola's OU 1 (Site 1) landfill. Wetland 5A and Wetland 64 are associated with NAS Pensacola's OU 2. The sites associated with OU 2 include Sites 11, 12, 25, 26, 27 and 30. Wetland 5A is located to the east of the A. C. Read Golf Course, and Wetland 64 is an approximately 41-acre area on the eastern shore of the upstream side of the NAS Pensacola Yacht Basin, which is in the northeastern quadrant of the base. The remaining wetland being evaluated is Wetland 48. Wetland 48 is in a mostly undeveloped portion of NAS Pensacola, north of Radford Boulevard, and south of the NAS Pensacola Fuel Farm.

E.3 REMEDIAL INVESTIGATION FINDINGS

A Remedial Investigation (RI) was completed for the NAS Pensacola Site 41 Combined Wetlands in three phases: (1) Phase I was performed during August 1994; (2) Phase II (formerly called IIA) was performed from November 1995 through January 1996; and (3) Phase III (formerly called IIB/III) was performed during August and September 1997. The RI conducted by EnSafe, Inc. included an evaluation of the nature and extent of contamination in surface water and sediment, an analysis of contaminant fate and transport, and human health and ecological risk assessments. The results of the RI were reported by EnSafe, Inc. in 2007. The RI identified adverse risk by human and ecological receptors to contaminants of potential concern (COPCs) in surface water and sediment. These COPCs are summarized for the Site 41 Combined Wetlands in the following sections.

Wetland 3

The following COPCs were identified in the RI in the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for Wetland 3:

HHRA COPCs

- Arsenic (adult maintenance worker dermal contact and ingestion, sediment)
- Methylene chloride (adult maintenance worker dermal contact and ingestion, sediment)

Surface water COPCs were not identified in the RI HHRA.

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include aluminum, barium, cadmium, chromium, iron, manganese, selenium, vanadium, zinc, aldrin, dieldrin, endosulfan sulfate, total chlordane, endrin, endrin ketone, carbon disulfide, alpha-hexachlorocyclohexane (BHC), total BHC, 4,4'-dichlorodiphenyldichloroethane (DDD), 4,4'- dichlorodiphenyltrichloroethane (DDT), total DDT, Aroclor-1260, total polychlorinated biphenyls (PCBs), 1,2-dichlorobenzene, 1,4-dichlorobenzene, and phenol.

Surface water COPCs retained in the RI based on ecological risk include aluminum, iron, lead, manganese, barium, cadmium, copper, vanadium, Aroclor-1260, endrin ketone, total endrin, acetone, total PCBs, total polynuclear aromatic hydrocarbons, 1,4-dichlorobenzene, chlorobenzene, and cis-1,2-dichloroethene (DCE).

Wetland 15

The following COPCs were identified in the HHRA and ERA for Wetland 15:

HHRA COPCs

- Arsenic (trespasser and worker dermal contact and ingestion, sediment and surface water)
- 4,4'-DDD (fisherman - fish tissue uptake from sediment)
- 4,4'-dichlorodiphenyldichloroethylene (DDE) (fisherman - fish tissue uptake from sediment)
- Aroclor-1260 (fisherman - fish tissue uptake from sediment)
- delta-BHC (fisherman - fish tissue uptake from sediment)

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include aluminum, arsenic, barium, beryllium, cobalt, iron, lead, manganese, selenium, vanadium, endosulfan I, heptachlor, endrin, endrin aldehyde, endrin ketone, total endrin, beta-BHC, delta-BHC, total BHC, 4,4'-DDD, total DDT, 2,2'oxybis(1-chloropropane)/bis(2-chlor), 2,4-dimethylphenol, 2-methylphenol (o-Cresol), 4-methylphenol (p-Cresol), and phenol.

Surface water COPCs retained in the RI based on ecological risk include the following: aluminum, antimony, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium, zinc, 4,4'-DDE, and total DDT.

Wetland 18A

The following COPCs were identified in the HHRA and ERA for Wetland 18A:

HHRA COPCs

- Arsenic (child trespasser and adult maintenance worker, sediment ingestion and dermal contact)
- Arsenic (child trespasser and adult maintenance worker, surface water dermal contact)

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include barium, iron, manganese, selenium, aldrin, alpha-chlordane, gamma-chlordane, total chlordane, endrin, endrin ketone, total endrin, beta-BHC, total BHC, 4,4'-DDD, 4,4'-DDT, total DDT, 1,4-dichlorobenzene, 4-methylphenol (p-Cresol).

Surface water COPCs retained in the RI based on ecological risk include the following: aluminum, arsenic, iron, lead, manganese, barium, chromium, and vanadium.

Wetland 18B

The following COPC was identified in the HHRA and ERA for Wetland 18B:

HHRA COPCs

- Arsenic (child trespasser and adult maintenance worker, sediment ingestion and dermal contact)

Surface water COPCs were not identified in the RI HHRA.

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include aluminum, arsenic, barium, beryllium, cyanide, iron, manganese, selenium, vanadium, 4,4'-DDD, 4,4'-DDT, and total DDT.

Surface water COPCs retained in the RI based on ecological risk include tiron, manganese, selenium, 4,4'-DDT, and total DDT.

Wetland 5A

The following COPC was identified in the HHRA and ERA for Wetland 5A:

HHRA COPCs
COPCs were not identified based on human health risk for Wetland 5A.

ERA COPCs
Sediment COPCs retained in the RI based on ecological risk include antimony, aluminum, barium, cadmium, cobalt, copper, lead, manganese, mercury, zinc, endosulfan I, endosulfan II, endosulfan sulfate, total endrin, total BHC, 4-methylphenol (p-Cresol), benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-chloroethoxy)methane, carbazole, indeno(1,2,3cd)pyrene, gamma-chlordane, total chlordane, 4,4'- DDD, 4,4'-DDT, and total DDT.

Surface water COPCs retained in the RI based on ecological risk include lead, manganese, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, vanadium, zinc, bis(2-ethylhexyl) phthalate (BEHP), dibromochloromethane, acetone, cis-1,2-DCE, acetone, bromodichloromethane, and 1,1-dichloroethane.

Wetland 48

The following COPC was identified in the HHRA and ERA for Wetland 48:

HHRA COPCs
COPCs were not identified based on human health risks for Wetland 48.

ERA COPCs
Sediment COPCs retained in the RI based on ecological risk include 4-4'-DDD, 4,4'-DDE, 4,4'-DDT, and total DDT.

Surface water COPCs were not identified based on ecological risk.

Wetland 64

The following COPCs were identified in the HHRA and ERA for Wetland 64:

HHRA COPCs

4-4'-DDD, 4,4'- DDE, 4,4'-DDT, aldrin, alpha-BHC, delta-BHC, alpha-chlordane, Aroclor-1254, Aroclor-1260, gamma-chlordane, and BEHP (game fish tissue ingestion, sediment)

Surface water COPCs were not identified in the RI HHRA.

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, selenium, silver, thallium, vanadium, zinc, heptachlor epoxide, aldrin, dieldrin, endosulfan I, endosulfan II, heptachlor, alpha-chlordane, gamma-chlordane, total chlordane, endrin, endrin aldehyde, total endrin, delta-BHC, gamma-BHC (Lindane), total BHC, 4,4'-DDD, total DDT, Aroclor-1254, Aroclor-1260, total PCBs, BEHP, 1,2-dichlorobenzene, 1,4-dichlorobenzene, carbazole, dibenzofuran, phenol, and carbon disulfide.

Surface water COPCs were not identified based on ecological risk.

E.4 TECHNICAL MEMORANDUM CONCLUSIONS

As part of the Preliminary Remediation Goal (PRG) process, the list of COPCs was further refined in a Technical Memorandum submitted by Tetra Tech NUS, Inc. to allow the FS to focus on those chemicals of concern (COCs) that are the primary risk drivers in each wetland (Appendix A). The Technical Memorandum refined the COPCs listed in Table 16-1 of the RI (EnSafe, 2007a) and provided the methodologies for developing the ecological and human health PRGs.

The following table provides the refined list of human health and ecological COCs for sediment at each of the Site 41 wetlands.

Wetland	Saltwater or Freshwater Wetland	Human Health COCs	Ecological COCs
3	Freshwater	Arsenic	Cadmium
5A	Freshwater	None	Copper, lead, and zinc
15	Saltwater	Arsenic	Arsenic, manganese, and selenium
18A	Freshwater	Arsenic	None
18B	Saltwater	Arsenic	None
48	Freshwater	None	4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and total DDT
64	Saltwater	None	Cadmium, chromium, copper, lead, silver, and zinc

The source of the human health COPCs in surface water at Wetlands 15 and 18A and ecological receptors at Wetlands 3, 15, and 18A are not completely derived from desorption from the sediments but is a combination of rainfall, nonpoint, and point source surface water runoff (e.g., drainage ditches and culverts) and discharge of groundwater into the wetlands. The source of the COCs that contribute to human health and/or ecological risk to surface water are currently being managed through permitted best management practices for storm water and through remedial decisions for groundwater for the individual OUs or sites. Therefore, because the surface water COPCs are being managed through other programs, this FS does not address impacts to surface water. Also, It should be noted that human health COPCs for surface water were not identified for Wetlands 3, 18B, 5A, 48, and 64 and ecological COPCs for surface water were not identified for Wetlands 48 and 64.

E.5 REMEDIAL ACTION OBJECTIVES AND PRELIMINARY REMEDIATION GOALS

Site-specific Remedial Action Objectives (RAOs) specify COCs, medium of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. This FS addresses contaminated sediment at Site 41. The RAOs were developed to permit consideration of institutional controls, monitoring, and containment alternatives based on current and potential future land use. The following RAOs were developed for Site 41 to protect the public from current and potential future health risks, as well as to protect the environment:

- Reduce unacceptable human health risk to maintenance workers associated with exposure to COCs at concentrations greater than PRGs established for sediment at Wetlands 3, 15, 18A, and 18B.

- Reduce, to the extent practicable, unacceptable risk to ecological benthic receptors exposed to COCs at concentrations greater than PRGs established for sediment at Wetlands 3, 5A, 15, 48, and 64.

Human Health COCs and corresponding PRGs for exposure to sediment by maintenance workers at Wetlands 3, 15, 18A, and 18B are presented in Section 2.1.5. Ecological COCs and corresponding PRGs for exposure to sediment by benthic receptors at Wetlands 3, 5A, 15, 48, and 64 are presented in Section 2.1.5.

E.6 REMEDIAL ALTERNATIVES FOR SEDIMENT

The following remedial alternatives were developed for Site 41 Wetlands:

- **SED-1: No Action (Wetlands 3, 5A, 15, 18A, 18B, 48, and 64).** No action would be taken. Retained as a baseline for comparison with other alternatives.

- **SED-2: Natural Recovery and Sediment Monitoring (Wetlands 3, 5A, 15, 18A, 18B, 48, and 64).** Natural recovery would consist of allowing naturally occurring processes to reduce the risks posed by sediment COCs over time. To evaluate natural recovery, sediment samples would be regularly collected and analyzed to establish trends in concentrations of COCs. Sediment monitoring would be implemented by conducting a Baseline Investigation to characterize the current concentrations of COCs in sediment. Sediment monitoring would consist of regularly collecting and analyzing sediment samples for human health and ecological COCs from within the areas of concern at Wetlands 3, 5A, and 18A, and ecological COCs from within the areas of concern at Wetlands 48 and 64. The sediment monitoring will be conducted to assess natural recovery and verify that migration of the COCs is not occurring.

  Sediment samples would also be collected at Wetland 18B to confirm that human health COC concentrations are below their PRGs. Sediment samples were collected from only one location at Wetland 18B in 1995 and 1997. Arsenic was detected at a concentration of 83.8 milligrams per kilogram (mg/kg) in 1995, which exceeds the PRG (14 mg/kg). The sample collected from the same location in 1997, however, contained arsenic at a concentration of 13.8 mg/kg. Because of the difference in the analytical results, there is some uncertainty in whether arsenic concentrations exceed the PRG, therefore, only sediment monitoring is retained for evaluation of Wetland 18B in the FS.

- **SED-3: Land Use Controls (LUCs), Natural Recovery, and Sediment Monitoring (Wetlands 3, 15, 18A, and 18B).** LUCs would consist of restrictions on land use to eliminate or reduce the potential for unacceptable human health risks because of exposure to contaminated sediment by restricting access to the wetlands. The LUCs would be maintained for as long as they are required to prevent unacceptable exposure to contaminated sediment and/or to preserve the integrity of the selected remedy. The natural recovery and sediment monitoring components of SED-3 would be the same as SED-2 for Wetlands 3, 15, 18A, and 18B. Sediment monitoring would evaluate natural recovery processes and consist of regularly collecting and analyzing sediment samples for human health and/or ecological COCs from within the areas of concern at Wetlands 3, 15, 18A, and 18B. Sediment monitoring would be implemented by conducting a Baseline Investigation to characterize the current concentrations of COCs in sediment.

- **SED-4: Ex-Situ Treatment - Excavation and Off-Site Disposal (Wetlands 3, 5A, 15, 18A, 48, and 64).** To ensure that this alternative removes the required amount of sediment to eliminate the risk to human and/or ecological receptors at Wetlands 3, 5A, 15, 18A, 48, and 64, the implementation of this alternative would include a Pre-Design Investigation (PDI) to refine the extent of the required excavation. The results from the PDI would be used to adjust the extent of the excavation. At Wetlands 3, 5A, 15, 18A, and 48, sediment with COCs at concentrations greater than human health and/or ecological PRGs would be excavated to 1 foot below ground surface (bgs). Because of the depth of water at Wetland 64 is approximately 8 to 10 feet over the proposed excavation areas (around the boat dock area), dredging would be performed using hydraulic dredging methods. Sediment with concentrations of COCs greater than ecological PRGs at Wetlands 64 would be excavated via dredging to 1 foot bgs. A digital global positioning system (DGPS) would be used to control the limits of the submerged cutter head on the hydraulic dredging equipment. Following the removal of contaminated sediment at Wetlands 3, 5A, 15, 18A, 48, and 64, verification samples would be collected from the excavation area to confirm the removal of COCs to concentrations less than their PRGs. Although the COCs are at concentrations that are considered to present adverse human health and/or ecological risks at the Site 41 Wetlands, the excavated sediment and cleared vegetation would be considered non-hazardous and could be disposed of in a Resource Conservation and Recovery Act Subtitle D landfill. Wetland reconstruction would include the planting of native species in the excavated areas.

It should be noted, however, that because proposed remedies SED-2 and SED-3 will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use/unrestricted exposure, a statutory review will be conducted within five years of initiation of the remedy and every five years thereafter to ensure that the remedy continues to be protective of human health and the environment.

Overall Protection of Health and Environment

Alternative SED-1 would not provide protection of human health and the environment. Alternatives SED-2 and SED-3 (Wetlands 3 and 15) would not be immediately protective of human health and/or ecological receptors. However, natural processes could eventually reduce the COCs to concentrations below their PRGs in the Site 41 wetland sediments. Human health and/or ecological receptors would be protected over time as naturally occurring processes reduce COCs to concentrations below their PRGs. SED-3 would be more protective of human health for Wetlands 3, 15, 18A, and 18B than SED-2. LUCs restricting access would be protective of human health by preventing unacceptable risks to workers from direct exposure to contaminated sediment. SED-4 would be more protective of human and ecological receptors for Wetlands 3, 5A, 15, 18A, 48, and 64 than SED-2 and SED-3. Removal of sediment that is contaminated above PRGs would eliminate or reduce the potential for unacceptable human health and ecological risks as a result of exposure to sediment contaminated by the COCs.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

SED-1 would not comply with chemical-specific ARARs because no action would be taken to reduce contaminant concentrations. SED-2 and SED-3 would eventually comply with location-, and action-specific ARARs. Chemical-specific ARARs are expected to be achieved through natural recovery. Sediment monitoring would be performed to evaluate natural recovery in alternatives SED-2 and SED-3. SED-4 would comply with the chemical-, location-, and action-specific ARARs for Wetlands 3, 5A, 15, 18A, 48, and 64.

Long-Term Effectiveness and Permanence

SED-1 would not have long-term effectiveness and permanence because contaminated sediment would remain on site. SED-2 would eventually provide long-term effectiveness and permanence after the COCs are reduced to concentrations below their PRGs through naturally occurring processes. Sediment monitoring of natural recovery processes would allow for evaluation of risks to human and/or ecological receptors over time. SED-3 would provide long-term effectiveness for human health receptors by restricting access to prevent unacceptable risk from direct exposure to the COCs by workers. SED-4 would provide long-term effectiveness and permanence by the removal of sediment with COCs at concentrations greater than their PRGs. This would effectively and permanently prevent unacceptable risk to human and/or ecological receptors from exposure to contaminants. This could also minimize the potential for leaching of the COCs from sediments to surface water.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives SED-1, SED-2, SED-3, and SED-4 would not reduce the toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and/or mobility of the COCs is expected to occur during the implementation of SED-2 and SED-3 through sedimentation, leaching, biodegradation, and other natural attenuating factors. SED-4 would reduce the volume of contaminants through permanent removal and off-site disposal of the sediment with COCs at concentrations greater than their PRGs. SED-4 would generate a wastewater residual from the on-site sediment dewatering operations, and it is anticipated that this wastewater could be discharged to the wetland from which it was obtained after some minimal treatment.

Short-Term Effectiveness

Because no action would occur, implementation of SED-1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community or the environment. Some short-term risks could be incurred by workers from exposure to contaminated sediment during on-site sampling activities in Alternatives SED-2 and SED-3 and during on-site remedial activities in Alternative SED-4. The potential for exposure, however, would be minimized by the wearing of appropriate personal protection equipment and compliance with Occupational Health and Safety Administration regulations and site-specific health and safety procedures. For Alternative SED-4, any potential negative short-term impacts to the surrounding community and environment from fugitive emissions and/or spillage of contaminated sediment could be minimized through the implementation of appropriate engineering controls (e.g., perimeter air monitoring, spill prevention procedures, etc.). SED-4 will have some potential short-term negative impacts to the community, however, because truck traffic may increase the noise level and/or result in spillage.

Implementability

SED-1 would be the easiest to implement because there would be no activities to implement. Alternatives SED-2 and SED-3 would also be easily implemented. The administrative aspects of SED-2 and SED-3 would be relatively simple to implement. If site ownership changed, appropriate provisions would be incorporated into the property transfer documents to ensure continued implementation of regular sediment monitoring for SED-2 and SED-3 and land use restrictions for Alternative SED-3. SED-4 would be the most complicated to implement.

The excavation component (Wetlands 3, 5A, 15, 18A, and 48) and dredging component (Wetland 64) of SED-4 could be performed with specialized construction equipment, resources, and materials that would be available for this purpose. The dredging component for Wetland 64 would be slightly more difficult than the excavation component for Wetlands 3, 5A, 15, 18A, and 48, because the removal would be in the boat dock area where equipment movement would be more challenging.

The administration aspects of SED-4 would be moderately difficult to implement. The off-site transportation and disposal of the excavated sediment and vegetation would require the completion of administrative procedures, which could readily be accomplished. To perform excavation/dredging and reconstruction of a wetland during SED-4, however, the involvement of the United States Army Corps of Engineers (USACE), Florida Department of Environmental Protection, and United States Environmental Protection Agency is required to permit properly construction activities.

Implementing SED-4 may result in unintended consequences that include damage to the existing wetlands and adjacent areas. Unintended environmental damage from construction activities in wetland areas typically include direct habitat loss, addition of suspended solids and modification of water levels and flow regimes. Negative impacts from the ecological damage could range from changes to the chemistry and biology of the local area to changes in hydrology that go well beyond the immediate area.

Cost

Wetland	Alternatives			
	SED-1 (Net Present Worth)	SED-2 (Net Present Worth)	SED-3 (Net Present Worth)	SED-4 (Capital Cost)
3	$0	$84,000	$134,000	550,000
5A	$0	$88,000	---	$776,000
15	$0	$88,000	$134,000	$882,000
18A	$0	$81,000	$134,000	$787,000
18B	$0	$81,000	$134,000	---
48	$0	$96,000	---	$3,234,000
64	$0	$135,000	---	$4,597,000
--- = No human health or ecological COCs; therefore, cost is not provided.				

Sustainability Evaluation Results

Based on the SiteWise model results, SED-4 will have greater greenhouse gas emissions, criteria pollutant emissions, energy consumption, water usage, and worker risk than the other alternatives evaluated. Therefore, SED-2 appears to be more sustainable and is capable of accomplishing the clean up goals in a timely and cost effective manner.

SiteWise is a stand-alone tool developed jointly by the U.S. Navy, USACE, and Battelle that assesses the environmental footprint of a remedial alternative/technology in terms of a consistent set of metrics in the August 2009 Department of Defense policy for "Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program."

1.0 INTRODUCTION

The United States Navy has maintained a presence in the Pensacola area since 1825 when a Navy yard was established on Pensacola Bay. Between 1828 and 1835, the Navy acquired approximately 2,300 acres as operations expanded. Several natural disasters in the early 1900's destroyed the yard and forced it into maintenance status in 1911. Three years later, the Navy's first permanent air station was established on the site of the old Navy yard. The air station has been the primary training base for naval aviators since that time, and the base continues to expand.

1.1 PURPOSE AND ORGANIZATION OF REPORT

This Feasibility Study (FS) Report for Operable Unit (OU) 16, Site 41 Combined Wetlands (Wetlands 3, 5A, 15, 18A, 18B, 48, and 64) at Naval Air Station (NAS) Pensacola, Florida, has been prepared by Tetra Tech NUS, Inc. (Tetra Tech) for Naval Facilities Engineering Command Southeast (NAVFAC SE) under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract Number N62467-04-D-0055, Contract Task Order (CTO) 0030.

Site 41 encompasses approximately 81 wetlands or wetland complexes, both tidal and non-tidal, within the base boundary of NAS Pensacola. Based on results presented in the Final Site 41 Remedial Investigation (RI) Report (EnSafe, 2007a), RI Report Addendum (EnSafe, 2007b), and the Technical Memorandum (provided in Appendix A) (Tetra Tech, 2010a), the following wetlands were retained for evaluation in this FS:

- Wetland 3
- Wetland 5A
- Wetland 15
- Wetland 18A
- Wetland 18B
- Wetland 48
- Wetland 64

The other wetlands in Site 41 were not retained because human health or ecological risk drivers were not identified at these sites in either the RI or the Technical Memorandum. This FS establishes Remedial Action Objectives (RAOs) and Preliminary Remediation Goals (PRGs); screens remedial technologies; and assembles, evaluates, and compares remedial alternatives for contaminated sediment at these seven retained Site 41 wetlands.

For the purpose of organization within this FS, the wetlands within OU 16 have been grouped based on geographic location. Wetlands 3, 15, 18A, and 18B are all located within the vicinity of NAS Pensacola's OU 1 (Site 1) landfill. Wetland 5A and Wetland 64 are associated within NAS Pensacola's OU 2. Wetland 5A is located to the east of the A. C. Read Golf Course, and Wetland 64 is an approximately 41-acre area on the eastern shore of the upstream side of the NAS Pensacola Yacht Basin, which is in the northeastern quadrant of the base. The remaining wetland being evaluated is Wetland 48. Wetland 48 is in a mostly undeveloped portion of NAS Pensacola, north of Radford Boulevard, and south of the NAS Pensacola Fuel Farm.

This FS Report has been organized with the intent of meeting the general format requirements specified in the United States Environmental Protection Agency (USEPA) RI/FS Guidance Document (USEPA, 1988) and contains the following five sections:

- Section 1.0, Introduction, summarizes the purpose of the report, provides site background information, summarizes the findings of the RI, and provides the report outline.

- Section 2.0, Remedial Action Objectives and General Response Actions, presents the RAOs, identifies Applicable or Relevant and Appropriate Requirements (ARARs), develops groundwater cleanup goals for chemicals of concern (COCs) and associated General Response Actions (GRAs), and provides estimates of the volumes of contaminated sediment to be remediated.

- Section 3.0, Screening of Remediation Technologies and Process Options, provides a two-tiered screening of potentially applicable sediment remediation technologies and identifies the technologies that were assembled into remedial alternatives.

- Section 4.0, Assembly and Detailed Analysis of Remedial Alternatives, assembles the remedial technologies retained from the Section 3.0 screening process into multiple sediment remedial alternatives, describes these alternatives, and performs a detailed analysis of these alternatives in accordance with seven of the nine Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) evaluation criteria.

- Section 5.0, Comparative Analysis of Remedial Alternatives, compares the sediment remedial alternatives on a criterion-by-criterion basis, for each of the seven CERCLA analysis criteria used in Section 4.0.

Appendix A contains the Technical Memorandum, Appendix B contains contaminant mass calculations, Appendix C contains the sustainable remediation evaluations, Appendix D contains the sediment excavation calculations, and Appendix E contains the Preliminary Data Report for Wetland 64.

1.2 OPERABLE UNIT 1 (SITE 1) SANITARY LANDFILL

Site 1 is an approximately 85-acre inactive sanitary landfill. Wetlands associated with Site 1 include 1, 3, 4D, 15, 16, 17, 18A, and 18B. Human health or ecological risk drivers were not identified at Wetlands 1, 4D, 16, or 17; therefore, these wetlands are not discussed further in this FS. The landfill was used from the early 1950's until 1976 for disposal of solid and industrial waste generated at NAS Pensacola as well as outlying Navy installations. The site received various wastes, such as polychlorinated biphenyls (PCBs), solvents, pesticides, oils, plating solutions, mercury, asbestos, paint chips and sludge, medical waste, pressurized cylinders, and household garbage. In addition, a tar pit was found on the western edge of the landfill and was the subject of a removal action.

The site elevation is from 8 to 20 feet above mean sea level (msl) and is densely vegetated with 15- to 25-foot tall planted pines and natural scrub vegetation. The site is within the north central portion of NAS Pensacola, approximately ½ mile east of Forrest Sherman Airfield. The landfill is bordered by an inland water body (Bayou Grande) to the north, by the A. C. Read Golf Course to the east, and by areas of natural scrub vegetation to the west and south. Beyond the scrub vegetation, Taylor Road lies approximately 200 feet south of the site. Developed areas immediately north of the landfill include a Boy Scout camp, a nature trail, an NAS Pensacola picnic area, and recreational Buildings 3553 and 3487.

Because soil is highly permeable at the site, the potential for substantial contamination transfer via surface water flow is limited. Two intermittent creeks lie within wetlands outside the landfill. One creek, approximately 50 to 100 feet east of the landfill's central portion (depending upon precipitation amounts), channels flow northeastward to a beaver pond (Wetland 3). The other originates approximately 500 feet west of the landfill's central portion and channels flow northwestward to Bayou Grande. Neither has been observed to receive direct surface water runoff from the landfill; it appears that they are fed by groundwater seepage when the water table is high. A dry stream bed is in the site's northern portion, immediately south and leading to Bayou Grande Pond. Surface water was not observed in this stream bed during the RI.

Buried waste in the landfill has been characterized in the RI as containing detectable concentrations of the analyzed parameters including inorganics, volatiles, semivolatiles, pesticides, and PCBs. The concentrations of target analytes in surface soil outside the landfill boundary appear to be similar to background. Subsurface soil within the boundary appears to have been impacted by landfill activities, thus resulting in the presence of inorganic and organic constituents at concentrations exceeding screening and regulatory criteria.

1.2.1 Shallow and Intermediate Groundwater

Groundwater in the surficial zone at Site 1 flows in an overall northward direction during both low and high tide, with components of flow to the north-northwest, northwest, and northeast toward Bayou Grande and other surface water features. This flow pattern generally mimics site topography, which is characteristic of unconfined surficial aquifers with high transmissivities.

The groundwater in the aquifer beneath Site 1 has been classified by the USEPA and the Florida Department of Environmental Protection (FDEP) as Class IIA and G-2, a potential source of drinking water (EnSafe, 2007a). The nature and extent of landfill-impacted groundwater have been evaluated on site. Inorganic and organic constituents are present in the surficial zone (shallow and intermediate well depths) beneath the site. Groundwater analytical results from 1993 and 1994 indicate that the 1993 analytical results were adversely affected (biased) by sample turbidity. The 1993 samples were collected with Teflon bailers, while the 1994 samples were collected with quiescent sampling techniques. Based on 1994 analytical results, groundwater quality impacts by inorganics to the shallow and intermediate aquifer zones appear to be limited to the site's center, along the landfill's eastern, western, and northwestern boundaries. Except for aluminum, iron, and manganese [indicated by background data to naturally occur at elevated (exceed regulatory standards) concentrations], inorganic concentrations exceeding regulatory standards are generally limited to areas within and around the landfill perimeter.

Organic constituents have consistently been detected above regulatory standards in Site 1 surficial groundwater samples. Consistent with the distribution of elevated inorganics, the highest organic concentrations were detected in groundwater samples collected at the site's center and along the eastern and western boundaries. Organic constituents extend downgradient from the landfill to areas along Bayou Grande's coastline, adjacent wetlands, and east-northeast beneath the golf course. Elevated inorganic or organic concentrations (except for a single pesticide concentration) were not detected in groundwater samples collected from the most downgradient monitoring well across the golf course opposite the landfill. This indicates that the organic constituents in groundwater that have migrated east-northeast from the landfill are limited to the area beneath the adjacent golf course. As with inorganics, organic constituent concentrations exceeding regulatory standards appear to be limited to areas within and around the landfill's perimeter.

The wetlands associated with Site 1 include Wetlands 1, 3, 4D, 15, 16, 17, 18A, and 18B. Wetlands 1, 4D, 16, and 17 were not retained for evaluation of remedial alternatives in this FS because human and ecological COCs were not identified for sediment

Figure 1-1 shows the location of the wetlands on a United States Geological Survey (USGS) 7.5-minute topographical map, and Figure 1-2 shows the wetland locations in relation to other facility features on a topographic map. Figure 1-3 shows Wetlands 3, 15, 18A, and 18B locations in relation to Site 1.

1.2.2 Wetland 3

Wetland 3 is located in the northern central portion of NAS Pensacola, west of the A. C. Read Golf Course and east of Site 1. This area is an old beaver pond that is a palustrine system with the predominant vegetation being scrub shrub emergent. Currently, the wetland consists of a highly vegetated emergent area characterized by sweet bay magnolias (*Magnolia virginian*), cattails (*Typha latifolia*), and saw grass (*Cladium jamaicense*). A shallow sheet flow of clear water drains from the southwest to the northeast through a culvert, which runs under John Tower Road, and beneath a golf course fairway into Wetland 4D, which empties into Bayou Grande. The open water portion of the wetland ranges from 0 to about 3 feet in depth and from 3 to 500 feet in width.

1.2.3 Wetland 15

Wetland 15 is on the shore of Bayou Grande, just northeast of Site 1, between Wetland 4D and the NAS Pensacola Picnic Ground. This wetland is bordered by the A. C. Read Golf Course to the south, east, and west, and Bayou Grande to the north. Wetland 15 is fed from the south by surface water runoff from the area of the golf course and from the north by tidal influences from Bayou Grande. Site 1 groundwater also flows toward this wetland.

Wetland 15 is an estuarine emergent system, with predominantly black needle rush *(Juncus romerianus)*. Wetland 15 generally flows north into Bayou Grande through a drainage channel about 3 feet wide. The open water portion of the wetland ranges from 1 to about 3 feet in depth and has a maximum width of about 300 feet. Sediment in the wetland is highly organic, with total organic carbon (TOC) up to 40 percent.

1.2.4 Wetland 18

Wetland 18 is located adjacent to the eastern shore of Redoubt Bayou, which is along the northern shoreline of Bayou Grande, situated at the midpoint of NAS Pensacola. Wetland 18 is

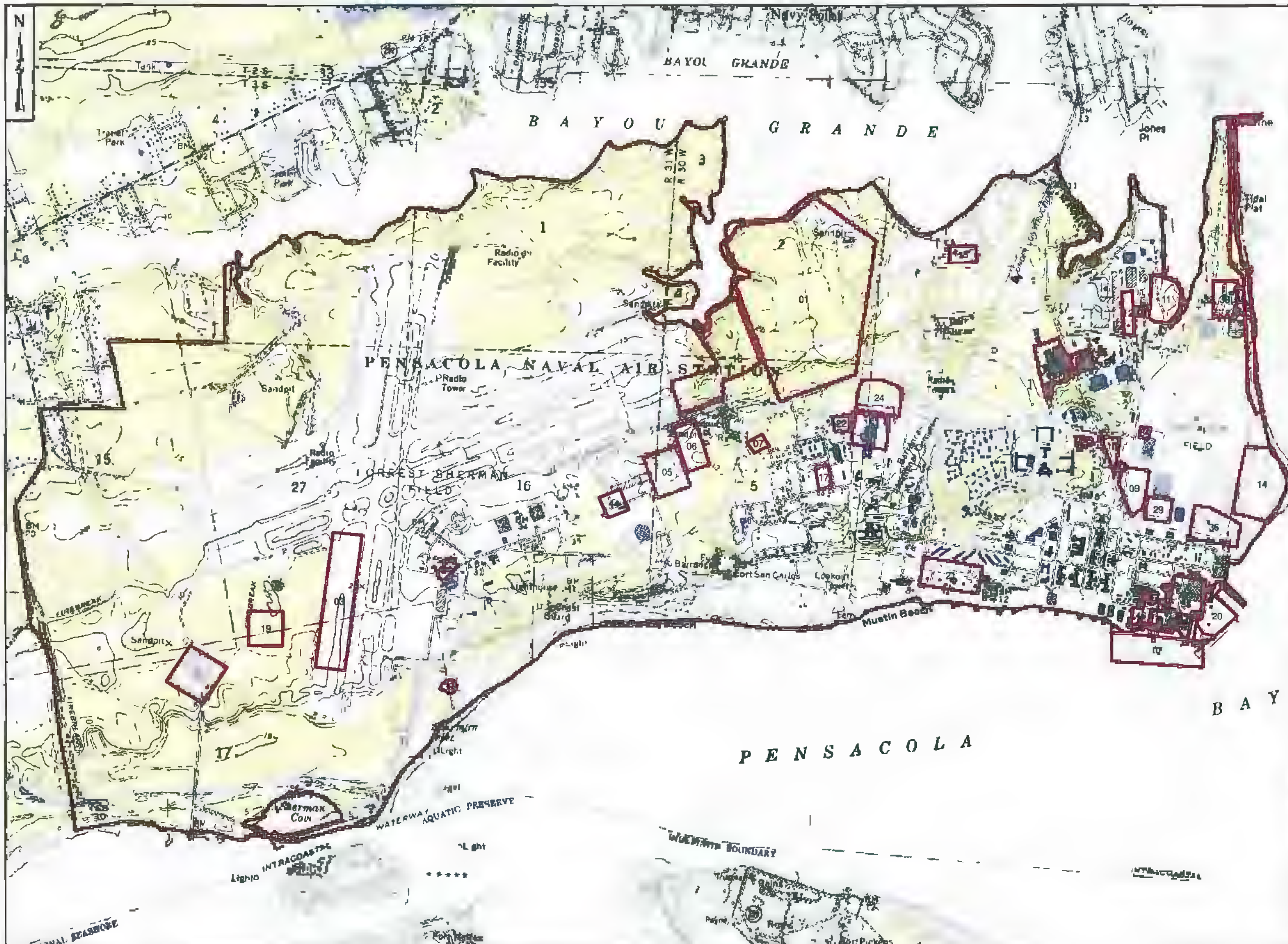

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Figure 1-1
Site Location Map
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

Site Boundary
Installation Boundary

0 2,000 Feet

TETRA TECH

Drawn By K MOORE 11/26/08
Checked By N ROCHNA 7/31/09
Approved By

Contract Number 112G00390
CTO 030

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Figure 1-2
NAS Pensacola Wetlands and Associated Sites
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

Road
Building
Wetland
Installation Boundary
Water

3,000 1,500 0 3,000
Feet

TETRA TECH

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Contract Number 112G00390
CTO 030

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Figure 1-3
Site Location Map
Wetlands 3, 15, 18A, and 18B
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Site Boundary
- Building
- Road
- Landfill Boundary
- Installation Boundary
- Water

700 350 0 700 Feet

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P:\GIS\PENSACOLA_NAS\MAPDOCS\MXD\SITE01_WETLANDS_LOCATION.MXD 12/21/10 KM influenced by Site 1 due to its proximity to that area. Wetland 18 is divided into two parts, A and B. Wetland 18A is classified as a palustrine emergent system, and Wetland 18B is classified as an estuarine emergent system. Wetland 18A is fed by groundwater seeps from Site 1 to the east and is a long narrow finger-shaped wetland running east to west. Wetland 18A, which is no deeper than a foot, and has a maximum width of 2 feet, transitions to Wetland 18B via a stream, approximately 2-feet wide, and located to the west. Wetland 18B is at the mouth of Wetland 18 and Redoubt Bayou and ranges from 1 foot to 8 feet deep, with a maximum width of 50 feet. Redoubt Bayou borders Wetlands 18A and 18B to the west, and Site 1 borders the wetlands to the east. This entire system is very shallow with occasional tidal surface flow and receives freshwater from a small surface water drainage pattern.

1.2.5 Ecological Risk Assessment (ERA)

The Site 41 wetlands were evaluated collectively to help determine where the highest probabilities of unacceptable ecological risk may occur and whether the risk is likely to be related to exposure from Site 1 at NAS Pensacola. For Site 41 wetlands, the tools that were used to evaluate risk on an OU-wide basis include the following:

- **Food-Chain Models (FCMs):** Many of the upper-level predators likely to be present within Site 41 wetlands could be exposed to contaminants of potential concern (COPCs) from more than one wetland. To evaluate this scenario, food-chain models were conducted on an OU-wide basis.

- **Effects Range Mean (ERM) Quotients:** This methodology is an effective way to pinpoint areas of potential excess risk from a mixture of COPCs. It is also useful in identifying locations most likely to be impacted by direct toxicity.

- **Base-wide Total Dichlorodiphenyltrichloroethane (DDT)-Level Comparison:** A base-wide screening level for total DDT was established at NAS Pensacola, and the DDT concentrations for each wetland were compared to the base-wide screening level.

- **TOC-Normalized Polynuclear Aromatic Hydrocarbon (PAH) Concentrations:** PAHs are widespread across NAS Pensacola, have been evaluated for each wetland based on their potential for adverse ecological effects, and are also considered the wetland-specific TOC.

- **TOC-Normalized Volatile Organic Compound (VOC) Concentrations:** The article *Technical Basis for Narcotic Chemicals and PAH Criteria. II. Mixtures and Sediments* (Di Toro, J. M. and J. A. McGrath, 2000) explains how TOC-normalized VOC concentrations in sediment can be compared to Equilibrium Partitioning Quotient (EqP) Sediment Quality Guideline (SQGs) to develop Hazard Quotients (HQs) for evaluation of potential sediment toxicity. Since wetland-specific TOC is available for this site, each Di Toro SQG is normalized based on the amount of organic carbon present at each location (rather than 1% as in the original methodology). At wetlands where TOC is not available for each sample location, the lowest TOC measured in that wetland was used as a conservative surrogate.

1.2.6 OU 1 Food-Chain Modeling

To evaluate the potential for risk to upper-trophic-level receptors that forage within the wetlands surrounding OU 1, FCMs were prepared. The wetlands in this evaluation include the following:

- Wetland 1
- Wetland 3*
- Wetland 4D
- Wetland 15
- Wetland 16*
- Wetland 17
- Wetland 18A and 18B*

Those wetlands with an asterisk were resampled and evaluated using the original Phase II RI data and the Phase III RI data. During the Phase III RI, fish tissue was collected at Wetland 18B and was included in the FCMs. FCMs were evaluated for three assessment endpoints as described below.

The following constituents were evaluated in the FCMs:

Pesticides [total hexachlorocyclohexane (BHC), total DDT, total chlordane, total endrin, and dieldrin]

- Total PCBs
- Mercury

1.2.8.1 Assessment Endpoint 1 — Health and Viability of Piscivorous Bird Communities that Forage in OU 1 Wetlands

Phase II RI Evaluation

The Phase II RI data indicated estimated daily doses of mercury and total DDT generate HQs greater than 1. Based on this exposure, there is some potential for unacceptable risk to piscivorous bird communities that feed exclusively from wetlands within Site 1. The daily dose for piscivorous birds was calculated, using the site-specific sediment and surface water concentrations and an estimated prey concentration based on literature Biota Sediment Accumulation Factor (BSAF).

Total DDT HQs for piscivorous birds ranged from 9.68 [maximum detected concentration / no observed adverse effects level (NOAEL)] to less than 1 [average concentration/lowest observed adverse effects level (LOAEL)]. The maximum detected concentration of total DDT [2.4 milligram per kilogram (mg/kg)] was detected in Wetland 18A at sample location 041M18A101. Total DDT was detected in each of the Site 1 wetlands, except for Wetland 17. The two highest detected concentrations of total DDT were both located in Wetland 18 (2.4 mg/kg at 041M18A101 and 2.1 mg/kg at 041M18B101). Wetland 18 was selected as a wetland for sampling during Phase III RI. During this round of sampling, fish tissue was collected from location 041M18B101 to evaluate the site-specific bioaccumulation of constituents detected in sediments.

None of the other constituents generated FCM HQs greater than 1 based on estimated exposure to piscivorous birds.

Phase III RI Evaluation

During the Phase III RI, sediment and surface water sampling was conducted along with fish tissue collection. Wetlands 3, 16, and 18B were resampled, and forage fish were collected at Wetland 18B. The site-specific tissue data replaced the estimates used in the Phase II RI FCMs. Using the site-specific data collected during the Phase III RI, none of the constituents generated FCM HQs greater than 1.

1.2.8.2 Assessment Endpoint 2 — Health and Viability of Piscivorous Mammal Communities that Forage in OU 1 Wetland

Phase II RI Evaluation

The Phase II RI data indicate concentrations of mercury generate HQs greater than 1 based on an estimated daily dose. Based on this exposure, there is some potential for unacceptable risk to piscivorous bird communities that feed exclusively from wetlands within OU 1. The daily dose for piscivorous birds was calculated, using the site-specific sediment and surface water concentrations and an estimated prey concentration based on literature BSAFs.

The mercury HQs for piscivorous mammals exceeds 1 and indicates the potential for unacceptable risk. Mercury HQs range from 4.51 (maximum detected concentration/NOAEL) to 0.17 (average concentration/LOAEL). Mercury was detected in Wetlands 1, 4D, and 16, with the maximum concentration detected in Wetland 16 (0.41 mg/kg at sample location 041M16020A). Dieldrin generated a HQ of 1.2 (maximum detected concentration/NOAEL) and 0.005 (average concentration/LOAEL). The maximum sediment concentration of dieldrin was detected at Wetland 1A. None of the other constituents generated an HQ greater than 1 for piscivorous mammals within OU 1.

Phase III RI Evaluation

The Phase III RI indicates that mercury was detected in three of the four sediment samples collected, with the maximum detected concentration of (0.1 mg/kg in Wetland 3 (041M030201). The fish tissue collected in Phase III RI was not analyzed for mercury. Therefore, fish tissue samples collected in the area of Wetland 18B for the Site 40, Bayou Grande, RI (EnSafe, 1999) have been used to fill this data gap. None of the COPCs generated any FCM HQs greater than 1 for piscivorous mammals.

1.2.8.3 Assessment Endpoint 3 — Health and Viability of Predatory Fish Communities that Forage in OU 1 Wetland

This assessment endpoint was evaluated using the Evans and Engels FCM for mercury. Using the Phase II RI sediment concentrations, this model generated HQs for mercury ranging from 7.02 (maximum detected concentration/NOAEL) to 1.88 (average concentration/LOAEL), indicating the potential for unacceptable risk to predatory fish.

Mercury concentrations identified from the Phase III RI sampling event were used in the FCMs. The mercury HQs for OU 1 wetlands range from 1.31 to 0.37 indicating that the maximum detected concentration poses an unacceptable risk to ecological receptors. Based on the FCM results using the most recent data, the maximum detected concentration location is the only sample that posed an unacceptable risk to predatory fish.

FCM Summary for OU 1

Based on the site-specific biota tissue sampling conducted at Wetlands 3, 16, and 18B, the assessment endpoint identified with the potential for risk was predatory fish. The maximum NOAEL HQ for this endpoint was 1.37, and the maximum LOAEL HQ is 0.65 assuming that the exposure occurred at the location of the maximum concentrations. Evaluating exposure at the average concentration measured in the OU 1 wetlands generates a NOAEL HQ of only 0.74.

1.2.9 Mean ERM Quotients

Sample locations in Wetlands 1B, 4D, 15, 16, and 18A were identified in the Phase II RI as likely to have contaminants in sediment that cause adverse affects to benthic invertebrates. The primary constituents exceeding individual ERM criteria included total DDT (and daughter products) within each wetland, cadmium (limited to Wetland 3), and several others only detected once (lead and PCBs). After the Phase III RI sampling was completed, however, reductions of constituent concentrations resulted in the wetlands being considered to have uncertainty regarding adverse effects because average survival approximates the critical threshold of 80 percent. Although several ERM exceedances are noted in the Phase II RI samples, only one constituent, total DDT, exceeded its ERM at one Phase III RI sampling location. These results indicate direct toxicity resulting from exposure to Site 1 wetland sediments is not likely (although it is possible) at the Phase III RI sampling locations.

The Phase II data indicates that the constituent most frequently exceeding its ERM was total DDT (and its daughter products). Cadmium also exceeded its ERM in a Phase II RI sediment sample at 1 of 10 locations. Of the four sample locations selected for sediment toxicity testing in Wetlands 3, 16, and 18B during the Phase III RI (41M030201, 41M030701, 41M160301, and 41M18B101) the only statistically significant toxic effect observed was for Wetland 3 at sample location 41M030701. The two constituents that generated the highest screening and refinement HQs in Wetland 3 were cadmium (9.3 mg/kg) and total DDT [69.3 microgram per kilogram (µg/kg)]. Wetland 3 was the only Site 1 wetland with cadmium at concentrations that had screening HQs greater than 1.

1.2.10 Base-wide Total DDT Levels

During the Phase II RI sampling, Wetlands 3, 4D, 15, 18A, and 18B had at least one sample exceeding the base-wide total DDT level. Because the Phase III RI sampling was not focused on total DDT results, many of these exceedances were not resampled. Of the OU 1 locations that were resampled during the Phase III RI, the only location sampled exceeding the base-wide level was in Wetland 18B.

1.2.11 TOC-Normalized PAH Concentrations

The Phase II RI sampling results indicate that the only wetlands with locations exceeding the Swartz Threshold Effects Concentration (TEC) were at Wetlands 1B (two locations) and 4D (one location). None of the locations exceeded the Swartz Extreme Effects Concentration (EEC), which indicates a virtual certainty of adverse effects. The Phase III RI sampling event results indicate that only Wetland 16 had a sample location exceeding the Swartz TEC. No statistically significant differences were observed when compared to the control for the site-specific toxicity testing conducted for Wetland 16 at sample location 041M1603.

1.2.12 TOC-Normalized VOC Concentrations

None of the Site 1 VOC detections had an HQ greater than 1.

1.2.13 OU1 Conclusions

Using the lines of evidence provided for the ERA, unacceptable risk was identified for direct toxicity to benthic invertebrates at Wetland 3. Because of the significantly different analytical results between the Phase II and III RIs and the limited number of samples collected during the Phase III RI, the Navy is also evaluating remedial alternatives for Wetlands 15 and 18A based on the Phase II RI results.

1.3 OPERABLE UNIT 2 AND ASSOCIATED WETLANDS

OU 2 is located in the northeastern portion of the base and is roughly 300 acres. OU 2 includes Sites 11 (North Chevalier Disposal Area), 12 (Scrap Bins), 25 (Radium Spill Area), 26 (Supply Department Outside Storage Area), 27 (Radium Dial Shop), and 30 (Building 649 Complex). The OU 2 investigation also included a portion of the former industrial waste water treatment plant (IWTP) sewer line serving the OU 2 area. The Site 41 wetlands associated with OU 2 include Wetlands 5A, 5B, 6, and 64. Wetlands 5B and 6 were not retained for evaluation of remedial alternatives in this FS because human and ecological COPCs were not identified for sediment. For continuity in discussing descriptions of the OU 2 wetlands, they have been included in this discussion. Figure 1-4 shows the locations of Wetland 5A and 64.

1.3.1 Wetland 5

Wetland 5, a wooded area within the developed portion of NAS Pensacola, is flanked to the west by the A. C. Read Golf Course, to the north by the former Naval Aviation Depot (NADEP) Dynamic Components Division (Building 649 Complex) and other buildings formerly used by NADEP, and to the south by Taylor Road. Wetland 5 is divided into two parts, 5A and 5B. Wetland 5A is a palustrine forested system, and Wetland 5B is a palustrine emergent system.

Wetland 5A (roughly 1.3 acres) is connected to Wetland 5B (1.2 acres) by a culvert, which runs under Murray Road. Wetland 5A is bordered by Murray Road to the east, the golf course to the west, and buildings to the north and south. A 200 to 300 foot vegetative buffer surrounding this area likely offers habitat to various species. The open water portion of the wetland ranges from 0 to 3 feet in depth and varies from 80 to 150 feet in width.

Little history is available concerning the origins of Wetland 5A, which is several decades old and likely began as a man made feature (a borrow pit). It served as a drainage pathway as early as the 1930's and

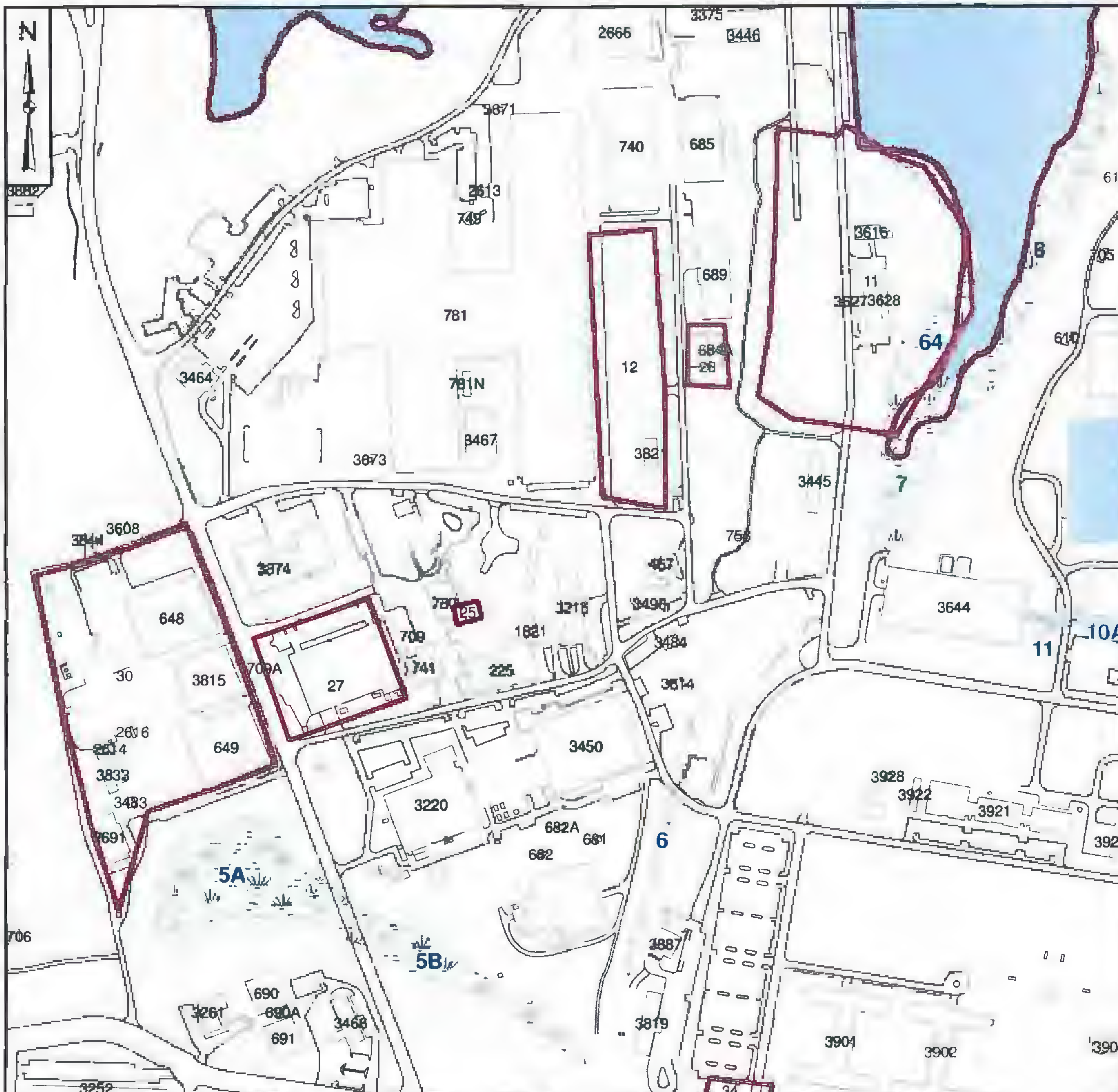

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Figure 1-4
Site Location Map
Wetland 5A and 64
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Site Boundary
- Building
- Road
- Installation Boundary
- Wetland
- Water

500 250 0 500 Feet

TETRA TECH

Drawn By: K. MOORE 11/26/08
Checked By: N. ROCHNA 12/21/10
Approved By:

Contract Number: 112G00390
CTO 030

P:\GIS\PENSACOLA_NAS\MAPDOCS\MXD\WETLAND64 5A_LOCATION.MXD 12/21/10 KM reportedly contained a saw mill during the 1940s. A 1939 map of the base labeled Wetland 5 as an "open ditch". In recent years, beaver dams constructed at the downstream end of Wetland 5A raised the water level in the basin containing this wetland, facilitating sedimentation and the emergence of a marsh. After a faulty valve in a nearby potable water storage tank was repaired in 1994, the water level in Wetland 5A has significantly receded. Previously, several thousand gallons of potable water per day accidentally discharged from this tank into Wetland 5A via an overflow pipeline Wetland 5A continues to serve as a storm water conduit. NAS Pensacola Storm Drainage Map 1276912 shows three outfalls in Wetland 5A Outfall T discharges storm water from the Bachelor Officers' Quarters area to the south. Outfall V and an unnamed outfall discharge storm water from the former Building 649 Complex. Wetland 5A drains via Wetland 5B into Wetland 6, which empties into the NAS Pensacola Yacht Basin (Wetland 64). Typical vegetation found in Wetland 5A consists of hardwoods, such as oaks and sweet bay magnolias.

Wetland 5B resembles and functions as a drainage ditch. It receives storm water from Wetland 5A and drains eastward into Wetland 6. NAS Pensacola Storm Drainage Map 1276912 shows one outfall in Wetland 5B, which discharges storm water from the Building 3220 area Vegetation in Wetland 5B includes cattails *(Typha latifolia)* and other emergent plants. Routine maintenance of the ditch includes removal of vegetation, debris, and sediment to allow for storm water flow.

OU 2 sites with the greatest potential to impact Wetland 5 include Site 30 and portions of the IWTP sewer line. Buildings 649 and 755 (Site 30) are north and upgradient of Wetland 5, and are separated by a service road, driveway, and a parking lot Building 649 was used from the 1940s to the 1950s as a tin-cadmium plating operation. Fifteen aboveground tanks near Building 649, ranging from 200 to 500 gallons, contained solutions of tin, cadmium, and cyanide Additionally, a 250-gallon tank stored 1,1,1-trichloroethylene (TCE). The contents of these tanks reportedly were dumped monthly into a "ditch" east of the building Based on current topography and historical data, this "ditch" was either the wetland itself or the wetland was directly fed by the ditch During the 1960's and 1970's, the 15 tanks stored phosphoric acid, caustics, potassium permanganate, degreasers, and chromate solutions, which were also periodically drained into the "ditch" According to historical data, the concentrated cyanide solutions were placed into a tank truck, transported to the Building 709 plating shop, and disposed of in the sanitary sewer. Plating operations in Building 649 ceased in the 1970's

Building 755 also operated as a plating shop during the 1960s and 1970s It had approximately 50 aboveground tanks ranging from 50 to 200 gallons in volume and containing plating solutions of nickel, silver, lead, tin, chromium, and other metals These tanks were also reportedly periodically drained into the "ditch" east of Building 649. Building 755 plating operations ceased in the 1970s (EnSafe, 1997)

The IWTP sewer line in the OU 2 area was investigated in conjunction with OU 2. The sewer line runs from the OU 2 area along Wetlands 5 and 6 to the IWTP (OU 10). The wastewater treatment plant, originally built in 1948, was replaced in 1971 with a modern plant that could accept industrial wastes. Most facilities discharging to the sewer did so without any pretreatment or waste segregation. The waste stream has included paint strippers, heavy metals, pesticides, radioactive wastes, fuels, cyanide waste, and waste oil (NEESA, 1983). Beginning in 1973, the Naval Air Rework Facility operations discharged to the sewer instead of to Pensacola Bay. The IWTP sewer line consisted of vitreous clay and cast-iron piping both installed before and after 1971.

1.3.2 Wetland 6

Wetland 6 is a drainage ditch that originates at the parade grounds north of the NAS Chapel and drains to the north into Wetland 7 and Wetland 64 (the Wetland 64 complex). Some of the Wetland 6 ditch banks and bottom are lined with concrete tile plates to prevent erosion and stabilize the channel Wetland 6 receives surface water from Wetland 5 and the area associated with the former Chevalier Field area [now Naval Air Technical Training Center (NATTC)] Wetland 6 is a palustrine wetland with open water. This wetland is bound by mowed grass buildings, or isolated areas of highly disturbed vegetation. The ditch portion of Wetland 6 is no deeper than about 3 feet and has a maximum width of about 3 to 5 feet Wetland 6 eventually drains into the Yacht Basin, (Wetland 64 complex) The Wetland 64 complex is tidally influenced Routine maintenance of the ditch includes removal of vegetation, debris, and sediment to allow for storm water flow.

IR Sites with the greatest potential to have impacted Wetland 6 included Sites 12 and 30 of OU 2, OU 6 (Sites 9, 29, and 34), and Sites 10 and 36. These sites are adjacent or near to this wetland. OU 6, Site 10 and Site 36 were approved for no further action Potential impacts from OU 2 media are discussed in Section 1 3.4

1.3.3 Wetland 64

Wetland 64 is an approximately 41-acre area on the eastern shore of the upstream side of the NAS Pensacola Yacht Basin, which is in the northeastern quadrant of the base. For the Site 41 RI, the Wetland 64 complex investigation incorporated several areas surrounding NAS Pensacola Yacht Basin: the southeast shore of the Yacht Basin, the open water area of the Yacht Basin, and adjacent Wetlands 7 and 8 The open water portion of the Wetland 64 complex is approximately 20 acres in size, ranging from about 2 to 15 feet in depth, and is 600 to 900 feet wide. The turning basin area in the open water portion is routinely dredged. Dredged material is deposited on Magazine Point on the east side of the Yacht Basin Adjacent Wetland 7 encompasses the downstream end of a storm water conduit (Wetland 6) that drains into the Yacht Basin (Wetland 64 complex) Wetland 6 drains storm water runoff from the area directly around NATTC and the NAS Chapel The NATTC was previously the Naval Aviation Depot or NADEP. Wetlands 5A and 5B contribute additional discharge to Wetland 6, which ultimately discharges into the Wetland 64 complex.

Adjacent Wetland 8 includes the western shore of Magazine Point. The western shore of the Yacht Basin also contains the NAS Pensacola Yacht Club and marina. A concrete seawall exists along the shoreline of the marina, from which several docks housing numerous boats extend into the Yacht Basin. The western shore of the Yacht Basin also contains buildings, a paved parking area, a fenced area for boat storage, and road access. The eastern bank of the Yacht Basin remains relatively undisturbed.

Evaluation of maps and aerial photography from 1939 and 1951 reveal the Wetland 64 area was once approximately one-third larger than the current area. Sometime after 1939, approximately 15 acres in the southwest portion (the area now encompassing IR Site 11, North Chevalier Disposal Site), and approximately 10 acres along the western side (the area now containing the building and parking areas associated with the Yacht Basin), were filled; apparently coincident with the construction of the marina. The filled area along Site 11 constricts the width of the open water portion of Wetland 64 to approximately 8 to 10 feet from where Wetland 6 discharges into this water body to the southern end of the marina

IR sites potentially affecting Wetland 64 include Site 10, OU 2 (Sites 11, 12, and 30), and OU 6 (Sites 9, 29, and 34) OU 6 and Site 10 were approved for no further action. Potential impacts from OU 2 media are discussed in Section 1 3 4

1.3.4 Potential Impacts from Operable Unit 2 Media to Wetlands 5, 6, and 64

Environmental investigations at OU 2 began in 1976 with an investigation of radium contamination in the sewer lines at Site 27 (NEESA, 1983) Four additional investigations were conducted during the next 15 years In 1991 and 1992, as part of the Navy's IR Program, contamination assessments were conducted at 22 sites, including the six OU 2 sites. At Site 11, metals, totals recoverable petroleum hydrocarbons (TRPH), VOCs, PAHs, and phenol were detected in unsaturated soil. At Site 30, metals, TRPH, PAHs, phenols, and VOCs were detected in surface water, groundwater, and soil Similar compounds were detected at the other four OU 2 sites.

Five other investigations that took place from 1992 to 1997 are described in the RI report. The conclusions of the RI were that the contaminants within OU 2 appear to be limited to the surface and subsurface soils, the surficial aquifer, and groundwater to surface water discharge and OU 2 wetlands, where point-source and non-point source storm water discharge, were found to occur (EnSafe, 1997).

The human health risk assessment (HHRA) that was undertaken for the OU 2 wetlands as part of the Site 41 RI included evaluations for the trespasser, the maintenance worker, and fisherman The results demonstrated that the COCs did not present an unacceptable risk to human receptors at the OU 2 wetlands.

In 2005, an OU 2 RI Addendum (EnSafe, 2005) provided an update for the five-plus year old RI data Based on the information collected for the addendum, groundwater associated with Sites 11 and 30 appears to have impacted Wetlands 5A, 6, and 7 and contains VOCs, SVOCs, pesticides, and metals at concentrations that exceed their Groundwater Cleanup Target Levels (GCTLs). The updated data were used to support the preparation of a FS.

The Space and Naval Warfare Systems (SPAWAR) Center conducted a Sediment Ecosystem Assessment Protocol (SEAP), integrated assessment for contaminated sediment at Wetland 64 in 2008. The study focused on Wetland 64 based on the previous remedial investigation that revealed metals, PAHs, PCBs, DDTs, and VOCs to be of potential ecological risk, particularly at the south end of the water body Primary components of the study included a groundwater discharge zone assessment for OU 2 Site 11 and an integrated in-situ sediment assessment at four focus stations in Wetland 64

The groundwater discharge was assessed using the Trident and UltraSeep systems Potential discharge zones were mapped using the Trident conductivity/temperature probe Trident sensor readings were taken at 3 ft below the sediment surface Areas of potential discharge were identified based on low subsurface conductivity In general, the groundwater discharge zone evaluation revealed shoreline areas with evidence of groundwater discharge which was quantified at one location with a mean rate of about 1 centimeter per day Laboratory analysis of groundwater discharge samples indicated that VOCs were not present but, trace levels of naphthalene and 1,2,4-trichlorobenzene were detected at one sample location. Porewater discharge samples collected at the sediment water interface indicated only chromium and nickel exceeded reporting limits at one location and nickel at separate location. PAHs did not exceed the reporting limits at any stations and DDE and DDD were measured slightly exceeding reporting limits at one sample location. The Preliminary Data Report for Wetland 64: Groundwater Discharge Zone & Integrated In Situ Sediment Assessments is provided in Appendix E

The integrated in-situ sediment assessment utilized a range of new and emerging technologies together with traditional measures to characterize exposure, uptake and response at four stations in Wetland 64. The stations were selected to represent a gradient of contamination primarily based on historical data from the remedial investigation at the site. Analytical results for sediment samples confirmed the expected concentration gradient. The sediment assessment reflected areas with low to moderate chemical loading in the bulk sediment with limited bioavailability, uptake, or response. Although bulk concentrations in sediment sometimes exceeded the screening benchmarks, other measures of exposure including porewater, discharge water, interface water and passive samplers generally indicate a lack of mobility and bioavailability. This was supported by the lack or limited uptake in tissues of exposed organisms, and the general absence of toxicity in either laboratory or in-situ exposed organisms. Based on the investigation, SPAWAR stated that toxicity identification evaluations (TIE) should provide a better understanding of the low survival rates observed at one sample location.

Remedial alternatives were evaluated in the OU 2 FS and the selected remedies were presented in the OU 2 Proposed Plan (PP) and Record of Decision (ROD). The soil remedy selected for OU 2 was Excavation and Off-site Disposal with Land Use Controls (LUCs). The groundwater remedy selected for OU 2 was monitored natural attenuation with LUCs. Although groundwater discharge to the wetlands has not been observed or is expected, an investigation is planned to assess the groundwater to surface water interface at Wetlands 5A, 5B, and 7 (Tetra Tech, 2010B) The investigation will focus on the groundwater vertical flow gradient and the discharge of groundwater to surface water The purpose of the investigation is to determine the groundwater flow path of contaminants associated with Sites 11 and 30 and to determine if alternative GCTLs may be established in accordance with Chapter 62-780, Florida Administrative Code (F.A C.) for the OU 2 groundwater monitoring program based on the absence of adverse affects to the surface water in the wetlands hydraulically downgradient of the two sites

1.3.5 Ecological Risk Assessment

The OU 2 wetlands were evaluated collectively in the S te 41 RI to assess where the highest probabilities of unacceptable risk may occur and whether that risk is likely to be related to exposure from IR sites at NAS Pensacola In the case of OU 2, the tools that were used to evaluate ecological risk on an OU-wide basis were presented in Section 1.2 9.

1.3.6 OU 2 Food-Chain Modeling

To evaluate the potential for risk to upper-trophic-level receptors that forage within the wetlands surrounding OU 2 — food-chain models were completed The wetlands in this evaluation include·

- Wetland 5A*
- Wetland 5B*
- Wetland 6
- Wetland 64*

Those wetlands with an asterisk were resampled and are evaluated using both the original Phase II RI data as well as the Phase III RI data. During the Phase III RI (September 1997) and later in 2001, fish tissue was collected at Wetland 64 and was included in the food-chain models. Food chain models were evaluated for three assessment endpoints as described below. The following constituents were evaluated in these food-chain models:

- Pesticides (total BHCs, total DDT, total chlordane, and total endrin)
- Total PCBs
- Mercury

1.3.6.1 Assessment Endpoint 1 — Health and Viability of Piscivorous Bird Communities that Forage in OU 2 Wetlands

Phase II RI Evaluation

The Phase II RI data indicated that concentrations of mercury generate HQs greater than 1 based on an estimated daily dose Tissue was not collected during the Phase II RI, so this daily dose was estimated using literature-based BSAFs to estimate prey concentrations using OU 2 sediment concentrations The only exposure concentration that generated an HQ greater than 1 was the maximum total DDT concentration (maximum detected concentration/NOAEL HQ = 1.58). This sample (041M60101) was located at Wetland 6 Based on these estimated mercury exposure concentrations there is a potential for unacceptable risk to the piscivorous bird communities foraging in OU 2 wetlands This Phase II RI data was the basis for the Phase III RI and later sampling events.

Phase III RI Evaluation

Using the data collected during the Phase III RI 2001 and 2004 events, constituents evaluated in the FCM did not have unacceptable levels via bioaccumulation through the food web. In 2001, fish tissue samples were collected from seven locations in Wetland 64 and analyzed for full analytical scans (including mercury). These tissue concentration results were used in the OU 2 food-chain models to replace the BSAF-derived prey concentrations used in the Phase II RI.

1.3.6.2 Assessment Endpoint 2 — Health and Viability of Piscivorous Mammal Communities that Forage in OU 2 Wetlands

Phase II RI Evaluation

The Phase II RI data indicated that concentrations of mercury and PCBs generate HQs greater than 1 based on a maximum estimated daily dose. This daily dose is based on site-specific sediment and surface water concentrations and literature-based BSAFs for tissue concentrations. Using the maximum detected concentration for mercury exposure, the NOAEL HQs exceeded 1 (HQs=3.47), the other HQs were less than 1. The maximum detected mercury concentration in sediment was detected at Wetland 5A. The maximum detected concentration for PCB exposure had a NOAEL HQ of 2.8 and a LOAEL HQ of 1.4. PCBs were detected in each of the OU 2 wetlands, with the maximum detected concentration at Wetland 64, sediment sample 041M640301. None of the other constituent had a FCM HQ greater than 1.

Phase III RI Evaluation

When the site-specific exposure concentrations were updated using the Phase III RI data (as explained above), none of the constituents produced an HQ greater than 1 indicating no adverse effects to piscivorous mammals are expected through accumulation via the food web.

1.3.6.3 Assessment Endpoint 3 — Health and Viability of Predatory Fish Communities that Forage in OU 2 Wetlands

The Evans and Engels exposure model for mercury was used to evaluate risk to predatory fish communities. The results are summarized below

Phase II RI Evaluation

The Phase II RI data indicate that concentrations of mercury in the OU 2 wetlands generated HQs greater than 1 based on estimated concentrations of prey items The HQs generated for OU 2 wetlands ranged from 17.13 (maximum detected concentrations/NOAEL) to 1 8 (average concentrations/LOAEL). Based on these estimated mercury exposure concentrations, there is a potential for unacceptable risk to predatory fish foraging in OU 2 wetlands.

Phase III RI Evaluation

Using the data collected during Phase III RI 2001 and 2004 events, exposure estimates and the resulting HQs decreased The HQs generated using these data range from 3 54 (maximum concentrations/

NOAEL) to 0.64 (average concentrations/LOAEL) for the OU 2 wetlands. The highest mercury concentrations were detected at three sample locations within Wetland 64. This evaluation replaced the estimated fish tissue concentrations with site-specific concentrations. However, the majority of the reduction in HQs results from lower mercury concentrations from the later sampling events.

Food-Chain Modeling Summary for OU 2

Based on the site-specific biota tissue sampling, the assessment endpoint identified with the potential for risk was predatory fish containing mercury at Wetland 64 The HQs generated using these data range from 3.54 (maximum concentrations/NOAEL) to 0.64 (average concentrations/LOAEL) for the OU 2 wetlands.

1.3.7 Mean ERM Quotients

Wetlands 5A, 5B, and Wetland 64 contained constituents at numerous sample locations that based on their mean ERM were likely to cause adverse effects or had a slight possibility of causing adverse effects. The locations consistently had concentrations of cadmium, chromium and lead that exceed their respective ERM values. Because these exceedances represent conditions that would be expected to cause adverse effects on benthic macroinvertebrates, this area was selected for site-specific toxicity testing. Based on the mean ERM quotient category evaluation, the area adjacent to Site 11 seems to be an area where constituents have consistently exceeded ERM levels Wetland 5 had high concentrations of constituents when originally sampled during the Phase II RI; however, those levels have not been repeated in two additional rounds of sampling in that wetland As a result, it does not appear that Wetland 5A is acting as a constant source for Wetlands 5B and 64

The results of the toxicity tests for Wetland 64 showed survival at less than 80 percent for *Leptocheirus* (78% survival at 041M640401 and 74% at 041M640601) and statistically significant impacts to growth in *Neanthes* (at 041M640501). The results of the site-specific toxicity tests suggest that adverse effects are likely to occur at the southern portion of Wetland 64.

1.3.8 Base-wide DDT Comparison

Total DDT exceeded its base-wide screening levels at Wetlands 5A, 6, and the southern portion of 64 Although DDT exceeds its base-wide screening level, food-chain models using site-specific tissue concentrations did not indicate the levels present in OU 2 are of concern for upper-trophic-level predators.

1.3.9 TOC-Normalized PAHs

None of the sample locations within OU 2 exceeded the Swartz EEC indicating a virtual certainty of adverse effects from TOC normalized PAHs. However, four locations in Wetland 5A (one during the Phase II RI and three during the Phase III RI), and three locations in Wetland 64 (in the southern portion of the wetland) exceeded the Swartz TEC, indicating the potential for adverse effects from PAHs. When these results were compared to the site-specific toxicity sampling conducted during the Phase III RI, statistically significant differences were found at 5A05 and 5A06. Although no statistically significant differences were identified at Wetland 64, two of the locations (6404 and 6406) had a *Leptocheirus* survival of less than 80 percent These results simply indicate that toxicity at these locations could be driven in part or in whole by PAHs identified in the sediments

1.3.10 TOC-Normalized VOCs

Only one location had a VOC HQ greater than 1 In Wetland 6, the detected acetone concentration of 4,000 µg/kg at location 0410608 had a Di Toro HQ of 1.36 (Di Toro, J M and J A. McGrath, 2000)

1.3.11 Conclusions

Using the lines of evidence presented in the Site 41 ERA the areas of primary concern are the southern portion of Wetland 64 and Wetland 5A Direct toxicity to the benthic community in Wetlands 5A and 64 and uptake of mercury in predatory fish in Wetland 64 were evaluated in this FS. EnSafe (2007a) recommended No Further Action for Wetlands 5B and 6.

1.4 REMAINING WETLANDS

The wetlands grouped as "Remaining Wetlands" are Wetlands 19 (A and B), 56, 57, 58, W2, 48, and 49. These wetlands are across the western portion of NAS Pensacola near Forrest Sherman Field Associated IR sites include

- Site 1 (OU 1) — Sanitary Landfill
- Site 4 — Army Rubble Disposal Area
- Site 5 — Borrow Pit
- Site 6 — Fort Redoubt Rubble Disposal Area
- Site 16 — Brush Disposal Area
- Site 39 (OU 12) — Oak Grove Campground

Associated petroleum sites include Site 19 (Fuel Farm Pipeline Leak), Site 37 (Sherman Field Fuel Farm Area) and UST 18 (Crash Crew Training Area).

1.4.1 Wetland 48

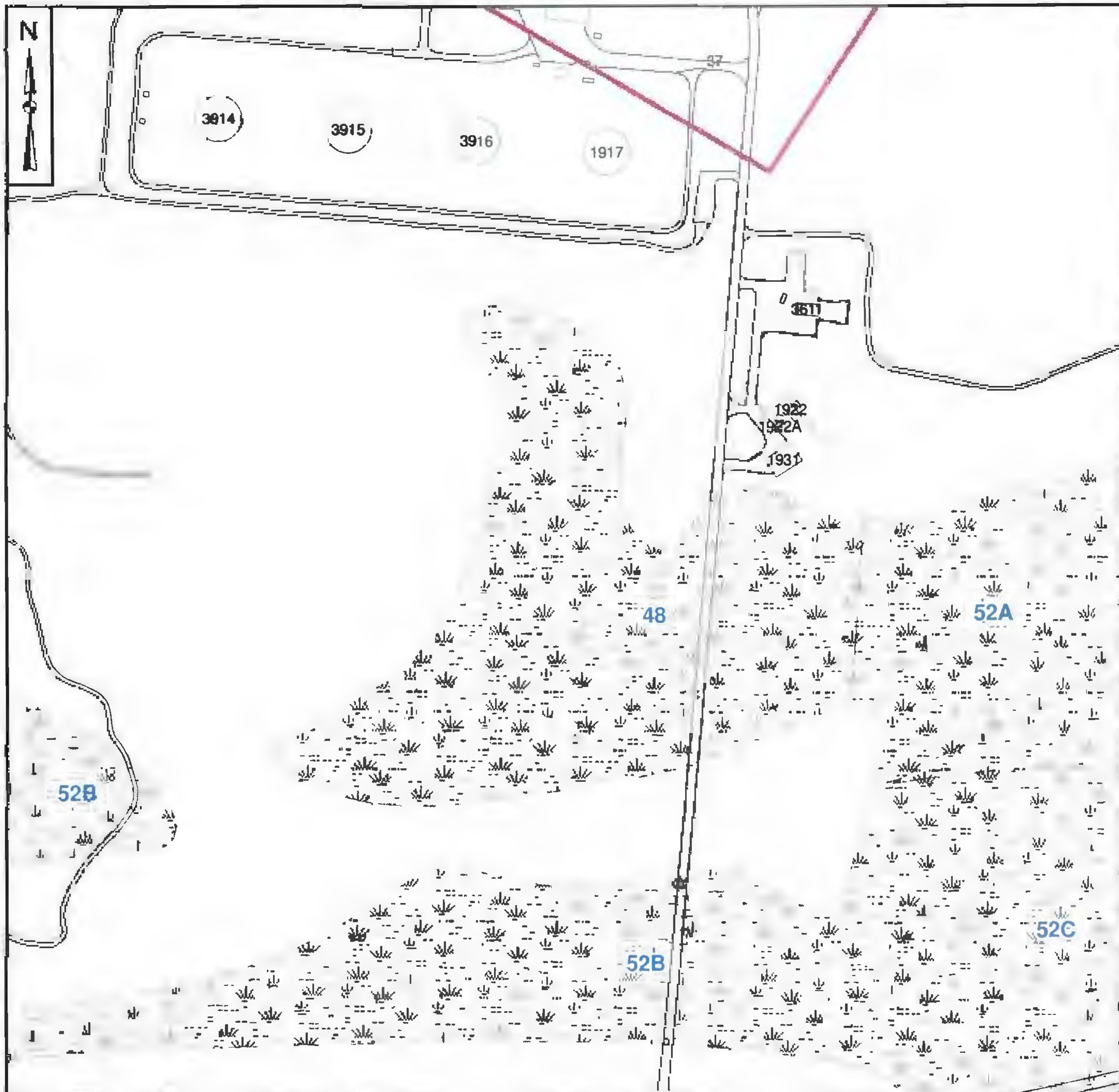
Wetland 48 is the only wetland in the Remaining Wetlands Group retained for evaluation in the FS. Wetland 48 is in a mostly undeveloped portion of NAS Pensacola, north of Radford Boulevard, and south of the NAS Pensacola Fuel Farm (Figure 1-5). It is a thickly vegetated palustrine forested wetland

The IR site potentially affecting Wetland 48 is Site 37. Site 37 (Sherman Field Fuel Farm Area) is located south of the western end of Forrest Sherman Field. The site consists of an approximately 3.5 acre, fenced area around the former fuel farm including four cut-and-cover storage tanks (Tank Numbers 1884, 1886, 1887, and 1888) The petroleum storage tank system was installed in 1945 and was used to store JP-4 Jet Fuel The fuel storage tanks were abandoned in place in 1995 after a new fuel facility was constructed adjacent to the south side of the original fuel farm

An equipment malfunction in 1983 resulted in the release of approximately 48,000 gallons of JP-4 Jet Fuel Initial recovery efforts by NAS Pensacola personnel included the installation of four recovery ditches along the fence line in the northwestern corner resulting in the recovery of approximately 600 to 700 gallons of free product However, recovery efforts were discontinued by direction of the NAS Pensacola Fire Marshall due to the proximity of open excavations containing free product to the active fuel farm area Additional recovery efforts n August 1983 included the installation of a product/groundwater recovery well system from approximately 50 to 140 feet west-northwest of the fuel farm. The system proved unsatisfactory, apparently due to its location, and recovery operations were discontinued

Wetland 48 is fed by surface water and groundwater Surface water drains to the east into Wetland 52, passing through a culvert under the access road to the fuel farm. Groundwater flow in the area is to the southeast.

Although Site 37 is nearby and up-gradient of Wetland 48, given the site history it is an unlikely source for the DDx compounds detected in Wetland 48 Further, based on a review of historic documents and historic application methods, there is not a specific known source for the release of the DDx compounds. The concentration of DDx compounds detected in Wetland 48 sediments are higher than those that would expected assuming the historic methods of application A possible source for the contamination may have been the ditches and culvert adjacent to the Sherman Field Fuel Road, which traverses the wetlands



NAVFAC
Naval Facilities Engineering Command

Figure 1-5
Site Location Map
Wetland 48
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Site Boundary
- Building
- Road
- Wetland
- Water

300 150 0 300 Feet

TETRA TECH

Drawn By K MOORE 11/26/08
Checked By; N ROCHNA 12/21/10
Approved By

Contract Number: 112G00390
CTO 030

P:\GIS\PENSACOLA_NAS\MAPDOCS\MXD\
WETLAND48_LOCATION MXD 12/21/10 KM

Phase II RI Evaluation

One sediment sample (041M480101) was collected from Wetland 48 and analyzed for Target Analyte List (TAL) metals, pesticides, PCBs, semivolatile organic compounds (SVOCs), and VOCs in January 1996. The sample location 041M4801 was centrally located within Wetland 48 and adjacent to a culvert along Fuel Farm Road. Wetland-specific and OU-wide evaluations in the RI Report determined that pesticide concentrations were a potential unacceptable excess risk. The pesticides, 4,4'dichlorodiphenyldichloroethane (4,4'-DDD), 4,4'- dichlorodiphenyldichloroethylene (4,4'-DDE), 4,4'-DDT, and total DDT (sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT) had concentrations that exceeded the NAS Pensacola base-wide sediment screening values.

In addition, Wetland 48 had the highest concentration of total DDT (3,460 µg/kg) in the NAS Pensacola wetlands. The mean ERM quotient evaluation classified the sample as a Category 3.

The total DDT sediment concentration generated a maximum NOAEL HQ of 14 during the FCM evaluation for the piscivorous bird community and a maximum NOAEL HQ of 1 34 for the piscivorous mammal community

2007 Wetland 48 Evaluation

Based on the results of the Phase II RI and food-chain modeling, Wetland 48 was resampled in 2007 to evaluate the DDT concentration and to delineate the extent of DDT contamination. Of the nine sediment samples collected at Wetland 48, eight exceeded base-wide screening levels for total DDT The total DDT concentration in the confirmation sample (041M4801) collected at the 1994 location (identified as 041M4801) increased from 3,460 µg/kg to 12,291 µg/kg. Two additional locations (14,400 µg/kg at 041M4802 and 5,400 µg/kg at 041M4809) also exceeded the 1994 maximum detected concentration

Florida Residual Petroleum Organic Method (FL-PRO) concentrations ranged from 190 mg/kg at 041M4801 to 31,000 mg/kg at 041M4803. The chromatograms and the laboratory standards were reviewed for the FL-PRO results The laboratory indicated that the results are heavier than their heavy oil standard

1.4.2 Ecological Risk Assessment

The wetlands in the Remaining Wetlands Group were evaluated collectively to help determine where the highest probabilities of unacceptable ecological risk may occur and whether risk is likely to be related to exposure from IR sites in the area For the Remaining Wetlands Group, the tools that were used to evaluate ecological risk on an OU-wide basis were presented in Section 1 2.9

1.4.3 Remaining Wetlands Food Chain Modeling

1.4.3.1 Assessment Endpoint 1 — Health and Viability of Piscivorous Bird Communities that Forage Throughout Miscellaneous Wetlands

Phase II RI Evaluation

Total DDT was the only constituent that had an HQ greater than 1 for the piscivorous bird community Total DDT HQs within these wetlands ranged from 1.4 (maximum detected concentration NOAEL HQ) to less than 1 for the average concentration LOAEL HQ, indicating a potential for adverse effects to piscivorous birds. The maximum detected total DDT concentration in sediment was within Wetland 48 at sample location 041M4801 (3,460 µg/kg) and was higher than the other concentrations detected in the Remaining Wetland Group

2007 Wetland 48 Evaluation

The maximum detected total DDT sediment concentration of 14.4 mg/kg generated a NOAEL HQ of 58.1 to less than 1 for the average concentration LOAEL HQ indicating a potential for adverse effects to piscivorous birds

1.4.3.2 Assessment Endpoint 2 — Health and Viability of Piscivorous Mammal Communities that Forage Throughout Miscellaneous Wetlands

Phase II RI Evaluation

The only constituent generating a HQ greater than 1 for the piscivorous mammal community was total DDT. The total DDT NOAEL HQ calculated using the maximum detected concentration (from Wetland 48, 041M4801) was 1.34 This HQ greater than 1 indicated the potential for adverse effects to the piscivorous mammal communities that may forage throughout the remaining wetlands However, based on the HQs, only the maximum detected total DDT sample location in Wetland 48 would generate the potential for adverse ecological effects.

2007 Wetland 48 Evaluation

The maximum detected total DDT concentration of 14 4 mg/kg generated a NOAEL HQ of 5.56 to less than 1 for the average LOAEL HQ, indicating a potential for adverse effects to piscivorous mammal community.

1.4.3.3 Assessment Endpoint 3 — Health and Viability of Predatory Fish Communities that Forage in and around Miscellaneous Wetlands

Phase II RI Evaluation

Mercury had an HQ of 2.4 for the NOAEL HQ calculated using the maximum detected concentration (0.14 mg/kg), the LOAEL HQ using the maximum detected concentration, and the NOAEL HQ calculated using the average concentration (0.06 mg/kg). However, the only location where mercury was detected in the Remaining Wetlands Group was sample location 041M5701. Therefore, while this location may present a potential for adverse effects, it is unlikely that this limited distribution and low HQs would impact the health and viability of the predatory fish communities that forage within the Remaining Wetland Group.

2007 Wetland 48 Evaluation

This endpoint was not evaluated in the 2007 RI Addendum for Wetlands 10 and 48.

Food-Chain Modeling Summary for Remaining Wetlands

Some potential for limited adverse impacts exists through exposure to total DDT and mercury via the food web within the miscellaneous wetlands. However, the potential for adverse impacts appears to occur only at one sample location for each constituent (041M4801 for total DDT and 041M5701 for mercury). Based on these results, no further actions are recommended for any of the wetlands in this group.

1.4.4 Mean ERM Quotients

Phase II RI Evaluation

Of the 13 sediment sample locations, eight locations had mean ERMs that have uncertainty regarding adverse ecological effects because the average survival approximates the critical threshold of 80 percent. Only one location had a mean ERM that suggest adverse effects are likely. This location was Wetland 48 sample 041M4801 for DDE and DDT. Using the ERM methodology, most of the wetlands incorporated within the Remaining Wetland Group have high uncertainty and require additional lines of evidence for evaluation as it is likely that some level of direct toxicity may be present within Wetland 48.

2007 Wetland 48 Results

This technique was not applied to the data collected in 2007.

1.4.5 Base-wide Total DDT-Levels

Phase II RI Evaluation

Two locations in the Remaining Wetlands Group exceeded the base-wide screening levels. The maximum detected concentration was in Wetland 48 at sample location 041M4801 (3,460 µg/kg)

2007 Wetland 48 Results

Of the nine samples collected at Wetland 48, eight exceeded the total DDT base-wide screening levels (110 µg/kg). The total DDT concentration in confirmation sample 041M4801 collected at the 1994 location (identified as 041M4801) increased from 3,460 µg/kg to 12,291 µg/kg. Two other locations 041M4802 (14,400 µg/kg) and 041M4809 (5,400 µg/kg) were also higher than the 1994 maximum detected concentration

1.4.6 TOC-Normalized Total PAHs Concentrations

TOC -normalized PAHs within the Remaining Wetlands Group did not exceed the Swartz TEC; therefore they are not likely to pose any unacceptable ecological risk related to exposure to PAHs

2007 Wetland 48 Results

This technique was not applied to the data collected in 2007

1.4.7 Conclusions

Using the lines of evidence presented in the ERA, DDT appears to be the primary concern in Wetland 48 for impacts to benthic invertebrates

1.5 NATURE AND EXTENT OF CONTAMINATION

An RI was completed at the NAS Pensacola Site 41 wetlands in three phases. (1) Phase I was performed during August 1994, (2) Phase II (formerly called IIA) was performed from November 1995 through January 1996; (3) Phase III (formerly called IIB/III) was performed during August and September 1997. The RI conducted by EnSafe, Inc. included an evaluation of the nature and extent of contamination in surface water and sediment, an analysis of contaminant fate and transport, and human health and ecological risk assessments. The results of the RI were reported by EnSafe in 2007. The RI identified COPCs, and these COPCs are identified in the following sections. Also, the COPCs identified in the RI were further evaluated in the Technical Memorandum (Appendix A) and the retained sediment COCs are listed in Section 2.1.4.

1.5.1 Wetland 3

During the RI, 8 surface water and 12 sediment samples were collected at Wetland 3. The following COPCs were identified in the HHRA and ERA for Wetland 3:

HHRA COPCs
The child trespasser and adult maintenance worker scenarios were assessed in the RI for Wetland 3 The following COPCs were identified in the HHRA:

- Arsenic (adult maintenance worker dermal contact and ingestion, sediment)
- Methylene chloride (adult maintenance worker dermal contact and ingestion, sediment)

Surface water COPCs were not identified in the RI HHRA

ERA COPCs
Sediment COPCs retained in the RI based on ecological risk include the following: aluminum, barium cadmium, chromium, iron, manganese, selenium vanadium, zinc, aldrin, dieldrin, endosulfan sulfate, total chlordane, endrin, endrin ketone, carbon disulfide alpha-BHC total BHC 4,4'-DDD, 4,4'-DDT total DDT, Aroclor-1260 total PCBs 1 2-dichlorobenzene 1 4-dichlorobenzene, and phenol

Surface water COPCs retained in the RI based on ecological risk include the following: aluminum, iron, lead, manganese, barium, cadmium, copper, vanadium Aroclor-1260, endrin ketone, total endrin acetone, total PCBs, total PAHs, 1,4-dichlorobenzene, chlorobenzene, and cis-1,2-dichloroethene (DCE)

1.5.2 Wetland 15

During the RI, two surface water and four sediment samples were collected at Wetland 15. The following COPCs were identified in the HHRA and ERA for Wetland 15:

HHRA COPCs
The child trespasser, adult maintenance worker, and fisherman scenarios were assessed in the RI for Wetland 15 The following COPCs were identified in the HHRA:

- Arsenic (trespasser and worker dermal contact and ingestion, sediment and surface water)
- 4,4'-DDD (fisherman - fish tissue uptake from sediment)

- 4,4'-DDE (fisherman - fish tissue uptake from sediment)
- Aroclor-1260 (fisherman - fish tissue uptake from sediment)
- delta-BHC (fisherman - fish tissue uptake from sediment)

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include the following: aluminum, arsenic, barium, beryllium, cobalt, iron, lead, manganese, selenium, vanadium, endosulfan I, heptachlor, endrin, endrin aldehyde, endrin ketone, total endrin, beta-BHC, delta-BHC, total BHC, 4,4'-DDD, total DDT, 2,2'oxybis(1-chloropropane)/bis(2-chlor), 2,4-dimethylphenol, 2-methylphenol (o-Cresol), 4-methylphenol (p-Cresol), and phenol.

Surface water COPCs retained in the RI based on ecological risk include the following. aluminum, antimony, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium, zinc, 4,4'-DDE, and total DDT

1.5.3 Wetland 18A

During the investigation two surface water and four sediment samples were collected at Wetland 18A. The following COPCs were identified in the HHRA and ERA for Wetland 18A

HHRA COPCs

The child trespasser and adult maintenance worker scenarios were assessed for Wetland 18A in the RI. The following COPCs were identified in the HHRA

- Arsenic (child trespasser and adult maintenance worker, sediment ingestion and dermal contact, and surface water dermal contact)

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include the following: barium, iron, manganese, selenium, aldrin, alpha-chlordane, gamma-chlordane, total chlordane, endrin, endrin ketone, total endrin, beta-BHC, total BHC, 4,4'-DDD 4,4'-DDT, total DDT, 1,4-dichlorobenzene, 4-methylphenol (p-Cresol).

Surface water COPCs retained in the RI based on ecological risk include the following: aluminum, arsenic, iron, lead, manganese, barium, chromium, vanadium

1.5.4 Wetland 18B

During the investigation, one surface water and two sediment samples were collected at Wetland 18B The following COPCs were identified in the HHRA and ERA for Wetland 18A

HHRA COPCs
The child trespasser and adult maintenance worker scenarios were assessed for Wetland 18B The following COPC was identified in the HHRA.

- Arsenic (child trespasser and adult maintenance worker, sediment ingestion and dermal contact)

Surface water COPCs were not identified in the RI HHRA.

ERA COPCs
Sediment COPCs retained in the RI based on ecological risk include the following: aluminum, arsenic, barium, beryllium, cyanide, iron, manganese, selenium, vanadium, 4,4'-DDD, 4,4 -DDT, and total DDT.

Surface water COPCs retained in the RI based on ecological risk include the following iron, manganese, selenium 4 4 -DDT, and total DDT

1.5.5 Wetland 5A

During the investigation, nine surface water and ten sediment samples were collected at Wetland 5A. The following COPCs were identified in the HHRA and ERA for Wetland 5A:

HHRA COPCs
The child trespasser and adult maintenance worker scenarios were assessed for Wetland 5A.

COPCs were not identified based on human health risk for Wetland 5A

ERA COPCs
Sediment COPCs retained in the RI based on ecological risk include the following antimony, aluminum, barium, cadmium, cobalt, copper, lead, manganese, mercury, zinc, endosulfan I, endosulfan II, endosulfan sulfate, total endrin, total BHC, 4-methylphenol (p-Cresol), benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-chloroethoxy)methane, carbazole, and indeno(1,2,3cd)pyrene, gamma-chlordane, total chlordane, 4,4'-DDD, 4,4'-DDT, and total DDT

Surface water COPCs retained in the RI based on ecological risk include the following: lead, manganese, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, vanadium, zinc, bis(2-ethylhexyl) phthalate (BEHP), dibromochloromethane, acetone, cis-1,2-DCE, acetone, bromodichloromethane, and 1,1-dichloroethane.

1.5.6 Wetland 48

During the investigation, one surface water and 10 sediment samples were collected at Wetland 48. The following COPCs were identified in the HHRA and ERA for Wetland 5A:

HHRA COPCs

The child trespasser and adult maintenance worker scenarios were assessed for Wetland 48 in the RI COPCs were not identified based on human health risks for Wetland 48.

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include the following 4-4'-DDD 4,4'-DDE, 4,4'-DDT and total DDT

Surface water COPCs were not retained in the RI based on ecological risk

1.5.7 Wetland 64

During the investigation, 2 surface water and 34 sediment samples were collected at Wetland 64 The following COPCs were identified in the HHRA and ERA for Wetland 5A.

HRA COPCs

The child trespasser and adult maintenance worker scenarios for surface water and sediment and the recreational and subsistence fishermen scenarios for game fish tissue ingestion were assessed for this wetland in the RI. The following COPCs were identified in the HHRA for Wetland 64.

- 4-4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, delta-BHC, alpha-chlordane, Aroclor-1254, Aroclor-1260, gamma-chlordane, and BEHP (game fish tissue ingestion, sediment)

Surface water COPCs were not identified in the RI based on human health risk.

ERA COPCs

Sediment COPCs retained in the RI based on ecological risk include the following. aluminum, barium, beryllium, cadmium, chromium cobalt, copper, iron, lead, manganese, mercury, selenium, silver, thallium, vanadium, zinc, heptachlor epoxide, aldrin, dieldrin, endosulfan I, endosulfan II, heptachlor, alpha-chlordane, gamma-chlordane, total chlordane, endrin, endrin aldehyde, total endrin, delta-BHC, gamma-BHC (Lindane), total BHC, 4,4'-DDD, total DDT, Aroclor-1254, Aroclor-1260, total PCBs, BEHP, 1,2-dichlorobenzene, 1,4-dichlorobenzene, carbazole, dibenzofuran, phenol, and carbon disulfide

Surface water COPCs were not retained in the RI based on ecological risk

It should also be noted, that as previously discussed, a SPAWAR investigation of the discharge zone and in situ sediments at Wetland 64 indicated "*The integrated in-situ sediment assessment generally reflects areas of low to moderate chemical loading in the bulk sediment with limited bioavailability, uptake or response. While bulk concentrations in sediment sometimes exceeded screening benchmarks, other measures of exposure including pore water, discharge water, interface water and passive samplers generally indicate a lack of mobility and bioavailability. This is supported by the lack or limited uptake in tissues of exposed organisms, and the general absence of toxicity in either laboratory or in-situ exposed organisms.*"

1.6 TECHNICAL MEMORANDUM CONCLUSIONS

As part of the PRG process, the list of COPCs was further refined in a Technical Memorandum submitted by Tetra Tech to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland The Technical Memorandum further refined the COPCs from the revised Table 16-1 of the RI (EnSafe 2007a) and provided the methodologies for developing the ecological and human health PRGs The retained sediment COCs are presented in Section 2.1.4 The Technical Memorandum is provided in Appendix A.

The source of the human health COPCs in surface water at Wetlands 15 and 18A and ecological receptors at Wetlands 3, 15, 18A is not completely derived from desorption from the sediments but is a combination of rainfall, nonpoint and point source surface water runoff (e.g., drainage ditches and culverts) and discharge of groundwater into the wetlands The source of the COCs that contribute to human health and/or ecological risk to surface water are currently being managed through permitted best management practices for storm water and through remedial decisions for groundwater for the individual OUs or Sites. Therefore, because the surface water COPCs are being managed through other programs this FS does not address impacts to surface water. Also, It should be noted that human health COPCs for surface water were not identified for Wetlands 3, 18B, 5A, 48, and 64 and ecological COPCs for surface water were not identified for Wetlands 48 and 64

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section identifies the media of concern, develops RAOs, and derives PRGs for the contaminated media within Site 41. The regulatory requirements and guidance that may potentially govern remedial activities are also presented in this section. In addition, this section presents GRAs that may be suitable to achieve the PRGs. Finally, this section presents estimates of the volumes of contaminated medium.

2.1 REMEDIAL ACTION OBJECTIVES

Development of RAOs is an important step in the FS process for Wetlands 3, 5A, 15, 18A, 18B, 48, and 64. The RAOs are medium-specific goals that define the objectives of conducting remedial actions to protect human health and the environment. RAOs for sediment are defined below. In addition to these RAOs, remedial actions must also have minimal impact on the Navy's ability to perform its mission at NAS Pensacola.

The development of PRGs considers chemical-specific ARARs which are the legal requirements that must be met during clean up of the site. Three types of legal requirements are addressed in a cleanup action:

- Chemical-specific ARARs address concentrations of contaminants that must be cleaned up.
- Action-specific ARARs regulate how a cleanup remedy is implemented. Regulations define where and how contaminants are managed.
- Location-specific ARARs address legal issues for special locations such as wetlands and tribal lands. There are no location-specific ARARs for Site 46.

Also, To Be Considered (TBCs) criteria may be used only when a default PRG is not available or considered protective. TBCs are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment. Section 2.1.2 identifies the ARARs and TBCs for sediment remediation.

2.1.1 <u>Statement of Remedial Action Objectives</u>

Site-specific RAOs specify COCs, medium of interest, exposure pathways, and PRGs or acceptable contaminant concentrations. This FS addresses contaminated sediment at the Site 41 Combined Wetlands. The RAOs were developed to permit consideration of institutional controls, monitoring, and containment alternatives based on current and potential future land use. The following RAOs were developed for Site 41 to protect the public from current and potential future health risks, as well as to protect the environment:

- Prevent unacceptable human health risk to maintenance workers associated with exposure to COCs at concentrations greater than PRGs established for sediment at Wetlands 3, 15, 18A, and 18B.

- Reduce, to the extent practicable, unacceptable risk to ecological benthic receptors exposed to COCs at concentrations greater than PRGs established for sediment at Wetlands 3, 5A, 15, 48, and 64.

Human Health COCs and corresponding PRGs for exposure to sediment by maintenance workers at Wetlands 3, 15, 18A, and 18B are presented in Section 2.1.5. Ecological COCs and corresponding PRGs for exposure to sediment by benthic receptors at Wetlands 3, 5A, 15, 48, and 64 are presented in Section 2.1.5

2.1.2 Applicable or Relevant and Appropriate Requirements

ARARs consist of the following:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

One of the primary concerns during the development of remedial action alternatives for hazardous waste sites under CERCLA is the degree of human health and environmental protection offered by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. The purpose of this requirement is to ensure that CERCLA response actions are consistent with other pertinent federal and state environmental requirements.

2.1.2.1 Definitions

The definitions of ARARs are as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, that although not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Per 40 Code of Federal Regulations (CFR) 300.400(g)(3), TBCs are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment. Examples of TBCs include Reference Doses (RfDs) and Cancer Slope Factors (CSFs).

According to 40 CFR 300.430(f)(1)(i)(A), overall protection of human health and the environment and compliance with ARARs are threshold requirements that each alternative must meet in order to be eligible for selection.

Per 40 CFR 300.400(g)(3), other advisories, criteria, or guidance are to be considered for a particular release. The TBC category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies.

Under CERCLA Section 121(d)(4), the Navy may waive compliance with an ARAR if one of the following conditions can be demonstrated:

- The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control upon completion.

- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.

- Compliance with the requirement is technically impracticable from an engineering perspective.

- The remedial action selected will attain a standard of performance that is equivalent to that required by the ARAR through the use of another method or approach.

- With respect to a state requirement, the state has not consistently applied the ARAR in similar circumstances at other remedial actions within the state.

- Compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility and the availability of Superfund money for response at other facilities (fund-balancing). This condition only applies to Superfund-financed actions.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) identifies three categories of ARARs [40 Code of Federal Regulations (CFR) Section 300.400 (g)]:

- Chemical-Specific: Health risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include the Clean Water Act (CWA) Ambient Water Quality Criteria (AWQCs).

- Location-Specific: Restrictions on actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present, such as the Endangered Species Act (ESA) and National Historic Preservation Act (NHPA).

- Action-Specific: Technology- or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include wastewater discharge standards, such as the National Pollution Discharge Elimination System (NPDES).

The following section discusses chemical-, location-, and action-specific ARARs for remedial actions that may be taken at Wetlands 3, 5A, 15, 18A, 18B, 48, and 64 and for the types of technologies that will be developed into remedial alternatives.

2.1.2.2 Chemical-Specific ARARs

Federal and state chemical-specific ARARs provide some medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants. No federal and state chemical-specific ARARs were identified for the Site 41 FS. However federal and state chemical-specific TBCs were identified. Table 2-1 presents federal and State of Florida chemical-specific TBCs, respectively, for this FS.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC TBCs
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
USEPA Regional Screening Levels (RSLs)	NA	To Be Considered (TBC)	Can be used to estimate risk and develop risk-based cleanup goals	Considered for determining areas of the site that pose an unacceptable risk and for developing PRGs.
Cancer Slope Factors (CSFs)	NA	TBC	CSFs are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	CSFs were used for development of human health protection PRGs for sediment at this site.
Reference Doses (RfDs)	NA	TBC	RFDs are guidance values used to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	RFDs were used for development of human health protection PRGs for sediment at this site.
State				
FDEP Inland Water Sediment Quality Guideline	NA	TBC	This document provides numerical sediment guidelines for freshwater sediment.	The guidelines were used to develop the PRGs for the freshwater wetlands.
FDEP Coastal Water Sediment Quality Guideline	NA	TBC	This document provides numerical sediment guidelines for saltwater sediment.	The guidelines were used to develop the PRGs for the freshwater wetlands.

Notes:
CSF = Cancer Slope Factor.
NA = Not applicable.
PRG = Preliminary Remediation Goal.
RSL = Regional Screening Levels
FDEP Florida Department of Environmental Protection
RfD = Reference Dose.
TBC = To Be Considered.
USEPA = United States Environmental Protection Agency

2.1.2.3 Location-Specific ARARs

Federal and state location-specific ARARs place restrictions on concentrations of contaminants or the conduct of activities based on the particular characteristics or location of a site. Table 2-2 presents federal and State of Florida location-specific ARARs, respectively, for this FS.

2.1.2.4 Action-Specific ARARs

Federal and state action-specific ARARs are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Table 2-3 presents federal and State of Florida action-specific ARARs, respectively, for this FS.

2.1.3 Media of Concern

The RI for Site 41 wetlands consisted of evaluating potential human health and ecological risks from chemicals in sediment. Based on the results of the risk assessments for human and ecological receptors in the RI, the predominant media of concern is sediment. The nature and extent of contaminated sediment at Site 41 Wetlands 3, 5A, 15, 18A, 18B, 48, and 64 has been defined and is summarized in Section 1.0 of this FS.

2.1.4 Chemicals of Concern

After comparison to refinement values, COPCs were further evaluated using the following lines of evidence to identify the primary risk drivers:

- Base-wide evaluation for DDT and breakdown products to provide a point of reference for determining impacts from general pesticide application.
- FCMs review for toxicity as it may travel from sediment to predator species such as green heron and mink.
- TOC normalization as a method for using carbon content of sediment to assess the availability of PAHs and VOCs to ecological receptors.
- Regression analysis of metals concentrations to evaluate whether metals are naturally-occurring.
- Mean ERM quotients to represent the likelihood of adverse effects due to direct toxicity.
- Selective toxicity testing after extrapolating results from representative wetlands.

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Endangered Species Act Regulations	50 CFR Parts 81, 225, 402	Applicable	This act requires federal agencies to take action to avoid jeopardizing the continued existence of federally listed endangered or threatened species.	If a site investigation or remediation could potentially affect an endangered species or their habitat, these regulations would apply.
Fish and Wildlife Coordination Act Regulations	33 CFR Subsection 320.3	Applicable	Requires that the United States Fish and Wildlife Service, National Marine Fisheries Service, and related state agencies be consulted prior to structural modification of any body of water, including wetlands. If modifications must be conducted, the regulation requires that adequate protection be provided for fish and wildlife resources.	If a remedial alternative involves the alteration of a stream or wetland, these agencies would be consulted.
National Environmental Policy Act (NEPA) Regulations, Wetlands, Floodplains, etc.	40 CFR Subsection 6.302 [a]	Applicable	These regulations contain procedures for complying with Executive Order 11990 on wetlands protection. Appendix A states that no remedial alternative adversely affect a wetland if another practicable alternative is available. If no alternative is available, impacts from implementing the chosen alternative must be mitigated.	If remedial action affects a wetland, these regulations would apply.

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
NEPA Regulations, Floodplain Management, Executive Order 11988	40 CFR Part 6, Appendix A	Applicable	Appendix A describes the policy for carrying out the Executive Order regarding floodplains. If no practicable alternative exists to performing cleanup in a floodplain, potential harm must be mitigated and actions taken to preserve the beneficial value of the floodplain.	If removal actions take place in a floodplain, alternatives would be considered that would reduce the risk of flood loss and restore and preserve the floodplain.
Fish and Wildlife Conservation Act	40 CFR Section 6.302	Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers.	United States Fish and Wildlife Service officials would be consulted on how to minimize impacts of any remedial activities on fish and wildlife.

Notes:
CFR = Code of Federal Regulations.
NEPA = National Environmental Policy Act.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Resource Conservation and Recovery Act (RCRA) Regulations, Identification, and Listing of Hazardous Wastes	40 CFR Part 261	Applicable	Defines the listed and characteristic hazardous wastes subject to RCRA. Appendix II contains the Toxicity Characteristic Leaching Procedure.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
RCRA Regulations, Identification and Listing of Hazardous Wastes	40 CFR Part 261	Applicable	Defines the listed and characteristic hazardous wastes subject to RCRA.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
CWA, NPDES	40 CFR Parts 122 through 125, and 131	Applicable	NPDES permits are required for any discharges to navigable waters. If remedial activities include such a discharge, the NPDES standards would be ARARs.	Any alternative that involves discharges into any navigable water would require compliance with these regulations, including treatment if necessary.
Migratory Bird Treaty Act	16 United States Code (U.S.C.) 703-711	Applicable	Protects migratory birds and their nests.	Proposed actions will not kill migratory birds or destroy their nests and eggs.
State				
Florida Hazardous Waste Rules – October 1993	Chapter 62-730, F.A.C.	Applicable	Adopts by reference sections of the federal hazardous waste regulations and establishes minor additions to these regulations concerning the generation, storage, treatment, transportation, and disposal of hazardous wastes.	These regulations would apply if waste on site was deemed hazardous and needed to be stored, transported, or properly disposed.
Florida Dredge and Fill Activities	Chapter 62-312, F.A.C.	Applicable	This rule establishes requirements for dredging, filling, excavating, or placing material in or over the waters of the state, including wetlands.	The requirements of these rules were considered when developing and implementing remedial activities that involve waters of the state.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Florida Air Pollution Rules – October 1992	Chapter 62-2, F.A.C.	Applicable	Establishes permitting requirements for owners or operators of any source that emits any air pollutant. This rule also establishes ambient air quality standards for sulfur dioxide, carbon monoxide, lead, and ozone.	Although this rule is directly applicable to industrial polluters, these requirements are relevant and appropriate for a remedial action that could result in release of regulated contaminants to the atmosphere, such as may occur during excavation.
Florida Regulation of Stormwater Discharge – May 1993	Chapter 62-25, F.A.C.	Applicable	Establishes requirements for discharges of untreated stormwater to ensure protection of the surface water of the state.	Remedial actions would consider the impact of discharge of untreated stormwater from the site.
Florida Ambient Air Quality Standards – December 1994	Chapter 62-272, F.A.C.	Applicable	Establishes ambient air quality standards necessary to protect human health and public welfare. It also establishes maximum allowable increases in ambient concentrations for subject pollutants to prevent significant deterioration of air quality in areas where ambient air quality standards are being met. Approved air quality monitoring methods are also specified.	These ambient air quality standards would be met for remedial actions involving the possible release of contaminants to the atmosphere.
Air Pollution Episodes – September 1994	Chapter 62-273, F.A.C.	Applicable	This rule classifies an air episode as an air alert, warning, or emergency and establishes criteria for determining the level of the air episode. It also establishes response requirements for each level.	These regulations would be adhered to if remedial actions involve air emissions.

Notes:
CFR = Code of Federal Regulations.
CWA = Clean Water Act.
F.A.C. = Florida Administration Code.
NPDES = National Pollution Discharge Elimination System.
RCRA = Resource Conservation and Recovery Act.
U.S.C. = United States Code.

- The analyses and results of human health and ecological risk assessments of the Site 41 wetlands are presented in Sections 10 through 15 of the RI Report. Pesticides (DDT, endrin, chlordane, BHC, PCBs, and dieldrin) were evaluated using multiple food chain models. DDT and its breakdown products were also compared to base-wide screening levels. Excess risk from pesticides at OU 1 and OU 2 was not indicated by the food chain model results. Therefore, those pesticides evaluated using the food chain models were not retained as risk drivers. DDT, DDD, and DDE were retained as risk drivers for Wetland 48 based on the food chain model results.
- Mercury was evaluated using a food chain model. Although mercury concentrations in sediment were below its refinement value at OU 2, mercury was calculated to show an excess risk to predatory fish. Therefore, mercury was retained as a risk driver at Wetland 64, the only wetland at OU 2 that has habitat to support predatory fish.
- VOCs and PAHs were eliminated as risk drivers based on the results of the TOC normalization analysis.

The following table provides a list of human health and ecological COCs retained for sediment at each Site 41 wetland.

Wetland	Saltwater or Freshwater Wetland	Human Health COCs	Ecological COCs
3	Freshwater	Arsenic	Cadmium
5A	Freshwater	None	Copper, lead, and zinc
15	Saltwater	Arsenic	Arsenic, manganese, and selenium
18A	Freshwater	Arsenic	None
18B	Saltwater	Arsenic	None
48	Freshwater	None	4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and total DDT
64	Saltwater	None	Cadmium, chromium, copper, lead, silver, and zinc

Notes:
COC = chemical of concern
DDT = Dichlorodiphenyltrichloroethane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene

2.1.5 Preliminary Remediation Goals

PRGs are target concentrations to which COCs must be reduced within a particular medium of concern to achieve one or more of the established RAOs. PRGs are developed to ensure that contaminant concentrations left on site after remedial action are protective of human and ecological receptors. PRGs were developed for the primary risk drivers that were chemicals selected as COCs based on the results of the HHRA and Baseline ERA after the list was refined to focus this FS. The PRGs are risk-based values or background, and were calculated as presented in Appendix A. Table 2-4 provides a comparison of site data with the proposed PRGs. Comparisons to human health PRGs will be conducted using a 95% upper confidence limit (UCL) because the PRGs are based on risks to a maintenance worker that could be exposed to sediment throughout the entire wetland, not just particular locations. For purposes of this FS, however, the chemical concentration of the COCs in each sample will be compared to their PRGs to characterize the extent of contamination and the 95% UCL will be used to calculate an exposure unit average concentration for the wetland. After additional analytical data are collected from sediment samples collected from the wetland, the 95% UCL for the COCs will be compared to their PRG to determine which sample locations, if any, need to be monitored or removed. This approach will be outlined in more detail in a monitoring plan. Comparison to the ecological PRGs will be done on a sample location basis because of the small home range for benthic invertebrates.

The COC-specific PRGs for sediment at Wetlands 3, 5A, 15, 18A, 18B. 48, and 64 are identified below.

PRGs for Wetland 3 COCs

Ecological COCs	Human Health COCs
Cadmium = 9.3 mg/kg	Arsenic = 14 mg/kg

PRGs for Wetland 5A COCs

Ecological COCs	Human Health COCs
Copper = 150 mg/kg Lead = 258 mg/kg Zinc = 460 mg/kg	None

PRGs for Wetland 15 COCs

Ecological COCs	Human Health COCs
Arsenic = 41.6 mg/kg Manganese = 260 mg/kg Selenium = 1 mg/kg	Arsenic = 14 mg/kg

PRGs for Wetland 18A COCs

Ecological COCs	Human Health COCs
None	Arsenic = 14 mg/kg

PRGs for Wetland 18B COCs

Ecological COCs	Human Health COCs
Arsenic = 41.6 mg/kg	Arsenic = 14 mg/kg

TABLE 2-4

COMPARISON OF SITE DATA WITH PROPOSED SEDIMENT PRGS
SITE 41 WETLANDS, FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Contaminant of Concern	Maximum Detected Value (mg/kg)	Selected PRG[1] (mg/kg)	No. Samples Exceeding PRGs	Locations Exceeding PRGs
Wetland 3				
Cadmium	72.7	9.3	---	NA
Arsenic	35.5	14*	3	41M0302 and 41M0303
Wetland 5A				
Copper	156	150	1	41M5A01
Lead	427	258	1	41M5A01
Zinc	2,290	460	1	41M5A01
Wetland 15				
Arsenic	141	14*	2	41M1502 and 41M1503
Manganese	520	260	1	41M1503
Selenium	2.7	1	2	41M1502 and 41M1503
Wetland 18A				
Arsenic	31.4	14*	1	41M18A2
Wetland 18B				
Arsenic	13.8	14*	0	NA
Wetland 48				
4,4'-DDD	13	0.05	7	41M4801, 41M4802, 41M4803, 41M4806, 41M4807, 41M4808, and 41M4809
4,4'-DDE	0.93	0.04	8	41M4801, 41M4802, 41M4803, 41M4805, 41M4806, 41M4807, 41M4808, and 41M4809
4,4'-DDT	7.1	0.063	3	41M4801, 41M4802, and 41M4803
Total DDT	14.4	0.57	4	41M4801, 41M4802, 41M4803, and 41M4809
Wetland 64				
Cadmium	23.2	20.2	2	41M6405 and 41M6410
Chromium	806	774	1	41M6410
Copper	200	146	1	41M6405
Lead	430	339	2	41M6404 and 41M6405
Silver	4	3	1	41M6405
Zinc	468	330	3	41M6404. 41M6405, and 41M6410

Notes:

1 = See Technical Memorandum (Tetra Tech, 2010A) for selection process.

*Human Health PRG.

mg/kg = milligram per kilogram.

PRG = Preliminary Remediation Goal. NA = Not applicable.

PRGs for Wetland 48 COCs

Ecological COCs	Human Health COCs
4,4'-DDD = 0.05 mg/kg 4,4'-DDE = 0.04 mg/kg 4,4'-DDT = 0.063 mg/kg Total DDT = 0.57 mg/kg	None

PRGs for Wetland 64 COCs

Ecological COCs	Human Health COCs
Cadmium = 20.2 mg/kg Chromium = 774 mg/kg Copper = 146 mg/kg Lead = 339 mg/kg Silver = 3 mg/kg Zinc = 330 mg/kg	None

2.2

2.3 GENERAL RESPONSE ACTIONS

GRAs are broadly defined remedial approaches that may be used by themselves or in combination with one or more of the other approaches to attain the RAOs. GRAs describe categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Remedial action alternatives are then assembled by identifying types of treatment technologies and process options associated with these technologies according to the GRAs. The technologies and process options are then screened and evaluated using GRAs individually or in combination to develop the remedial alternatives.

The following GRAs were evaluated for sediment at Wetlands 3, 5A, 15, 18A, 18B, 48, and 64:

- No Action
- Limited Action (Sediment Monitoring and Natural Recovery)

In addition to the above GRAs, the following actions were evaluated for sediment at Wetlands 3, 15, 18A, and 18B:

- LUCs (LUCs were considered only for Wetlands 3, 15, 18A, and 18B because human receptors are at risk)

In addition to the above GRAs, the following actions were evaluated for sediment at Wetlands 3, 5A, 15, 18A, 48, and 64:

- Removal
- Disposal

2.4 ESTIMATED VOLUMES OF CONTAMINATED SEDIMENT

Calculations were performed to determine the volumes of contaminated sediment with COC concentrations greater than PRGs in Wetlands 3, 5A, 15, 18A, 48, and 64 (Table 2-5).

2.4.1 Wetland 3

The human health area of concern (areas with COC concentrations greater than PRGs) is estimated to contain 255 cubic yards of contaminated sediment and is shown on Figure 2-1. Cadmium was retained as an ecological COC for Wetland 3 and equals its PRG; however, although cadmium concentrations equal its PRG, arsenic exceeds its PRG of 14.

2.4.2 Wetland 5A

The contaminated sediment volume based on ecological screening values is estimated to be 746 cubic yards. The ecological areas of concern are shown on Figure 2-2.

2.4.3 Wetland 15

The human health areas of concern (areas with COC concentrations greater than PRGs) are estimated to contain 586 cubic yards of contaminated sediment and are completely encompassed within the ecological area of concern. The ecological areas of concern are estimated to have a volume of 974 cubic yards of contaminated sediment. The overall contaminated sediment volume is estimated to be 974 cubic yards. The human health and ecological areas of concern are shown on Figure 2-3.

2.4.4 Wetland 18A

The contaminated sediment volume based on human health screening values is estimated to be 684 cubic yards. The human health area of concern is shown on Figure 2-4.

2.4.5 Wetland 18B

Two sediment samples were collected on different dates from one location at Wetland 18B. The concentration of arsenic at Wetland 18B in one of the samples was greater than its PRG but was slightly below the PRG in the other sample. Therefore there is some uncertainty in whether this wetland should be carried through the FS. Because of this uncertainty, and lack of data for Wetland 18B, a volume of contaminated sediment was not calculated. The volume of contaminated sediment may be calculated in the future if analytical results from additional sampling events indicate that the concentration of the COC (arsenic) in sediment at Wetland 18B exceeds its PRG. The COC concentrations are shown on Figure 2-5.

2.4.6 Wetland 48

The ecological area of concern is estimated to have a volume of 5,980 cubic yards of contaminated sediment. The ecological area of concern is shown on Figure 2-6.

2.4.7 Wetland 64

The ecological areas of concern are estimated to have a total volume of 3,243 cubic yards of contaminated sediment. The ecological areas of concern are shown on Figure 2-7.

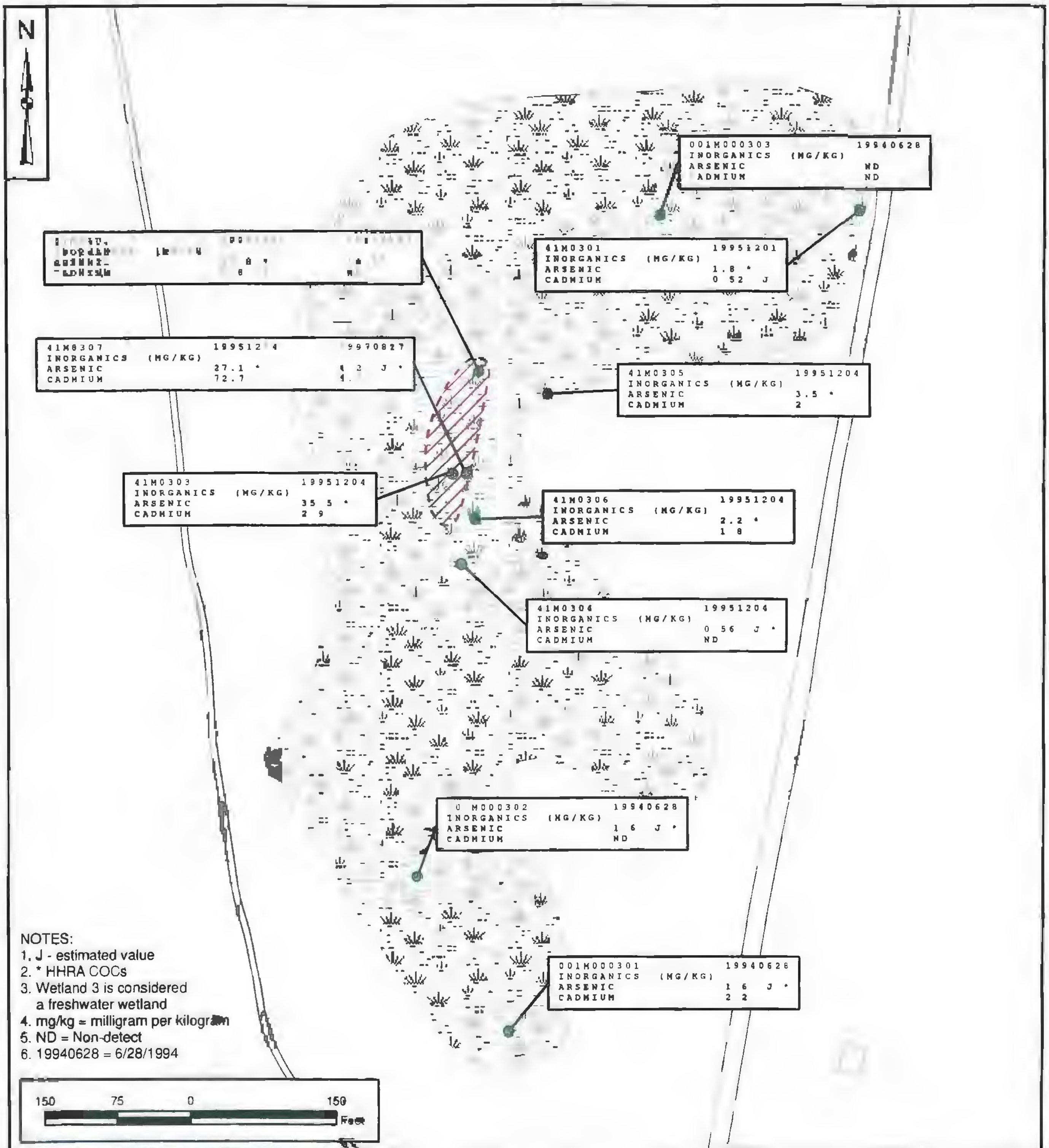
TABLE 2-5

**VOLUMES OF CONTAMINATED SEDIMENT
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA**

Calculated volumes of contaminated sediment at Wetlands 3, 5A, 15, 18A, 18B, 48, and 64 from Figures 2-1 through 2-7. Areas reported were calculated using a Geographic Information System.

Wetland	Human Health or Ecological AOC	Surface Area (square feet)	Excavation Depth (feet)	Volume (cubic feet)	Volume (cubic yards)
3	Human Health	6,895	1	6,895	255
5A	Ecological	20,154	1	20,154	746
15	Human Health	15,826	1	15,826	586
	Ecological	26,290	1	26,290	974
18A	Human Health	18,470	1	18,470	684
18B	---	---	---	---	---
48	Ecological	161,470	1	161,470	5,980
64	Ecological	46,350	1	46,350	1,717
	Ecological	41,200	1	41,200	1,526

AOC = Area of concern.



NAVFAC

Figure 2-1
Wetland 3
COCs in Sediment
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- HHRA AOC
- Building
- Wetland

TETRA TECH

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Checked By: N. ROCHNA 9/29/10
Approved By:

Contract Number: 112G00390
CTO 030

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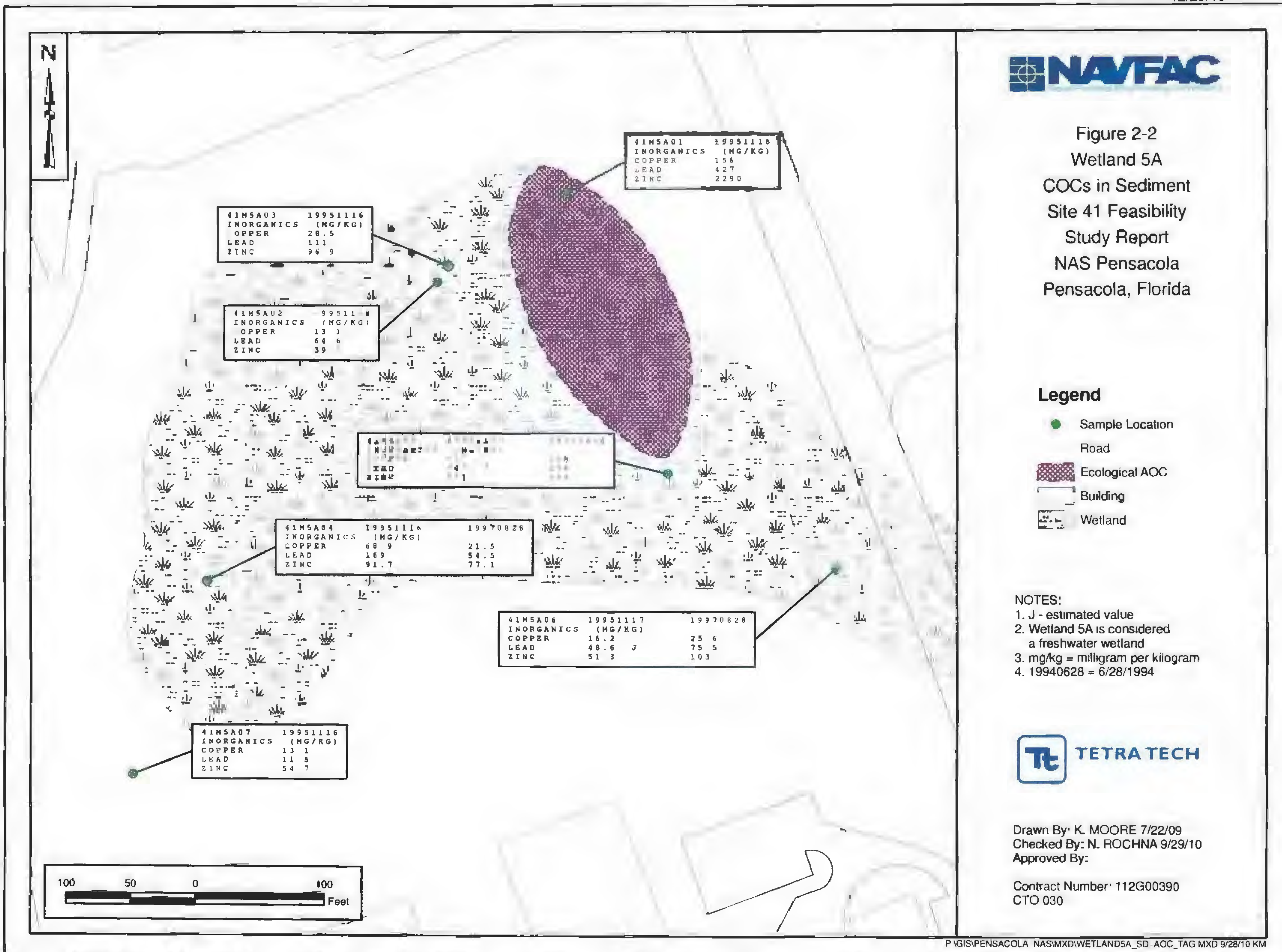
N
41M5A01 19951116
INORGANICS (MG/KG)
COPPER 156
LEAD 427
ZINC 2290
41M5A03 19951116
INORGANICS (MG/KG)
OPPER 28.5
LEAD 111
ZINC 96 9
41M5A02 99511
INORGANICS (MG/KG)
OPPER 13 1
LEAD 64 6
ZINC 39
41M5A04 19951116 19970826
INORGANICS (MG/KG)
COPPER 68 9 21.5
LEAD 169 54.5
ZINC 91.7 77.1
41M5A06 19951117 19970828
INORGANICS (MG/KG)
COPPER 16.2 25 6
LEAD 48.6 J 75 5
ZINC 51 3 103
41M5A07 19951116
INORGANICS (MG/KG)
COPPER 13 1
LEAD 11 5
ZINC 54 7
100 50 0 100
Feet
NAVFAC
Figure 2-2
Wetland 5A
COCs in Sediment
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida
Legend
Sample Location
Road
Ecological AOC
Building
Wetland
NOTES:
1. J - estimated value
2. Wetland 5A is considered a freshwater wetland
3. mg/kg = milligram per kilogram
4. 19940628 = 6/28/1994
TETRA TECH
Drawn By: K. MOORE 7/22/09
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Approved By:
Contract Number: 112G00390
CTO 030
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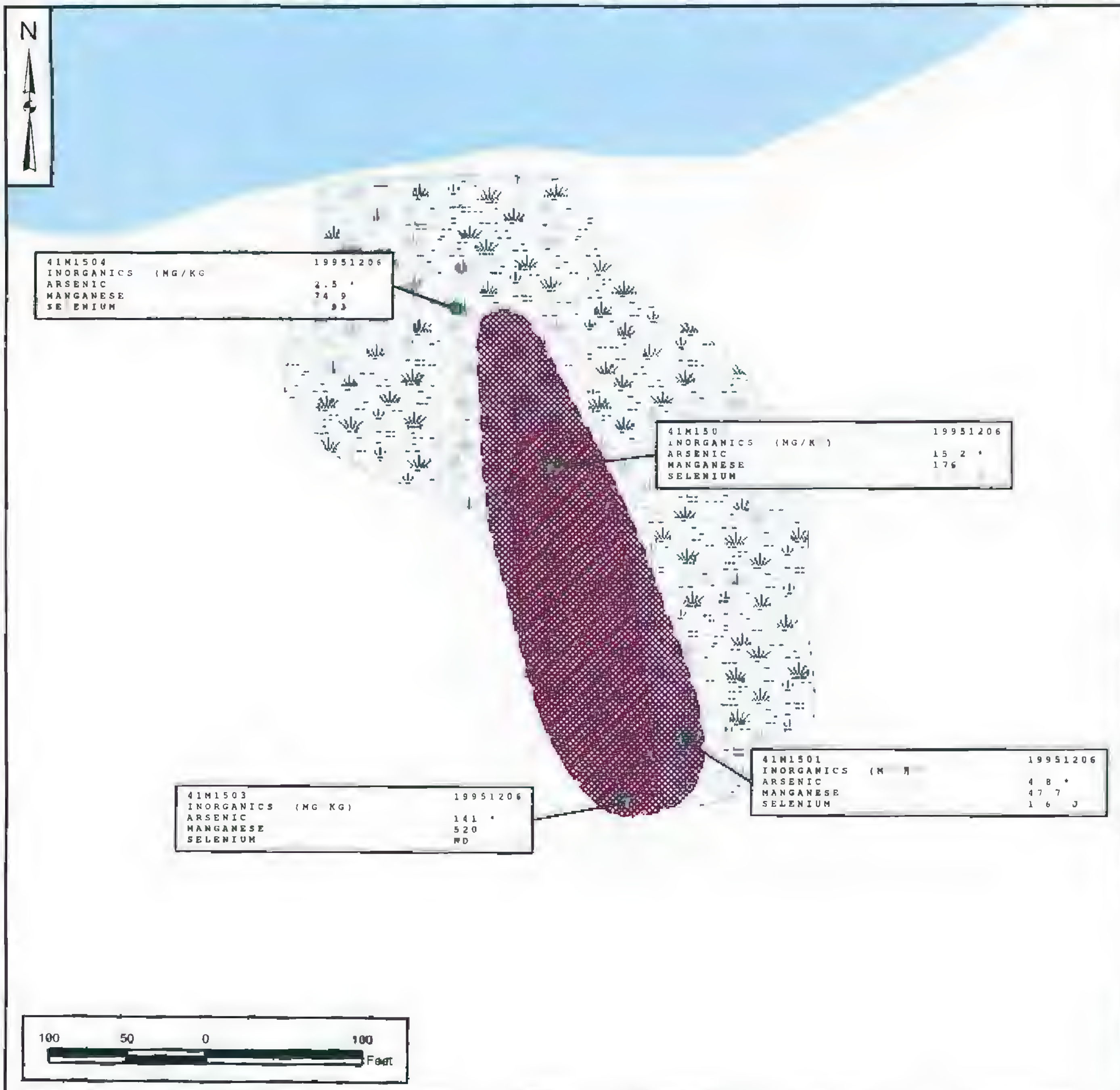

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Figure 2-3
Wetland 15
COCs in Sediment
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- HHRA AOC
- Ecological AOC
- Wetland
- Water

NOTES;
1. J - estimated value
2. * HHRA COPCs
3. Wetland 15 is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. ND = Non-detect
6. 19940628 = 6/28/1994

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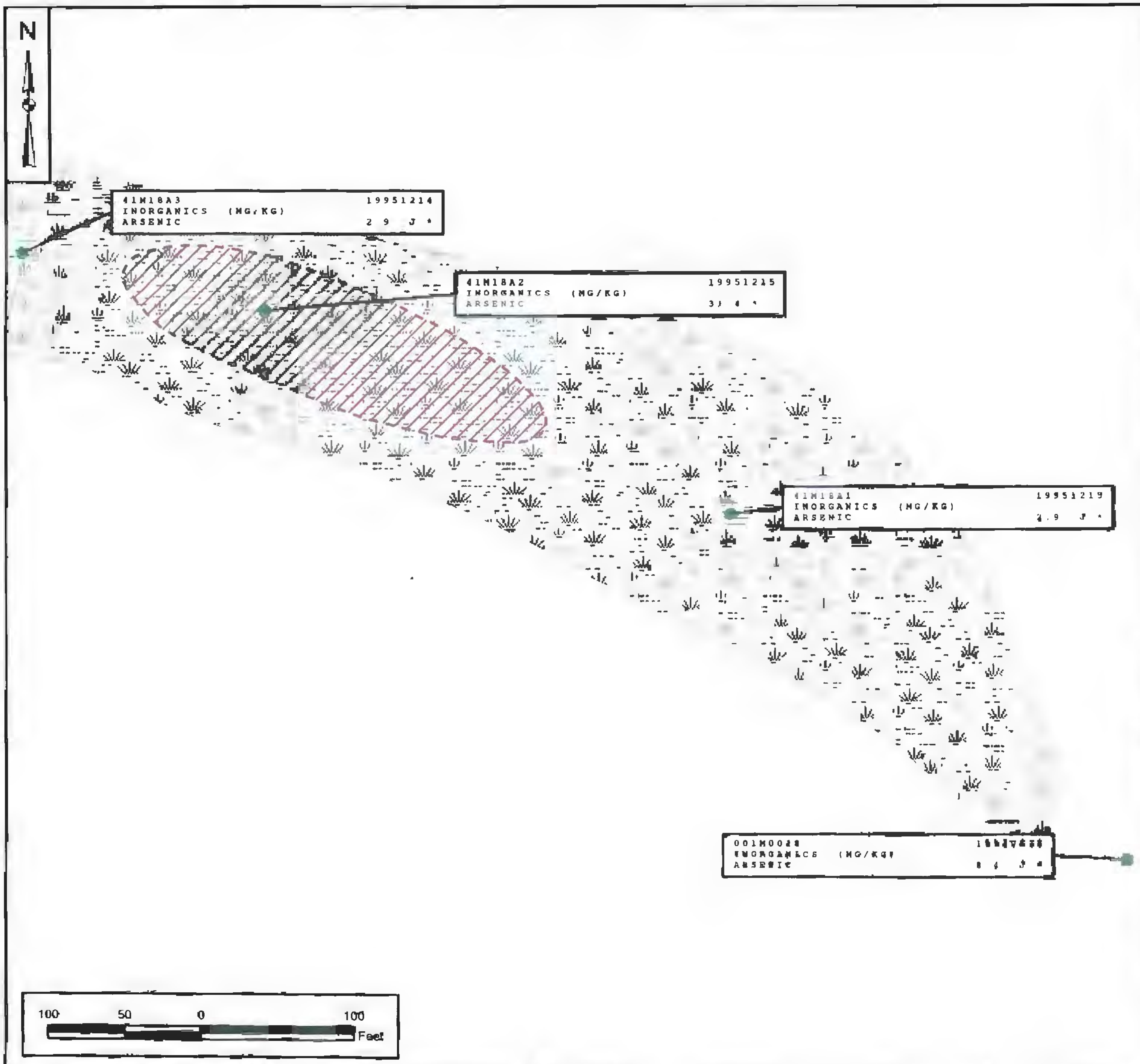

![NAVFAC]

Figure 2-4
Wetland 18A
COCs in Sediment
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- HHRA AOC
- Wetland

NOTES
1. J - estimated value
2. * HHRA COPCs
3. Wetland 18A is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. 19940628 = 6/28/1994

TETRA TECH

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Figure 2-5
Wetland 18B
COCs in Sediment
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Wetland
- Water

NOTES.
1. * HHRA COPCs
2. Wetland 18B is considered a saltwater wetland
3. mg/kg = milligram per kilogram
4. 19940628 = 6/28/1994

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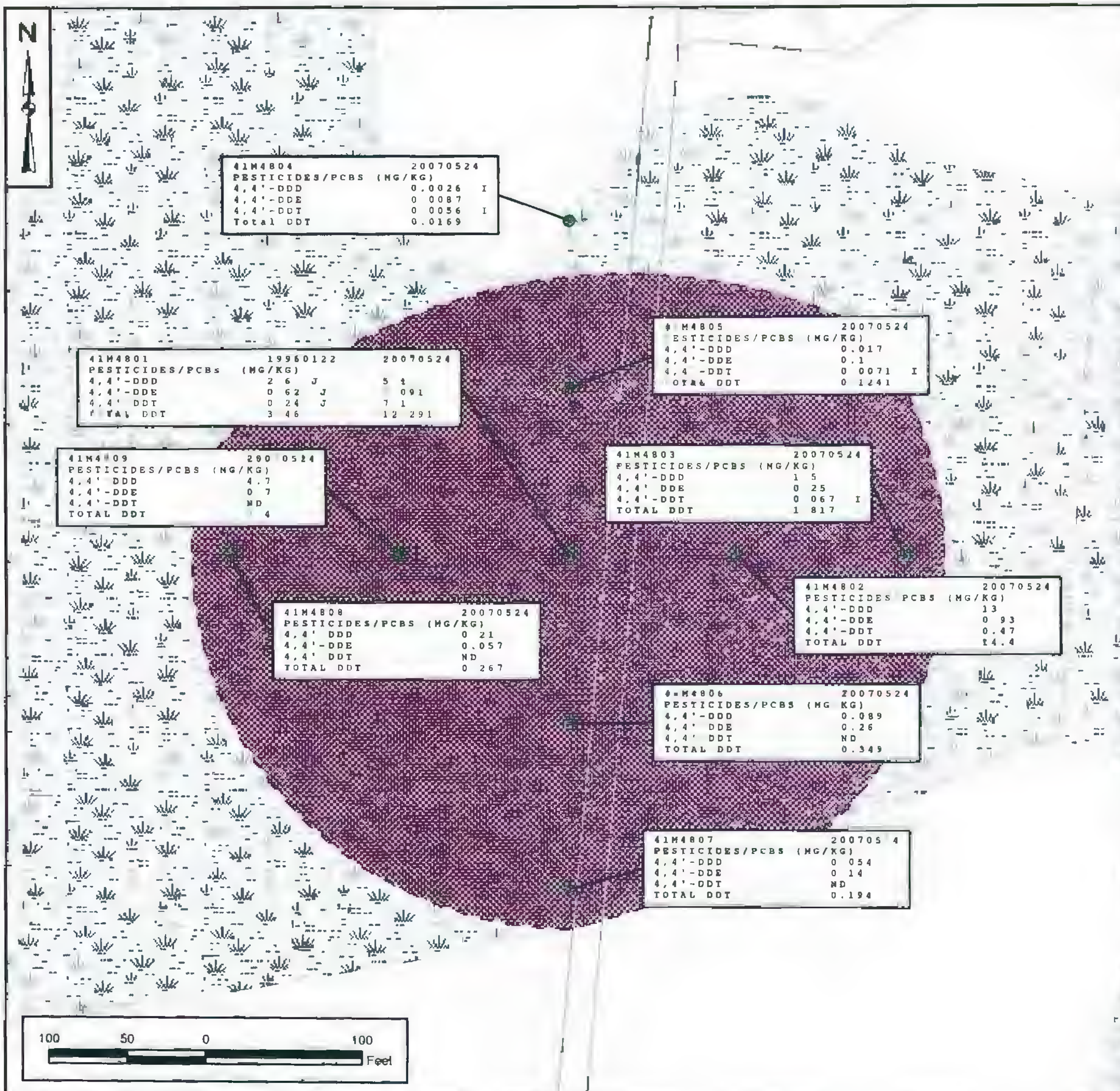

NAVFAC

Figure 2-6
Wetland 48
COCs in Sediment
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Ecological AOC
- Building
- Wetland

NOTES
1. Wetland 48 is considered a freshwater wetland
2. mg/kg = milligram per kilogram
3. ND = Non-detect
4. 19940628 = 6/28/1994

TETRA TECH

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Approved By.

Contract Number 112G00390
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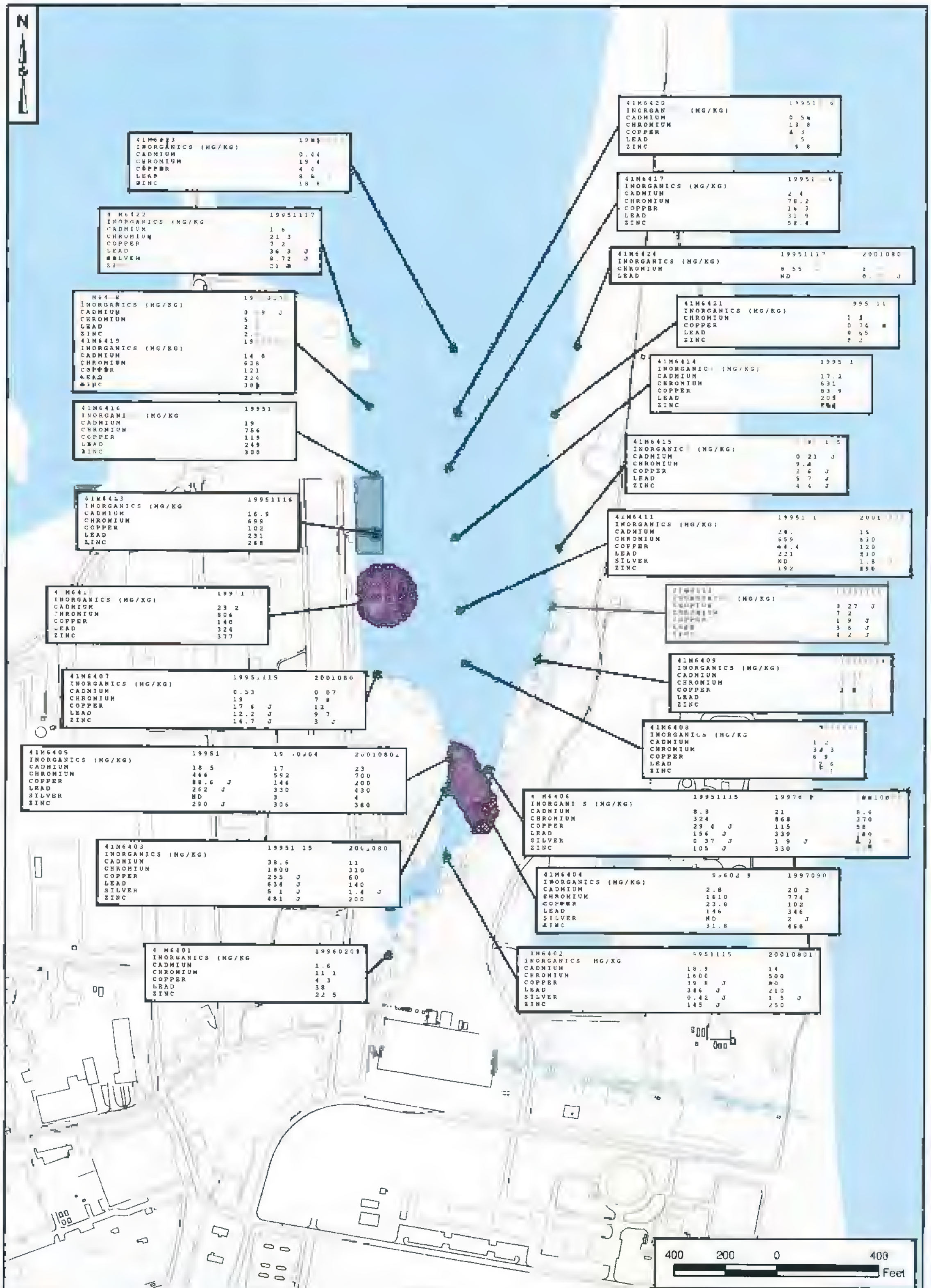

NAVFAC

Figure 2-7
Wetland 64
COCs in Sediment
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Ecological AOC
- Building
- Wetland
- Water

NOTES:
1. J - estimated value
2. * HHRA COPCs
3. Wetland 64 considered a saltwater wetland

TETRA TECH

Drawn By: K. MOORE 7/13/09
Checked By: N. ROCHNA 12/22/10
Approved By:

Contract Number: 112G00390
CTO 030

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3.0 SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The following section identifies, screens, and evaluates the potential remediation technologies and process options that may be applicable for use in assembling remedial alternatives for sediment within Wetlands 3, 5A, 15, 18A, 18B, 48, and 64. The primary objective of Section 3.0 of this FS is to develop an appropriate range of remedial technologies and process options to be used for developing remedial alternatives.

The basis for remediation technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Identification of ARARs
- Development of RAOs
- Identification of GRAs
- Identification of volumes or areas of concern

Remediation technology screening is performed in this section with the completion of the following analytical steps:

- Identification and screening of remediation technologies and process options
- Evaluation and selection of representative process options

Within Section 3.0, a variety of remediation technologies and process options are identified for each of the GRAs listed in Section 2.2 and then screened. The selection of remediation technologies and process options for initial screening is based on the Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA (USEPA, 1988). The screening is first conducted at a preliminary level to focus on relevant remediation technologies and process options, and then the screening is conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the remediation technologies that have passed the detailed evaluation and screening.

The evaluation criteria for detailed screening of remediation technologies and process options that have been retained after the preliminary screening are effectiveness, implementability, and cost. The following are descriptions of these evaluation criteria:

Effectiveness

Effectiveness is evaluated based on the following criteria:

- Ability of the technology to address the estimated areas or volumes of the contaminated media.
- Ability of the technology to meet the RAOs.
- Technical reliability (innovative versus well proven) with respect to contaminants and site conditions.
- Potential impacts to human health and the environment during implementation.

Implementability

Implementability is evaluated based on the following criteria:

- Overall technical feasibility at the site
- Availability of vendors, mobile units, storage and disposal services, etc.
- Administrative feasibility
- Special long-term operation and maintenance (O&M) requirements

Cost

Cost is evaluated based on the following criteria:

- Capital cost
- O&M costs

Technologies and process options are identified in the following sections.

3.1 PRELIMINARY SCREENING OF SEDIMENT REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The following identifies and screens remediation technologies and process options for sediment at a preliminary stage based on implementation with respect to site conditions and COCs. The table below summarizes the preliminary screening of technologies and process options applicable to sediment. It presents the GRAs, identifies the technologies and process options, and provides a brief description of each process option followed by screening comments. These sediment remediation technologies and process options are retained for detailed screening based on the results of preliminary screening.

General Response Action	Remediation Technology	Process Option
No Action	None	Not Applicable
Limited Action	LUCs	Institutional Controls
		Engineered Controls
	Sediment Monitoring	Sampling and Analysis
	Natural Recovery	Biodegradation, Dilution, Dispersion
Containment	Physical Capping	Sediment Cover
	Reactive Media Cover	Reactive Core Mat
Removal	Bulk Excavation	Dredging
In-Situ Treatment	Enhanced Natural Recovery	Thin-Layer Placement
	Biological	Phytoremediation
	Chemical/Physical	Stabilization/Solidification
Disposal	Landfill	Off-site Landfilling

3.2 DETAILED SCREENING OF SEDIMENT REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

3.2.1 No Action

No Action consists of maintaining the status quo at the site. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison with other alternatives and their effectiveness in mitigating risks posed by site contaminants. Because no remedial actions would be conducted under this alternative, there are no costs associated with "walking away" from the site. There would also not be any reduction in risk through exposure control or treatment. No Action would not be effective in evaluating contaminant mobility and potential migration off site because sediment monitoring would not be performed.

Effectiveness

No Action would not be effective in meeting the sediment RAOs. Evaluation of reductions in sediment COC concentrations through natural recovery or the potential for migration of COCs off site or to another medium could not be achieved because sediment monitoring would not be performed. Human health and ecological risk evaluation through this response action would not be possible.

Implementability

There would be no implementability concerns because no action would be implemented.

Cost

There would be no costs associated with No Action.

Conclusion

Because of NCP requirements, No Action is retained for the wetlands as a baseline for comparison with the other alternatives.

3.2.2 Limited Action

The technologies considered under this GRA include LUCs, sediment monitoring, and natural recovery.

3.2.2.1 LUCs

LUCs are designed to protect public health and the environment from residual contamination at environmental sites. LUCs consist of administrative or legal mechanisms that typically include deed or zoning restrictions, permits, etc., designated as institutional controls and/or physical controls that typically include fencing, security guards, etc., designated as engineering controls. Site-specific LUCs are typically implemented through a LUC Remedial Design (RD) that is prepared in accordance with the Navy Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions (DoD, 2004) following approval of the ROD. LUCs typically include the performance of regular site inspection to verify continued implementation.

For wetland sediments, LUCs would consist of institutional controls, in which access and future land use would be limited or restricted.

Effectiveness

LUCs consisting of site use and site access restrictions would effectively minimize unacceptable risks from direct exposure of human receptors to contaminated sediment. LUCs would not be effective at meeting RAOs pertaining to ecological receptors.

Implementability

LUCs would be easy to implement on a military facility where access is already restricted. A LUC RD could be readily prepared. LUCs for NAS Pensacola could easily be integrated and implemented.

Cost

The capital and O&M costs for LUCs would be low.

Conclusion

LUCs are retained for the development of sediment remedial alternatives for Wetland 18A, specifically to minimize human health risks.

3.2.2.2 Sediment Monitoring

Sediment monitoring would consist of regular sampling and analyzing sediment for the COCs throughout the areas of sediment contamination to evaluate whether the PRGs have been met. Sediment monitoring could also evaluate the potential for migration of COCs either off site through erosion or transfer to another medium by leaching, particularly surface water. Sediment monitoring would be implemented by conducting a Baseline Investigation to characterize the current concentrations of COCs in sediment. If the concentrations of COCs have decreased to below PRGs a Partnering Team meeting would take place to discuss the path forward. The monitoring plan would include the location and number of sediment samples to be collected, the types of data (e.g., description of the environment, collecting sediment for laboratory analysis, conducting insitu or laboratory ecological toxicity testing) to be collected, the data quality objectives, and decision rules for how the data will be evaluated.

Sediment monitoring is supported by the SPAWAR investigation of the discharge zone and in situ sediments at Wetland 64 which found that the "*The integrated in-situ sediment assessment generally reflects areas of low to moderate chemical loading in the bulk sediment with limited bioavailability, uptake or response. While bulk concentrations in sediment sometimes exceeded screening benchmarks, other measures of exposure including pore water, discharge water, interface water and passive samplers generally indicate a lack of mobility and bioavailability. This is supported by the lack or limited uptake in tissues of exposed organisms, and the general absence of toxicity in either laboratory or in-situ exposed organisms.*"

Effectiveness

Sediment monitoring alone would not reduce the toxicity, mobility, or volume of contaminants in sediment. However, sediment monitoring would allow for a determination of contaminant reduction through natural recovery and the potential off-site migration of COCs. Human health and ecological risk evaluation through sediment monitoring would be possible.

Implementability

Sediment monitoring would be easy to implement. Ecological sampling and sediment monitoring has been performed at NAS Pensacola. The resources and material required for sediment monitoring are readily available.

Cost

The capital and O&M costs of sediment monitoring would be low.

Conclusion

Sediment monitoring is retained for the development of sediment remedial alternatives for the Site 41 wetlands.

3.2.2.3 Natural Recovery

Natural recovery would consist of allowing naturally occurring processes to reduce the risks potentially posed by the COCs in sediment over time. Natural recovery could involve physical processes (sedimentation, advection, dilution, dispersion, bioturbation, or volatilization), biological processes (biodegradation, biotransformation, or phytoremediation), or chemical processes (natural oxidation/reduction or sorption). To evaluate natural recovery, sediment samples would be regularly collected and analyzed to establish trends in concentrations of COCs and determine if the PRG have been met.

Effectiveness

Historical analytical data for Wetlands 3, 5A, 18B, and 64 (Figures 2-1, 2-2, 2-5, and 2-7) indicate a decreasing trend in the concentration of COCs in sediment at these wetlands. This decreasing trend suggest that a natural recovery processes for the COCs could reduce unacceptable risk to human and ecological receptors. Natural recovery processes reduce the concentrations of COCs in sediment because inorganic and organic COCs can be removed via various physical, biological, or chemical processes. Sorption may marginally act as a risk reduction mechanism within the relatively fine sediment present in the wetlands at NAS Pensacola, specifically if sedimentation is occurring. However, the anticipated quantity of sedimentation is not significant enough to prevent migration of COCs in sediment to surface water. Natural variations in oxidation/reduction may marginally affect the concentrations of organic and inorganic COCs.

Implementability

Natural recovery would be easy to implement because it requires sediment monitoring as its only action. As noted earlier, the resources and materials required for sediment monitoring are readily available.

Cost

The capital and O&M costs for natural recovery would be low.

Conclusion

Natural recovery is retained for the development of sediment remedial alternatives for the Site 41 wetlands.

3.2.3 Containment

The technologies considered under this GRA include physical and reactive media cover capping.

3.2.3.1 Physical Capping

Physical capping could be utilized by installing a relatively impermeable cover system over the contaminated sediment to prevent direct exposure of ecological receptors. Capping could minimize sediment COC migration to surface water and off site. The cover system would typically consist of a layer, at least 2 feet thick, of clean material with geotechnical characteristics (particle size, density, texture) such that it would be likely to remain above the contaminated sediment.

Effectiveness

Capping would not remove sediment COCs or reduce their toxicity. Nonetheless, capping is a well-established and proven technology that could be effective in preventing direct exposure of ecological receptors to contaminated sediment. A cap could be effective in minimizing the potential for off-site migration of sediment COCs, principally as a result of erosion and sedimentation.

Implementability

Installation of a cap over contaminated sediment is typically fairly easy to implement, and the required material and services are readily available. However, sediment capping would likely pose a significant detriment to species within the benthic zone, adversely affect the wetland hydrology and result in unintended damage to areas that are not contaminated. Unintended environmental damage from construction activities in wetland areas typically include: direct habitat loss, addition of suspended solids and modification of water levels and flow regimes. Negative impacts from the ecological damage could range from changes to the chemistry and biology of the local area to changes in hydrology that go well beyond the immediate area. Site-specific health and safety procedures and Occupation Safety and Health Administration (OSHA) regulations would have to be complied with to ensure that exposure to workers to the COCs is minimal.

Cost

The capital costs for physical capping would be moderate. Because of the need for frequent and long-term monitoring and maintenance, O&M costs would be relatively high.

Conclusion

Because of significant concerns regarding damage to the existing wetland ecology and hydrology, continued contaminant mobility, and O&M costs, physical capping is eliminated for the development of sediment remedial alternatives.

3.2.3.2 Reactive Media Cover

Implementation of a reactive media cover would consist of installing a reactive core mat (RCM) composed of reactive media "sandwiched" between two permeable layers of geotextile and non-woven composite material. The cover system typically consists of a RCM installed directly above the area of concern. A second layer of permeable geotextile with a higher density (usually sand filled) is then installed above the reactive layer to ensure placement of the reactive media. Reactive material within the RCM contains contaminant-specific treatment media such as organoclay, activated carbon, zero-valent iron, or apatite. Depending on the design of the composite material, the reactive media can treat or sequester contaminants via various physical, chemical, and biological mechanisms.

Effectiveness

Although a relatively new technology, reactive media covers have been successfully implemented for COCs such as the ones present in Site 41 sediment. A reactive media cover could prevent the flux of COCs in sediment into surface water. In addition, a RCM can also act as a substrate to encourage biological degradation. However, biological growth on the RCM is not normally favorable, because biological fouling may limit media effectiveness and require routine RCM replacement.

Implementability

Installation of a RCM over contaminated sediment is typically fairly easy to implement. Although few vendors provide materials and support RCM technology, the required materials and services can be readily acquired. However, installation of a RCM would likely pose a detriment to species within the benthic zone, adversely affect wetland hydrology and result in unintended damage to areas that were not contaminated. Depending on the biological and contaminant loading on the cover, routine maintenance of the cover may be required, and replacement of the RCM may be warranted if the media become spent or fouled. The construction methods to implement a reactive media cover are likely to result in unintended consequences that include damage to the existing wetlands and adjacent areas. Unintended environmental damage from construction activities in wetland areas typically include: direct habitat loss, addition of suspended solids and modification of water levels and flow regimes. Negative impacts from the ecological damage could range from changes to the chemistry and biology of the local area to changes in hydrology that go well beyond the immediate area.

Cost

The capital costs for implementation of a reactive media cover would be moderate to high depending on the desired media within the cover. Because of the need for long-term monitoring and maintenance, O&M costs could potentially be high.

Conclusion

Due to significant concerns regarding damage to the existing wetlands and hydrology, implementability, and O&M concerns, reactive media covers are eliminated for the development of sediment remedial alternatives.

3.2.4 Removal

The technology considered under this GRA is bulk excavation and dredging. The three dredging methods considered for sediment removal include mechanical, hydraulic, and pneumatic processes.

3.2.4.1 Long-Reach Backhoe

Most sediment would be accessible to excavation through use of a long-reach backhoe. Due to the nature of wetlands, load-bearing mats would be placed in the pathway of the backhoe or other equipment to provide access to the wetland. Similarly, the load-bearing mats would be placed in the excavation areas upon which the backhoe would be required to move to adequately excavate the contaminated sediments during remedial activities.

Backhoes are typically used to remove small volumes of sediment and may result in potential loss of sediment due to an open excavator bucket. However, backhoes can be more effective than dredging systems for removing dense or hard material and for dredging of shallow sediment along shorelines.

3.2.4.2 Mechanical Dredging

Mechanical dredging uses either normal excavation equipment (e.g., backhoe or Gradall) if it can reach the sediment depth or digging buckets (e.g., clamshell buckets) or dragline buckets suspended by a cable from a crane. This equipment can operate from shore or from a floating platform. Dragline buckets are used with a crane and are similar to digging buckets, with the difference that dragline buckets are open on one side and are lowered into the sediment with a lifting cable then pulled back towards the crane with a second cable.

Mechanical dredging typically removes subaqueous sediment at nearly the in-place density and water content. However, some water is added to the collected sediment because every bucket cannot be filled completely with sediment. Mechanical dredging typically adds a volume of water 20 to 50 percent of the bucket capacity. On-site dewatering of excavated sediment is common.

3.2.4.3 Hydraulic Dredging

Hydraulic dredges are routinely used to move large sediment volumes. A typical hydraulic dredge consists of a suction head that collects the sediment as a slurry. The suction head is connected to a hydraulic pump that aspirates the sediment slurry and conveys it to the desired location for further processing. The machinery may also be equipped with rotating cutting tools or augers to enhance sediment removal. Hydraulic dredges typically use a volume of water 5 to 10 times that of the in-place sediment to be removed to create and transport the sediment slurry. The cutter or auger head hydraulic dredge is most commonly used to remove sediment and can effectively remove a wide variety of sediment types, including dense sand and hard clay. Hydraulic dredges that do not use a cutter or auger head can normally only remove relatively soft sediment with little debris. These hydraulic dredges often include water jets to help loosen and slurry the sediment.

3.2.4.4 Pneumatic Dredging

Pneumatic dredges are similar to hydraulic dredges, except that in place of a pump, they use a pressure gradient created with compressed air to lift and move dredged material. Pneumatic dredges are not common and are used primarily for small-scale cleanup of spilled contaminants and marine archaeology.

Effectiveness

Excavation by dredging is a well-established and demonstrated technology to remove a wide variety of sediment from aquatic environments. Excavation by dredging is effective at addressing any class of contaminant (i.e., organic or inorganic) because it physically and non-selectively removes impacted material. Thus, excavation by dredging may be an effective technology to remove contaminated sediment. Removal methods (backhoe and dredging) are likely to result in unintended consequences that include damage to the existing wetlands and adjacent areas. Unintended environmental damage from construction activities in wetland areas typically include: direct habitat loss, addition of suspended solids and modification of water levels and flow regimes. Negative impacts from the ecological damage could range from changes to the chemistry and biology of the local area to changes in hydrology that go well beyond the immediate area.

Implementability

Excavation by dredging is a well-proven technology that can be readily implemented at most sites. Silt curtains, sheet piles or coffer dams may be required to minimize the migrations of contaminated sediments during the excavation or dredging activities. A sediment containment and dewatering areas would be required for the wet sediments. Water from the containment area may require treatment prior to discharge to the wetlands from which the sediments were excavated. Dredging equipment and/or services are readily available from multiple vendors or contractors. During the bulk excavation and dredging activities, site-specific health and safety procedures and OSHA regulations would have to be complied with to ensure that the exposure of workers to COCs is minimized.

Cost

Bulk excavation and dredging costs are typically moderate to high. Post-removal sediment and water management and disposal costs can substantially increase the overall costs of a wet sediment and dredging removal action.

Conclusion

Because impacted sediment zones at Wetlands 3, 5A, 15, 18A, 48, and 64 can be removed and are accessible via excavation by bulk excavation or mechanical dredging methods, these methods are retained as a remedial alternative.

3.2.5 In-Situ Treatment

The technologies considered under this GRA include enhanced natural recovery, phytoremediation, and chemical stabilization/solidification.

3.2.5.1 Enhanced Natural Recovery

Enhanced natural recovery would consist of accelerating the previously discussed natural recovery processes (particularly biodegradation and sedimentation) through engineering means. The addition of a thin-layer of clean sediment (typically 6-inches) is an effective engineering means of encouraging natural recovery via biodegradation and sedimentation. Appropriately, this option is commonly referred to as thin-layer placement.

Effectiveness

Compared to natural recovery without enhancement, thin-layer placement could accelerate the biodegradation of organic COCs in sediment by providing an appropriate support medium for biological activity. Conversely, thin-layer placement is not anticipated to affect the removal of inorganic COCs. In addition, it is likely that thin-layer placement would address predominantly the upper layer of contaminated sediment, but the deeper layers would remain essentially unaffected. Thin-layer placement may enhance natural recovery through sedimentation by increasing the thickness of clean material. However, this effect would be minimal because the typical thickness of material involved in thin-layer placement (6 inches or less) would not by itself result in adequate risk reduction for human or ecological receptors.

Implementability

The implementability of enhanced natural recovery through thin-layer placement is typically fairly easy. Accurate placement of a fairly thin layer of sand or similar material would be easy to achieve, and the layer would be relatively easy to maintain over the long term. The thin layer may be a detriment to benthic species and alter hydrologic characteristics of the wetland. Placement of the thin layer may damage areas that are not contaminated by the COCs.

Cost

The capital and O&M costs for enhanced natural recovery through thin-layer placement would be moderate.

Conclusion

Enhanced natural recovery via thin-layer placement is eliminated from further consideration because of effectiveness concerns and the potential for adverse effects on benthic communities and wetland hydrology.

3.2.5.2 Phytoremediation

Phytoremediation involves the use of plants to reduce hazardous organic and inorganic contaminants to non-toxic or less toxic concentration levels. Phytoremediation is most applicable in large areas with low to moderate contaminant levels. The remedial technology may be utilized in sediment to process COCs through one or more of the mechanisms:

- Phytoextraction – root uptake or translocation of contaminants within plants. Plant harvesting is generally required for contaminant removal. Demonstrated mechanism for cadmium, cobalt, chromium, mercury, manganese, arsenic, and zinc.

- Phytostabilization – immobilization of a contaminant via root absorption, adsorption, accumulation, or precipitation or the utilization of plants to prevent contaminant migration. Demonstrated mechanism for arsenic, cadmium, chromium, arsenic, and zinc.

- Rhizodegradation – microbial breakdown of contaminants in sediment within the root zone of plants. Demonstrated mechanism for PAHs, total petroleum hydrocarbons (TPH), pesticides, chlorinated solvents, and PCBs.

- Phytodegradation – metabolic breakdown of contaminants by plants or the external breakdown of contaminants from compounds produced by plants. Demonstrated mechanism for organic compounds, chlorinated solvents, phenols, and herbicides.

- Phytovolatilization – contaminant uptake and transpiration by a plant to the atmosphere. Demonstrated mechanism for chlorinated solvents and several inorganics (e.g. selenium, mercury, and arsenic).

Phytoremediation may utilize various species of plants depending on the required mechanism and COCs. A treatability study would be required to verify species selection and quantify removal efficiency for specific COCs. If thereafter found applicable, native or introduced species would be planted in the areas of contamination. If non-native plants are utilized, appropriate control techniques would be used to verify that genetic contamination or invasive spread does not occur. If native species are selected, the remediation potential of existing plants should be carefully assessed.

An array of the above mechanisms may be implemented for removal and containment of the COCs. Sediment samples would be regularly collected and analyzed to evaluate the progress of remediation.

Effectiveness

The effectiveness of phytoremediation is documented in many cases for the in-situ removal or containment of inorganic and organic contaminants such as the Site 41 COCs. A combination of several mechanisms may be utilized to incorporate the variety of COCs requiring remedial action. Treatability testing would be required to evaluate the site-specific applicability of phytoremediation. Successful application of phytoremediation could achieve RAOs and reduce human and ecological risks. However, plant toxicology and organisms within the herbivorous food chain should be evaluated in detail prior to application to ensure that implementation does not create adverse affects.

Implementability

Phytoremediation of contaminated sediment would be relatively easy to implement at NAS Pensacola. Planting of selected species would be relatively unobtrusive with respect to existing biota.

Cost

The capital and O&M costs for phytoremediation would be low.

Conclusion

Sediment COC concentrations greater than PRGs are limited to the top 6-inches of sediment. Inorganics in the sediment become part of the plant matter as plants grow and are cycled back to wetland sediments after the plant expires or when leaves drop. Therefore, phytoremediation would require harvesting plants to remove plant matter that contains inorganic COCs, which would be recycled to wetland sediments if not removed. . The harvesting events could also result in unintended physical damage to the wetlands. Therefore, phytoremediation is not retained as a GRA due to concerns with effective plant root depths extending beyond the impacted depth.

3.2.5.3 Chemical Stabilization/Solidification

Chemical stabilization would consist of mixing contaminated sediment with chemical reagents that modify COCs to render them less soluble and hence less mobile. Chemical solidification binds the COCs within the matrix of the material being treated. The most common stabilization reagents are phosphates, carbonates, hydroxides, and sulfates. Common solidification reagents include pozzolanic-based materials such as Portland cement, cement kiln dust (CKD), and fly ash. Other reagents such as thermoplastic binders (i.e., asphalt); sorbents such as granular activated carbon (GAC), clays, zeolites, and anhydrous sodium silicate; and MAECTITE® have also been successfully used for chemical stabilization/solidification.

For in-situ chemical stabilization/solidification, the above-mentioned chemical reagents are typically mixed with the contaminated sediment to be treated using specialized mechanical excavating and blending equipment that combines augering of the sediment with high-pressure injection of the reagents.

Effectiveness

Chemical stabilization/solidification is a well-established and proven technology, but its effectiveness is highly dependent on the type of material being treated and the type of COCs being immobilized. A physical and chemical characterization of the media and COCs to be immobilized and/or treated is needed. Treatability testing is typically required to determine the most suitable stabilization/solidification reagents and mixing ratios. The effectiveness of in-situ chemical stabilization/solidification could be limited by incomplete in-situ sediment/reagent blending, which is typically not as complete as in an ex-situ environment.

In-situ chemical stabilization/solidification would effectively minimize the potential for migration of COCs from sediment to other environmental media such as surface water. However, in-situ chemical stabilization/solidification does not eliminate the toxicity of COCs immobilized in the treated sediment and leaves this treated sediment in place. Long-term stability and leachability of the treated sediment would remain as potential concerns because COCs would remain within the treated sediment. These concerns are particularly valid for application of this technology to sediment within saltwater wetlands, where the high salinity of NAS Pensacola surface water could significantly impact the long-term stability of the stabilized sediment.

The construction methods to implement in-situ chemical stabilization/solidification may result in unintended consequences that include damage to the existing wetlands and adjacent areas. Unintended environmental damage from construction activities in wetland areas typically include: direct habitat loss, addition of suspended solids and modification of water levels and flow regimes. Negative impacts from the ecological damage could range from changes to the chemistry and biology of the local area to changes in hydrology that go well beyond the immediate area.

Implementability

In-situ chemical stabilization/solidification is typically fairly easy to implement, and qualified contractors are readily available to perform this work. Treatability tests would be required to determine the appropriate mix ratios prior to implementation. Implementation of this technology within saturated media may not be feasible or effective. Similarly, the areal extent of sediment that would require treatment may be cost prohibitive. In-situ would disturb the sediment and would require the installation of turbidity curtains so the treated and contaminated sediments would not be mobilized and transported to other areas of the wetland or further downstream. The in-situ chemical stabilization/solidification would adversely affect the existing benthic communities and alter the hydrology of the wetlands. Areas that are not affected by the COCs could be adversely affected by the equipment used to implement this technology.

Cost

The costs of stabilization/solidification would be high. The application of this technology would be contracted as a service.

Conclusion

In-situ chemical stabilization/solidification is eliminated from further consideration because of potential adverse affects to the existing benthic community, altering the wetland hydrology, damage to adjacent areas, effectiveness, and other implementability concerns.

3.2.6 Disposal

The only technology considered under this GRA is off-site landfilling.

Off-Site Landfilling

Off-site landfilling would consist of transporting dredged sediment for burial at a permitted facility. Prior to landfilling, the sediment would be dewatered to meet landfill moisture requirements for waste and sediment with higher concentrations of COCs will require treatment by one or more ex-situ treatment technologies at an off-site treatment, storage, and disposal facility (TSDF). In addition, sediment that contains metals with Toxicity Characteristic Leaching Procedure (TCLP) extract concentrations greater than RCRA toxicity characteristic concentrations would be identified as hazardous and would have to be disposed of at a hazardous waste TSDF. At the TSDF, sediment would undergo treatment to satisfy land disposal restrictions (LDRs) prior to secure landfilling. Based on currently available analytical data, it is unlikely that sediment would require treatment at an off-site TSDF or that sediment would be identified as hazardous.

Effectiveness

Landfilling would not permanently or irreversibly reduce the concentrations or toxicities of sediment COCs. However, although the CERCLA preference for treatment relegates landfilling to a less preferable option, this technology could be an effective disposal option for contaminated sediment. Landfills are only permitted to operate if they meet certain requirements of design and operation governing foundation, liner, leak detection, leachate collection and treatment, daily cover, post-closure inspections and monitoring, etc., which ensure the effectiveness of these facilities. The requirements of a hazardous waste TSDF are typically more stringent than those of a municipal solid waste landfill.

Implementability

Off-site landfilling would be easy to implement provided the excavation method is applicable. Permitted municipal solid waste and hazardous waste TSDFs are available for this purpose. In certain cases, disposal at either type of facility may require pretreatment, which would mainly include the removal of free liquids by dewatering to facilitate the transport of dredged sediment for disposal. A waste profile would have to be prepared, including indications of contaminant concentrations and their leachabilities. Adverse impact of the surrounding community and the environment from off-site transportation of contaminated sediment would be adequately mitigated by adherence to spill prevention procedures and by compliance with Department of Transportation (DOT) regulations.

Cost

The cost of off-site disposal would be low to moderate for a municipal solid waste landfill, moderate for a non-hazardous waste TSDF, and high for a hazardous waste TSDF.

Conclusion

Landfilling is retained for the development of sediment remedial alternatives because removal of contaminated sediment was retained for Wetlands 3, 5A, 15, 18A, 48, and 64.

3.3 SELECTION OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

Table 3-1 presents a summary of GRA's retained for specific wetlands. These technologies are evaluated in detail for the applicable wetlands in Section 4.0.

TABLE 3-1

RETAINED GENERAL RESPONSE ACTION SUMMARY
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

General Response Action	Remediation Technology	Process Option	Wetland						
			3	*5A*	*15*	*18A*	*18B*	*48*	*64*
No Action	None	Not Applicable	✔	✔	✔	✔	✔	✔	✔
Limited Action	Land Use Controls	Institutional Controls	✔		✔	✔	✔		
		Physical Controls	✔		✔	✔	✔		
	Sediment Monitoring	Sampling and Analysis	✔	✔	✔	✔	✔	✔	✔
	Natural Recovery	Biodegradation, Dilution, Dispersion	✔	✔	✔	✔	✔	✔	✔
Containment	Capping	Sediment Cover							
	Reactive Media Cover	Reactive Core Mat							
Removal	Bulk Excavation	Excavation	✔	✔	✔	✔		✔	
		Mechanical Dredging							✔
In-Situ Treatment	Enhanced Natural Recovery	Thin-Layer Placement							
	Biological	Phytoremediation							
	Chemical/Physical	Stabilization/Solidification							
Disposal	Landfill	Offsite Landfilling	✔	✔	✔	✔		✔	✔

✔ – Denotes retained General Response Action (GRA).

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP (40 CFR Part 300). These criteria and the relative importance of these criteria are described in the following subsections.

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR Part 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability

- Cost

The balancing criteria are used to compare and weigh the relative merits of each remedial alternative to the no action alternative and to each other.

The remaining two of the nine criteria: State Acceptance and Community Acceptance are considered to be modifying criteria that must be considered during remedy selection. These last two criteria are evaluated after the FS has been reviewed by the State of Florida and the Proposed Plan has been discussed at a public meeting, if required and requested, and opened to public comment. Therefore, this document addresses only seven of the nine criteria.

4.1.1.1 Overall Protection of Human Health and the Environment

Alternatives must be assessed for adequate protection of human health and the environment, in both the short and long term, from unacceptable risks posed by hazardous substances or contaminants present at the site by eliminating, reducing, or controlling exposure to levels exceeding cleanup goals. Overall protection draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

4.1.1.2 Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under federal environmental laws and state environmental or facility siting laws. CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or a waiver must be obtained [see also 40 CFR 300.430(f)(1)(ii)(B)] (waivers are described in Section 2.1.2.1).

ARARs include only federal and state environmental or facility siting laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), non-binding other advisories, criteria, or guidance may be considered in determining remedies [To Be Considered (TBC) guidance category].

4.1.1.3 Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative will prove successful. Factors that will be considered as appropriate include the following:

- Magnitude of Residual Risk - Risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and Reliability of Controls - Controls such as containment systems and LUCs that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. In particular, the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative such as a cap, slurry wall, or treatment system; and the potential exposure pathways and risks posed if the remedial action needs replacement.

4.1.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the alternative employs recycling or treatment that reduces the toxicity, mobility, or volume will be assessed, including how treatment is used to address the principal threats posed by the site. Factors that will be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that they will treat.

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.

- The degree of expected reduction in toxicity, mobility, or volume of waste due to treatment or recycling and the specification of which reduction(s) is occurring.

- The degree to which the treatment is irreversible.

- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.

- The degree to which treatment reduces the inherent hazards posed by principal threats at the site.

4.1.1.5 Short-Term Effectiveness

The short-term impacts of the alternative will be assessed considering the following:

- Short-term risks that could be incurred by the community during implementation.

- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.

- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.

- Time until protection is achieved.

4.1.1.6 Implementability

The ease or difficulty of implementing the alternatives will be assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).

- Availability of services and materials, including the availability of adequate off-site treatment capacity, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure necessary additional resources; the availability of services and materials; and the availability of prospective technologies.

4.1.1.7 Cost

Capital costs will include both direct and indirect costs. Annual O&M costs will be provided, and a net present value of the capital and O&M costs will also be provided. Typically, the cost estimate accuracy range is plus 50 percent to minus 30 percent.

4.1.1.8 State Acceptance

The state's concerns that must be assessed include the following:

- The state's position and key concerns related to the preferred alternative and other alternative.

- State comments on ARARs or the proposed use of waivers.

- These concerns cannot be evaluated until the state has reviewed and commented on the FS. These concerns will be discussed, to the extent possible, in the Proposed Plan to be issued for public comment.

4.1.1.9 Community Acceptance

This assessment consists of responses of the community to the Proposed Plan and includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment can be conducted after comments on the Proposed Plan are received from the public.

4.1.2 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan to the community for review and comment. The preferred alternative must meet the following criteria:

- Protection of human health and the environment.
- Compliance with ARARs unless a waiver is justified.
- Cost effectiveness in protecting human health and environment and in complying with ARARs.
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

The second step consists of the review of public comments and determination by the Navy and USEPA, in consultation with the State of Florida, as to whether the preferred alternative continues to be the most appropriate remedial action for the site.

4.2 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR SEDIMENT

This section will develop the remedial alternatives for sediment at Site 41. Additional site-specific information and assumptions will be provided in this section to further explain the alternative development process.

The following alternatives for sediment remediation have been developed for the Site 41 Wetlands (3, 5A, 15, 18A, 18B, 48, and 64):

- SED-1: No Action
- SED-2: Natural Recovery and Sediment Monitoring

It should be noted that arsenic concentrations are below calculated PRGs, based on the most recent sediment sample results for Wetland 18B. However, a Baseline Investigation is being proposed for Wetland 18B to verify that arsenic concentrations remain less than PRGs.

An additional alternative has been included for Wetlands 3, 15, 18A, and 18B:

- SED-3: LUCs, Natural Recovery, and Sediment Monitoring

An additional alternative has been included for Wetlands 3, 5A, 15, 18A, 48, and 64:

- SED-4: Ex-Situ Treatment – Removal (Excavation or Dredging) and Disposal

A description and detailed analysis of these alternatives are provided in the following sections.

4.2.1 <u>SED-1: No Action</u>

4.2.1.1 Description

The No Action alternative maintains the site as is. This alternative does not address the sediment contamination and is retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of the contaminants. The site would not be available for unrestricted use.

4.2.1.2 Detailed Analysis

<u>Overall Protection of Human Health and the Environment</u>

SED-1 would not provide protection of human health and the environment. Under the current land use, there could be unacceptable risks to human health and/or ecological receptors from direct exposure to contaminated sediment. Because sediment monitoring would not be performed, potential fluctuations in COC concentrations would not be detected.

Compliance with ARARs

Compliance with location-specific ARARs would be purely incidental, the wetland status of the site would prohibit or limit future use or development. Action-specific ARARs are not applicable to this alternative and there are no chemical–specific ARARs identified for Site 41.

Long-Term Effectiveness and Permanence

SED-1 would have no long-term effectiveness and permanence because contaminated sediment would remain on site. Because there would be no LUCs to restrict the disturbance of sediment within the site boundaries, the potential would also exist for unacceptable risk to develop for human and/or ecological receptors. Because there would be no sediment monitoring, potential COC concentration fluctuations would not be detected. Although COC concentrations will eventually decrease to PRGs through natural recovery, no sediment monitoring would verify this.

Reduction of Toxicity, Mobility, or Volume through Treatment

SED-1 would not reduce the toxicity, mobility, or volume of contaminants through treatment because no treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of SED-1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. SED-1 would never achieve the RAOs, this would not be verified through sediment monitoring.

Implementability

Because no action would occur, SED-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. Implementability of administrative measures is not applicable because no such measures would be taken.

Cost

There would be no costs associated with the No Action alternative.

4.2.2 SED-2: Natural Recovery and Sediment Monitoring

SED-2 consists of two major components: (1) Natural recovery and (2) sediment monitoring.

4.2.2.1 Description

Component 1: Natural Recovery

Natural recovery would consist of allowing naturally occurring processes to reduce the human health or ecological risks posed by the COCs over time. Natural recovery could involve physical processes (sedimentation, advection, dilution, dispersion, bioturbation, or volatilization), biological processes (biodegradation, biotransformation, or phytoremediation), and/or chemical processes (natural oxidation/reduction or sorption). To evaluate natural recovery, sediment samples would be regularly collected and analyzed to establish trends in concentrations of COCs and evaluate whether the PRGs are met.

Component 2: Sediment Monitoring

Sediment monitoring would be implemented by conducting a Baseline Investigation to characterize the current concentrations of COCs in sediment. If the concentrations of COCs have decreased to below PRGs, the NAS Pensacola Partnering Team would meet and discuss the path forward. The monitoring plan would include the location and number of sediment samples to be collected, the types of data (e.g., description of the environment, collecting sediment for laboratory analysis, conducting insitu or laboratory ecological toxicity testing) to be collected, the data quality objective and decision rules for how the data will be evaluated.

Sediment monitoring would consist of regularly collecting and analyzing sediment samples from within the areas of concern at Wetlands 3, 5A, 15, 18A, 48, and 64 to assess natural recovery and verify that migration of the COCs is not occurring.

Sediment samples would also be collected at Wetland 18B to confirm that COC concentrations remain below their PRGs. Sediment samples were collected from only one location at Wetland 18B in 1995 and 1997. Arsenic was detected at a concentration of 83.8 mg/kg in 1995, which exceeds the PRG (14 mg/kg). However, arsenic was detected at a concentration of 13.8 mg/kg in a sediment sample collected from the same location in 1997. Therefore sediment monitoring was retained because there is some uncertainty in whether arsenic concentrations exceed its PRG.

Because each wetland has different COCs and detected concentrations of COcs, the sampling and analyses program would be different and specific to each wetland. The number of samples to be collected and parameters for laboratory analyses for each wetland are listed in Table 4-1. Sediment sample locations and the need for conducting insitu or laboratory ecological toxicity testing would be determined and described in a sampling and analysis plan. The sediment monitoring would be performed at the frequency described in the sampling and analysis plan until PRGs have been met. The need to conduct a more active remedial approach would be evaluated during the five-year review.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, an independent statutory review will be conducted within five years of initiation of remedial action. Although considered part of Alternative 2, the five year review is an independent statutory review that is conducted in accordance with Section 121(c) of CERCLA and NCP §300.430(f)(5)(iii)(c). The review is required within five years of initiation of remedial action and every five years thereafter to ensure that the remedy continues to be protective of human health and/or the environment. Additionally, if the results of the five-year reviews reveal that remedy integrity is compromised and protection of human health is insufficient, then additional remedial actions will be evaluated by the Navy, USEPA, and FDEP. Each five-year review consists of a review of relevant documents, interviews, a site inspection, and preparation of a summary report.

TABLE 4-1

SEDIMENT MONITORING
SITE 41 WETLANDS – FEASIBILITY STUDY REPORT

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland	Number of Samples to be Collected	Analysis												
		Metals									Pesticides/PCBs			
		Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Selenium	Silver	Zinc	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT
3	10	x	x											
5A	10				x	x				x				
15	10	x					x	x						
18A	10	x												
18B	10	x												
48	20										x	x	x	x
64	20		x	x	x	x			x	x				

*For purposes of costing, the number of samples to be collected as presented above were assumed. The actual number of samples and locations will be determined in the sampling and analysis plan developed for sediment monitoring.

4.2.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

SED-2 would not be protective of human health and/or the environment at the time of implementation. However, protection of human and ecological receptors would occur over time. The sediment monitoring associated with SED-2 would identify when protection of human and ecological receptors would occur. Five-year reviews would be conducted to evaluate the adequacy of the remedy. If contaminant trends do not identify a continual decrease in COC concentrations, or if sediment monitoring does not identify continued accumulation of cleaner sediment over the contaminated areas, a determination of the adequacy of the alternative would be made in accordance with the decision making process that would be identified in the long-term sediment monitoring plan associated with this alternative.

Compliance with ARARs

Although SED-2 does not remove or reduce COC concentrations to the identified PRGs upon implementation, it should achieve the identified PRGs after natural processes are given sufficient time to reduce COC concentrations. Therefore, SED-2 would comply with location-, and action-specific ARARs once natural processes are given adequate time to reduce the COCs to concentrations below their PRGs.

Long-Term Effectiveness and Permanence

SED-2 would provide long-term effectiveness and permanence once the COC concentrations meet their PRGs through naturally occurring processes. Once PRGs are achieved, it is expected that the COCs would remain at concentrations below their PRGs. Five-Year reviews would be conducted to evaluate results of regular sediment monitoring and the adequacy of the remedy.

Reduction of Toxicity, Mobility, or Volume through Treatment

The implementation of SED-2 would not provide a reduction in toxicity, mobility, or contaminant volume within Wetlands 3, 5A, 15, 18A, 18B, 48, and 64 through treatment. However, reduction of contamination toxicity and mobility could occur as a result of naturally occurring processes.

Short-Term Effectiveness

Implementation of SED-2 would not result in short-term adverse risk to the local community and the environment. Some short-term risks could be incurred by workers from exposure to contaminated sediment during sediment monitoring activities. However, the potential for exposure would be minimized by the wearing of appropriate personal protection equipment (PPE), and compliance with OSHA regulations and site-specific health and safety procedures.

Implementability

Natural recovery would be very easy to implement because it requires limited actions of sediment monitoring and evaluation. The resources and materials required for sediment monitoring are readily available.

Cost

The estimated costs for Alternative SED-2 are as follows.

Wetland	Capital Cost	30-Year NPW of O&M Cost	30-Year NPW
3	$9,000	$75,000	$84,000
5A	$9,000	$79,000	$88,000
15	$9,000	$79,000	$88,000
18A	$9,000	$72,000	$81,000
18B	$9,000	$72,000	$81,000
48	$9,000	$87,000	$96,000
64	$9,000	$126,000	$135,000
Total	$63,000	$590,000	$653,000

The above cost figures have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. A detailed breakdown of estimated costs for this alternative is provided in Appendix B.

4.2.2.3 Sustainability Evaluation Results

Due to limitations in the SiteWise model, the only input for SED-2 is the travel to and from NAS Pensacola for sampling Wetlands 3, 5A, 15, 18A, 18B, 48, and 64. It is assumed there will be 2 days of sampling for each wetland and travel back and forth from the site 200 miles each way. This yields the following:

CO_2 Emissions Metric ton	Nox Emissions Metric ton	Sox Emissions Metric ton	PM_{10} Emissions Metric ton	Total Energy MMBTU	Accident Risk Fatality	Accident Risk Injury
0.60	6.61	NA	0.00065	1.56	9.76E-05	6.80E-06

Notes:

CO_2 = carbon dioxide

Nox = nitrogen oxide

Sox = sulfur oxide

PM_{10} = particles measuring 10 microns or less

MMBTU = one thousand thousand British Thermal Units

A summary of the sustainability evaluation for this alternative is provided in Appendix C.

4.2.3 SED-3: LUCs, Natural Recovery, and Sediment Monitoring (Wetlands 3, 15, 18A, and 18B)

4.2.3.1 Description

SED-3 consists of three major components: (1) LUCs, (2) natural recovery, and (3) sediment monitoring. The LUC component of SED-3 was only considered for Wetland 3, 15, 18A, and 18B because only human receptors are at risk.

Component 1: LUCs

LUCs would be implemented to prevent unacceptable risks to human receptors (e.g., maintenance workers) from exposure to the COCs that exceed their cleanup criteria in sediment at the wetlands. These LUCs would be implemented in the form of both institutional controls (ICs) such as master planning based on administrative controls over future land usage and engineering controls (ECs) such as site signage will be implemented. How these LUCs would be implemented and maintained would be detailed in a LUC Remedial Design (RD) for the site prepared by the Navy and submitted to USEPA and FDEP for review and concurrence after finalization of the ROD.

Component 2: Natural Recovery

This component would be the same as SED-2.

Component 3: Sediment Monitoring

This component would be the same as SED-2.

4.2.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

SED-3 would be protective of human health. LUCs restricting access would be protective of human health by preventing unacceptable risks to workers from direct exposure to the COCs in sediment. SED-3 would not be protective of the environment (Wetlands 3 and 15) at the time of implementation. However, protection of ecological receptors at Wetlands 3 and 15 would occur over time. The sediment monitoring associated with SED-3 would identify when protection of ecological receptors would occur. Five-year reviews would be conducted to evaluate the adequacy of the remedy. If contaminant trends do not identify a continual decrease in COC concentrations, or if sediment monitoring does not identify continued accumulation of cleaner sediment over the contaminated areas, a determination of the adequacy of the alternative would be made in accordance with the decision making process that would be identified in the long-term sediment monitoring plan associated with this alternative.

Compliance with ARARs

SED-3 would comply with location- and action-specific ARARs.

Long-Term Effectiveness and Permanence

SED-3 would provide long-term effectiveness and permanence for human health receptors upon implementation. Restricting access to workers would prevent unacceptable risk from direct exposure to the COCs in sediment.SED-3 would provide long-term effectiveness and permanence for ecological receptors once the COC concentrations meet their PRGs through naturally occurring processes. Once PRGs are achieved, it is expected that the COCs would remain at concentrations below their PRGs. Five-Year reviews would be conducted to evaluate results of regular sediment monitoring and the adequacy of the remedy.

Reduction of Toxicity, Mobility, or Volume through Treatment

SED-3 would not reduce the toxicity, mobility, and volume of contaminants because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative SED-3 would not result in short-term adverse impact to the local community and the environment. Some short-term risks could be incurred by workers from exposure to contaminated sediment during sediment monitoring activities. However, the potential for exposure would be minimized by the wearing of appropriate PPE, and compliance with OSHA regulations and site-specific health and safety procedures.

Implementability

The administrative aspects of Alternative SED-3 would be relatively simple to implement. If site ownership changed, appropriate provisions would be incorporated into the property transfer documents to ensure continued implementation of land use restrictions. As noted earlier, the resources and materials required for sediment monitoring are readily available.

Cost

The estimated costs for Alternative SED-3 at Wetlands 3, 15, 18A, and 18B are as follows:

Wetland	Capital Cost	30-Year NPW of O&M Cost	30-Year NPW
3	$23,000	$111,000	$134,000
15	$23,000	$111,000	$134,000
18A	$23,000	$111,000	$134,000
18B	$23,000	$111,000	$134,000

The above cost figures have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. A detailed breakdown of estimated costs for this alternative is provided in Appendix B.

4.2.3.3 Sustainability Evaluation Results

Alternative SED-3 only applies to Wetlands 3, 15, 18A, and 18B, and thus can only be compared to SED-2 and SED-4 for Wetlands 3, 15, 18A, and 18B. This alternative involves traveling to the site to sample, and has the same inputs and emissions as alternative SED-2. A detailed summary of the sustainability evaluation for this alternative is provided in Appendix C.

A detailed summary of the sustainability evaluation for this alternative is provided in Appendix C.

4.2.4 SED-4: Ex-Situ Treatment - Excavation and Off-Site Disposal (Wetlands 3, 5A, 15, 18A, 48, and 64)

4.2.4.1 Description

SED-4 consists of five major components: (1) Pre-design investigation (PDI), (2) removal (excavation or dredging) of contaminated sediment, (3) verification sampling, (4) off-site sediment disposal, and (5) wetland reconstruction.

Component 1: Pre-Design Investigation

To ensure that this alternative removes the required amount of sediment to eliminate the risk to human and/or ecological receptors at Wetlands 3, 5A, 15, 18A, 48, and 64, the implementation of this alternative would include a PDI to refine the extent of the required excavation. For the purposes of costing for this FS it was assumed that the PDI would include collecting sediment samples to more accurately define the limits of contaminated sediment. The assumed number of samples to be collected during the PDI is presented in the table below. The results from the PDI would be used to adjust the extent of the excavation. The actual number of samples and locations will be determined in the sampling and analysis plan developed for the PDI.

Wetland	Number of Samples to be Collected
3	18
5A	44
15	53
18A	43
48	38
64	19

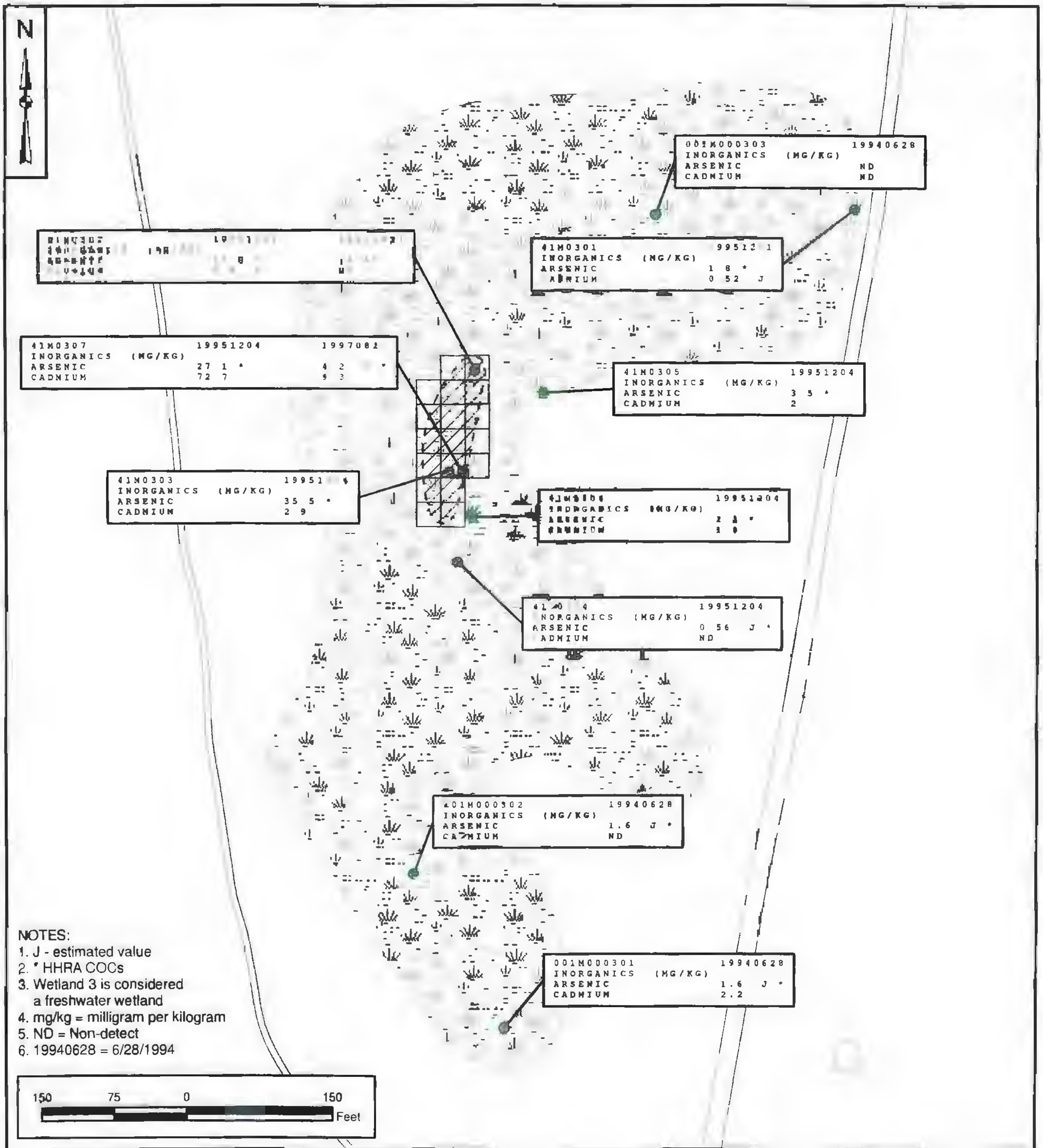
Component 2: Excavation

Sediment with concentrations of COCs greater than human health and/or ecological PRGs would be excavated or dredged to an assumed depth of 1 foot below the existing ground surface (bgs). The proposed excavation areas for each wetland are presented on Figures 4-1 through 4-6. The proposed excavation areas and estimated volumes are as follows.

Wetland	Area (square yards)	Volume (cubic yards)
3	1250	417
5A	3056	1,019

15	3,681	1,227
18A	2,986	995
48	23,750	7,904
64	21,111	7,037

Bulk excavation at Wetlands 3, 5A, 15, 18A and 48 (figures 4-1 through 4-5) could be conducted using a long-reach backhoe. Load-bearing mats would be used to provide access to the excavation area in the wetlands and to move around the excavation area. A temporary containment area would need to be constructed to dewater the sediment. The on-site dewatering would be required to reduce the moisture content in the soils to a level that is acceptable for off-site disposal at an off-site landfill. Sediment in the water obtained from the excavated soils would be allowed to settle out prior to discharging of the water to the wetland from which the soil was excavated. If necessary, the water would require treatment (e.g. filtration or activated carbon) prior to discharge.



NAVFAC

Figure 4-1
Wetland 3
Areas of Excavation
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- 25-ft Excavation Grid
- HHRA AOC
- Building
- Wetland

TETRA TECH

Drawn By: K. MOORE 7/22/09
Checked By: N. ROCHNA 12/22/10
Approved By:

Contract Number: 112G00390
CTO 030

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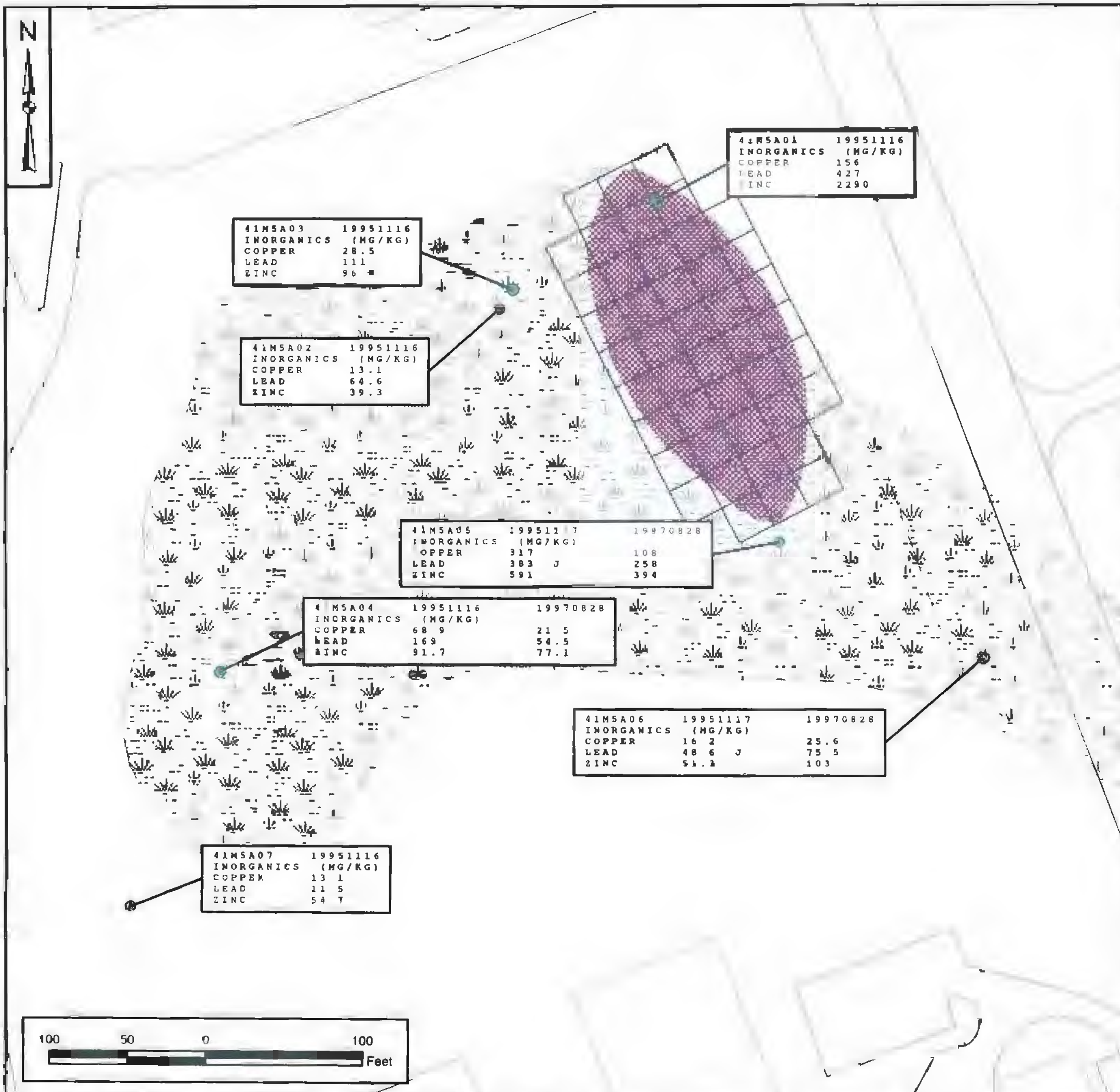

NAVFAC

Figure 4-2
Wetland 5A
Areas of Excavation
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- 25-ft Excavation Grid
- Ecological AOC
- Building
- Wetland

NOTES:
1. J - estimated value
2. Wetland 5A is considered a freshwater wetland
3. mg/kg = milligram per kilogram
4. ND = Non-detect
5. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K MOORE 7/23/09
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Approved By

Contract Number. 112G00390
CTO 030

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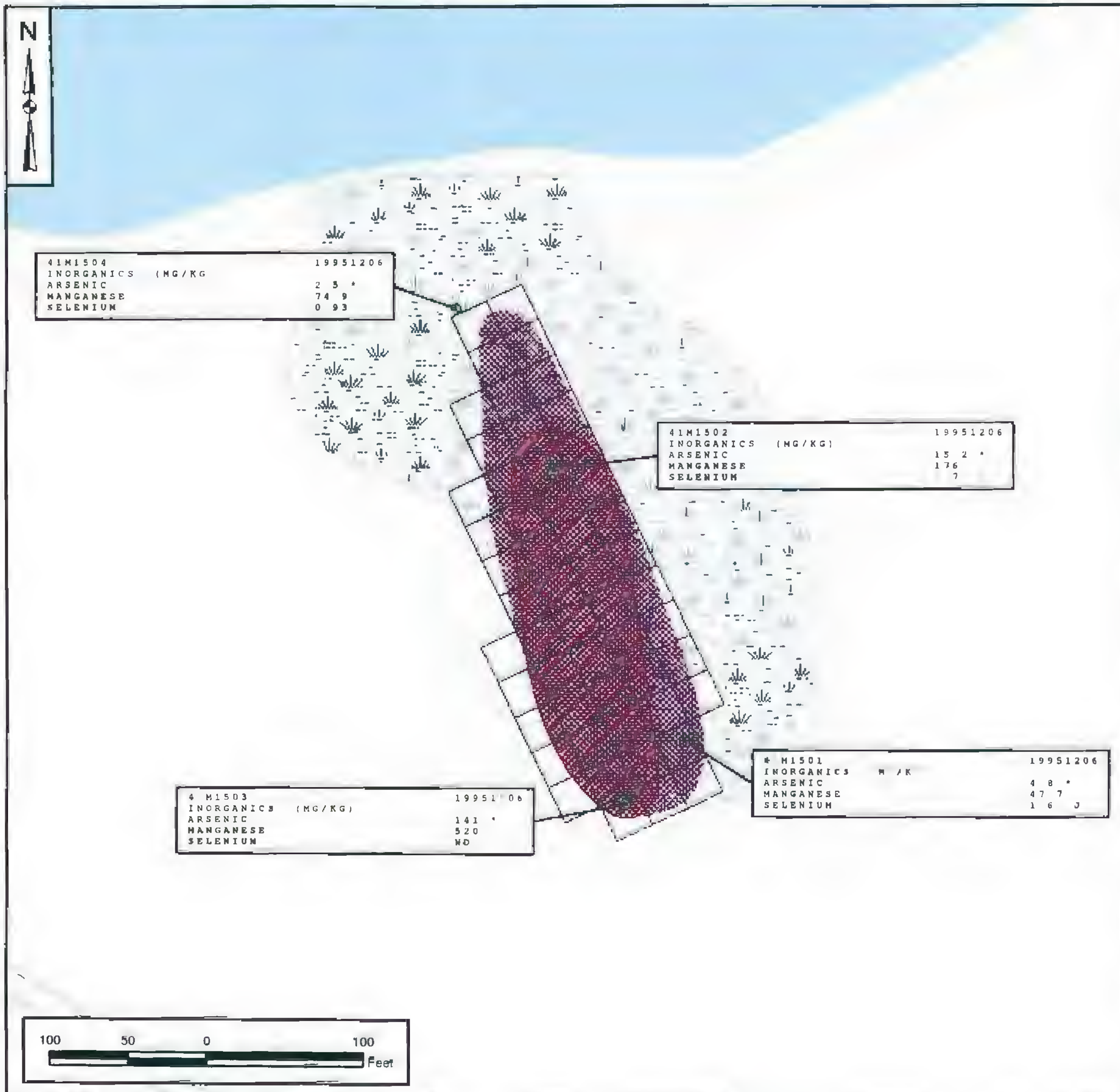

NAVFAC

Figure 4-3
Wetland 15
Area of Excavation
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- 25-ft Excavation Grid
- HHRA AOC
- Ecological AOC
- Wetland
- Water

NOTES.
1. J - estimated value
2. * HHRA COPCs
3. Wetland 15 is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. ND = Non-detect
6. 19940628 = 6/28/1994

TETRA TECH

Drawn By K MOORE 7/23/09
Checked By N ROCHNA 12/22/10
Approved By

Contract Number. 112G00390
CTO 030

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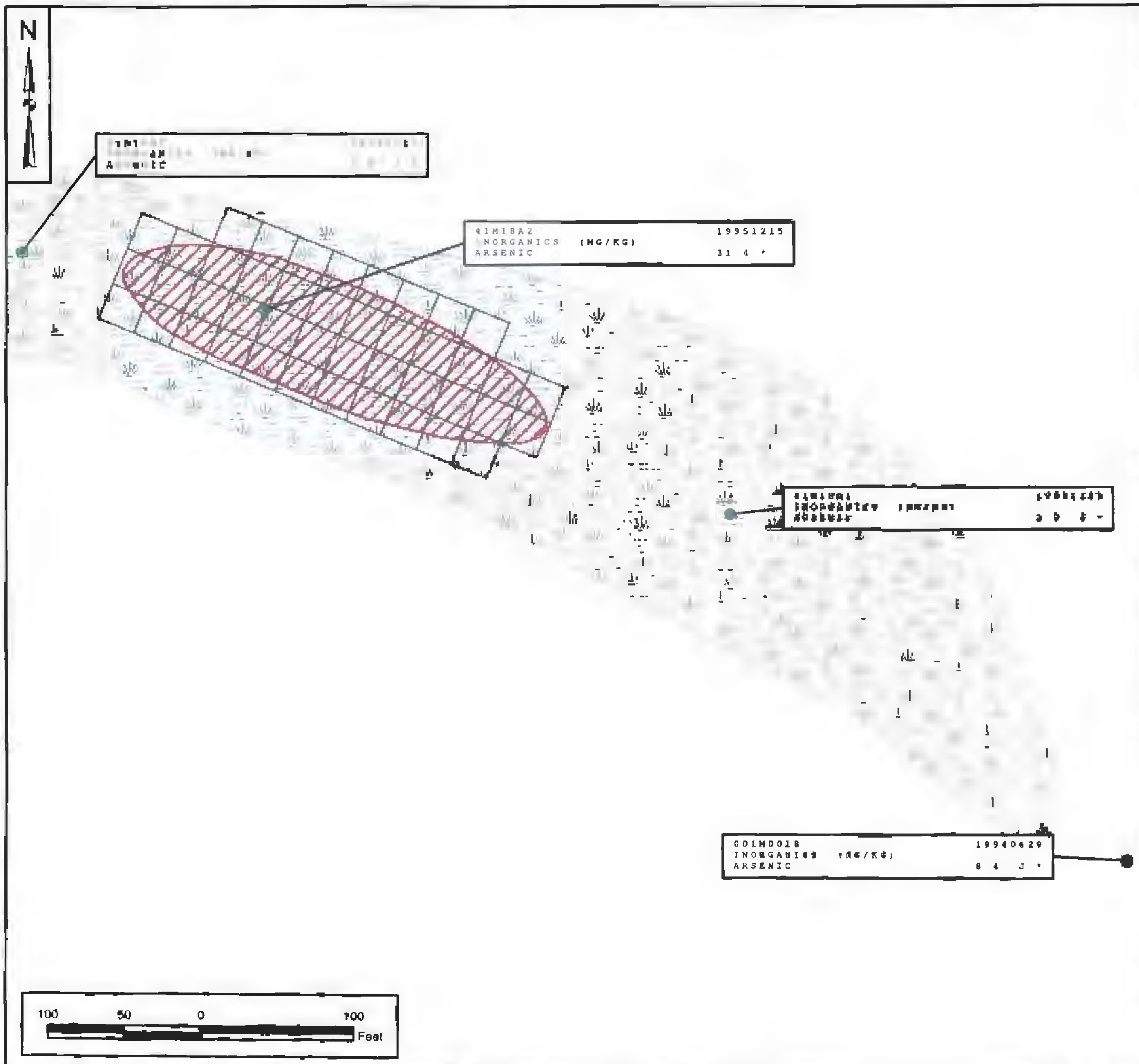

NAVFAC

Figure 4-4
Wetland 18A
Area of Excavation
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- 25-ft Excavation Grid
- HHRA AOC
- Wetland

NOTES.
1. J estimated value
2. * HHRA COPCs
3. Wetland 18A is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. ND = Non-detect
6. 19940628 = 6/28/1994

TETRA TECH

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Checked By. N ROCHNA 12/22/10
Approved By

Contract Number. 112G00390
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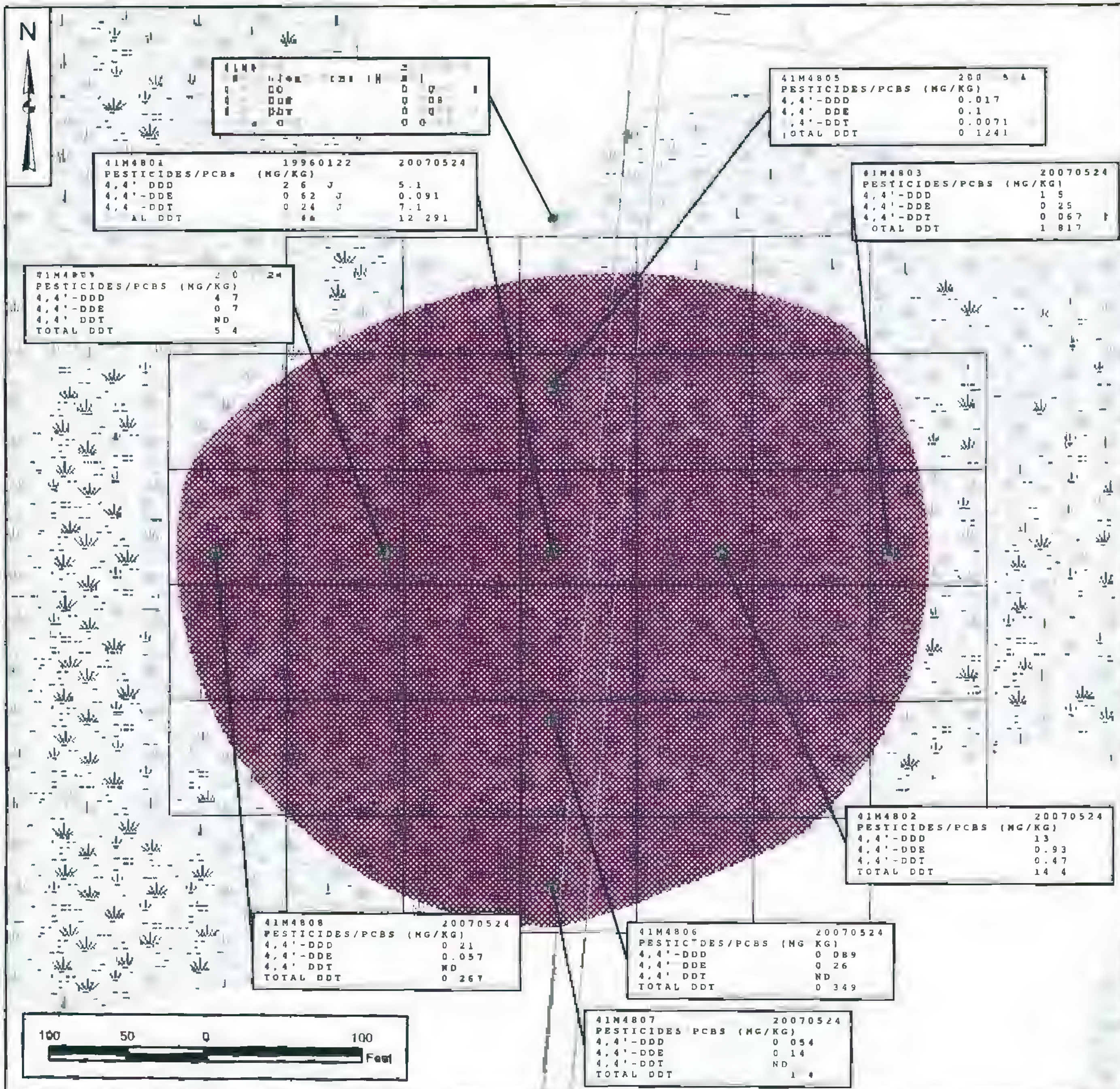

NAVFAC

Figure 4-5
Wetland 48
Area of Excavation
Site 41 Feasibility
Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- 75-ft Excavation Grid
- Ecological AOC
- Building
- Wetland

NOTES
1. Wetland 48 is considered a freshwater wetland
2. mg/kg = milligram per kilogram
3. ND = Non-detect
4. 19940628 = 6/28/1994

TETRA TECH

Drawn By K MOORE 7/23/09
Checked By: N ROCHNA 12/22/10
Approved By:

Contract Number 112G00390
CTO 030

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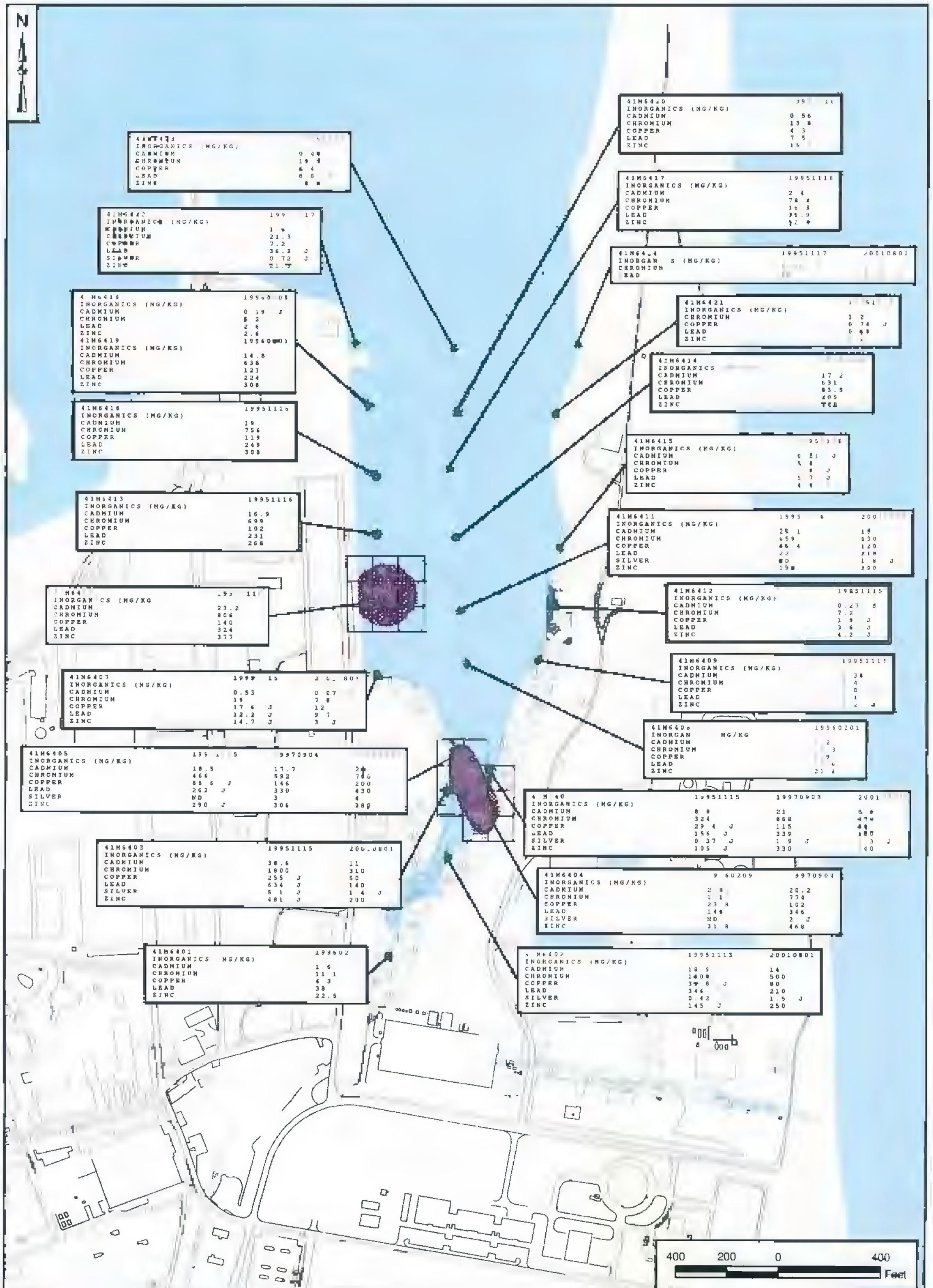

NAVFAC

TETRA TECH

Figure 4-6
Wetland 64
Areas of Excavation
Site 41 Feasibility Study Report
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- 100-ft Excavation Grid
- Ecological AOC
- Building
- Wetland
- Water

NOTES:
1. J - estimated value
2. * HHRA COPCs
3. Wetland 64 considered a saltwater wetland

Drawn By: K. MOORE 7/23/09
Checked By: N. ROCHNA 12/22/10
Approved By:

Contract Number: 112G00390
CTO 030

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Because of the depth of water is approximately 8 to 10 feet over the proposed excavation areas (around the boat dock area) at Wetland 64, dredging would be performed using hydraulic dredging methods. Sediment with concentrations of COCs greater than ecological PRGs would be excavated via dredging to 1 foot bgs. The proposed excavation area for Wetland 64 is presented on Figure 4-6. An estimated area of 21,111 square yards will be dredged, resulting in a sediment volume of 7,037 cubic yards being removed and disposed. A digital global positioning system (DGPS) would be used to control the limits of the submerged cutter head on the hydraulic dredging equipment.

The dredged sediments removed from Wetland 64 would be hydraulically pumped to a processing or dewatering pad where the sediment would be pumped into geosynthetic filter bags (sediment bags) and allowed to dewater by gravity. The dewatering pad would need to be constructed to contain 7,037 cubic yards of wet sediments and the water expected to be generated through the hydraulic dredging process. Following the dewatering process, the removed sediment would be loaded into trucks and transported to an off-site landfill. Water removed from the sediment would be treated and discharged back to wetland. Based on the contaminants in the sediment requiring removal, it is expected that the water treatment would include pumping the water through a filtration unit and an activated carbon unit.

Component 3: Verification Sampling

Following the excavation of contaminated sediment at Wetlands 3, 5A, 15, 18A, 48 and 64, verification samples would be collected from the excavation area to confirm the removal of COCs to concentrations less than PRGs. The Navy would develop a verification sampling and analysis plan that would identify the number and/or frequency of verification samples.

Component 4: Off-Site Disposal

Although the COC concentrations are considered human and/or ecological risks, for Wetlands 3, 5A, 15, 18A, 48, and 64, the excavated sediment and cleared vegetation would be considered non-hazardous and could be disposed in a permitted RCRA Subtitle D landfill. Samples of the vegetation and excavated sediment would be collected and analyzed to ensure that the waste materials comply with the landfill permit. Prior to disposal, the sediment would be allowed to dewater at a temporary holding area until it meets the moisture content required by the off-site landfill.

Approximately 7,037 cubic yards (in-place volume) of sediment over a 17,867-square-yard area would be hydraulically dredged from Wetland 64. The water generated through hydraulic dredging and dewatering would be expected to be equal to approximately 6 parts water to 1 part sediment. Based on similar dewatering and consolidation projects, it is estimated that the dredged sediment would consolidate approximately 20 percent over a 6- to 9-month dewatering period. Therefore, the expected volume of dredge material to be disposed off site would be approximately 80 percent of the in-place sediment volume (5,630 cubic yards).

Component 5: Wetland Reconstruction

Removal of 1 foot of sediment from Wetlands 3, 5A, 15, 18A, and 48 would be preceded by the stripping of vegetative cover from these areas. Wetland reconstruction would be necessary and would include planting native species to return each wetland to a pre-construction condition that is similar to the existing condition.

4.2.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

SED-4 would be protective of human health and the environment.

Removal of sediment with COC at concentrations greater than CGs would eliminate or reduce the potential for unacceptable human health and/or ecological risks as a result of exposure to the contaminated sediment.

Compliance with ARARs

SED-4 would comply with applicable location-, and action-specific ARARs.

Long-Term Effectiveness and Permanence

SED-4 would provide long-term effectiveness and permanence.

Removal of sediment with COC concentrations greater than CGs would effectively and permanently prevent unacceptable risk by human and/or ecological receptors from exposure to the COCs and their potential migration to surface water by erosion or leaching from sediment to surface water.

Reduction of Toxicity, Mobility, or Volume through Treatment

SED-4 would not reduce the toxicity, mobility, and volume of contaminants because no treatment would occur. However, SED-4 would reduce the volume of contaminants through permanent removal and off-site disposal of the sediment with concentrations greater than their CGs. Alternative SED-4 would also

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APPENDIX A

TECHNICAL MEMORANDUM (Tetra Tech, 2010)

TECHNICAL MEMORANDUM –
REFINED LIST OF CHEMICALS OF CONCERN FOR THE FEASIBILITY STUDY AND DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS FOR SEDIMENT SITE 41 – COMBINED WETLANDS, NAVAL AIR STATION PENSACOLA

Introduction

The final Remedial Investigation (RI) report for Site 41, the Combined Wetlands at Naval Air Station (NAS) Pensacola, was submitted on November, 2007 (EnSafe, 2007a). Based on the recommendations of the RI report and RI Report Addendum (EnSafe, 2007b), only Wetlands 3, 5A, 15, 16, 18A, 18B, 48, and 64 were retained for evaluation in the Feasibility Study (FS). The RI report also presented a list of chemicals in each wetland that were retained as chemicals of concern (COCs) for consideration in the FS (Table 16-1 in the RI report) (EnSafe, 2007a). EnSafe subsequently re-evaluated the data and revised Table 16-1 from the RI report to further refine the list of COCs. This revised Table 16-1 is presented in Attachment A of this Technical Memorandum.

The initial COPCs listed in Table 16-1 in Attachment A are the same as those in Table 16-1 of the RI report. However, Table 16-1 in Attachment A contains an additional column which focuses this memorandum on the risk drivers in the wetlands by incorporating the analysis of the TOC-normalized PAHs, site-wide DDT concentrations, regression analysis for metals, toxicity testing results, and food-chain modeling results. The Navy is not indicating that COPCs greater than refinement values do not pose an excess risk. The Navy is attempting to focus the remediation evaluation on the primary risk drivers. In addition, based on regulators comments on the Draft Technical Memorandum, the following additional information was included to address the re-evaluation of certain chemicals in Table 16-1:

- Lead was not identified as a risk driver at Wetland 15 because the regression analysis in Appendix K demonstrated that lead concentrations were not enriched with respect to iron concentrations in Phase II samples.
- For example, food-chain modeling of the OU 1 wetlands for the heron, mink, and red drum indicated chlordane, endrin, BHC, and DDT had NOAELs of less than 1; therefore, chlordane, endrin, BHC, and DDT were not identified as risk drivers.
- Food-chain models for the heron, mink, and red drum at OU 2 wetlands also indicated NOAELs of less than 1 for PCBs, dieldrin, chlordane, DDT, and BHC. Therefore, those parameters were not identified as risk drivers.
- For instances where totals (total PCBs, total endrin, total chlordane, total BHC, total DDT) were retained, individual detected parameters such as 4,4'-DDD, aroclor-1260, and gamma-chlordane were evaluated for NOECs and LOECs in place of the totals in this technical memorandum.

A summary of the list of COCs in each wetland is presented in Table 1. This table also lists whether the wetland is freshwater or saltwater, and whether the chemicals are ecological or human health COCs. Figures 1 through 8 show the concentrations of the COCs in the sediment samples for each of the wetlands. Even though the list of COCs was refined after the RI report, a conservative process was used in the refinement so there were still a large number of COCs at some of the wetlands (see Table 1) and several of the COCs are not likely to be risk drivers. As part of the Preliminary Remediation Goal (PRG) process, the list of COCs is further refined in this Technical Memorandum to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. The remainder of this Technical Memorandum presents:

- The further refinement of the COCs from the revised Table 16-1 (see Attachment A)
- The methodologies for developing the ecological and human health PRGs
- The human health and ecological PRGs that will be used in the FS

Several tasks associated with this refinement step are as follows:

- Calculate no observed effects concentrations (NOECs) or lowest observed effects concentrations (LOECs) using the results of the toxicity testing (and benthic community analysis where applicable)
- Compile the list of reference concentrations
- Update the refinement values
- Develop ecological PRGs after considering the NOECs, LOECs, reference concentrations, and refinement values
- Develop human health PRGs using reasonable exposure assumptions

Note that some of the chemicals were retained as COCs in surface water only. However, surface water is not evaluated in the FS because the primary sink for contaminants is sediment and remediation of surface water is not typically conducted.

Calculation of NOECs and LOECs

Risks to sediment invertebrates were determined in the Baseline Ecological Risk Assessment (BERA) using a line of evidence approach that included sediment chemistry, benthic community analysis, and toxicity tests. Data for all three lines of evidence were available for five of the wetlands (3, 5A, 16, 64, and 18B) while two lines evidence (sediment chemistry and toxicity tests) were available at Wetland 5B. Only one line of evidence (sediment chemistry) was available for the other wetlands. As discussed in Section 4.2 of the RI report, the wetlands were placed into one of five groups based on contaminants, physical characteristics, and whether they were impacted by IR sites. Physical characteristics of the sediment such as percent total organic carbon (TOC) and grain size vary within the wetlands. These differences are discussed in the uncertainty section. The following bullets present the five groups and which of the wetlands recommended in the RI Report for inclusion in the Feasibility Study (except Wetland 5B) are included with each group:

- Group A: Wetland 64
- Group B: Wetlands 3 and 5A
- Group C: Wetlands 15, 16, 18A and 18B
- Group D: Wetland 5B
- Group E: Wetland 48

The data collected in the BERA were further evaluated to develop NOECs and LOECs. NOECs are defined as the greatest concentrations in a sample that did not have a toxic response and LOECs are defined as the lowest concentrations greater than the NOEC in a sample that had a toxic response. NOECs and LOECs are developed using samples from the same sample set and represent the same exposure conditions. The first step conducted to develop the NOECs and LOECs was to determine which sediment samples were considered "toxic" based on the evaluations in the BERA. Table 2 presents a summary of the toxicity tests and benthic community analysis for each of the locations where the data were collected, along with the overall conclusion from the BERA as to whether sediment invertebrates at the location were likely impacted. The samples considered "toxic" are shaded in black on Table 2.

There were two sample (041M5A0501 and 041M640501) that were not considered toxic despite significant reductions in growth for *C. tentans* and *N. arenaceodentata*, respectively, due to the high benthic diversity at those sample locations. The conclusion of Section 11.1.4.4 of the RI report states that "Based on the evaluation of Wetland 5A to date, previous levels of constituents caused statistically significant reduction of growth at one sampling station, 041M5A05. However, the community index indicated that this location indicated the highest levels of diversity in Wetland 5A." Therefore, the reduction in growth does not appear to be impacting the benthic community at this location. The conclusion of Section 11.3.4.3 of the RI report states that "Based on the results of the chemistry and toxicity data, sample locations 041M640401 and 041M640601 exhibited conditions in which toxic chemicals were probably stressing the system." The report did not conclude that 041M640501 was a toxic location. For these reasons, neither sample was considered toxic for purposes of setting PRGs. However, the uncertainty section presents an evaluation of the data assuming that those samples were considered toxic to show how the PRGs would have changed.

The second step involved compiling the analytical data for each of the samples in Table 1, and using the data to develop NOECs and LOECs for each group of samples. The rationale provided in the RI Report was that by subdividing the wetlands into groups, any risk quantified in one wetland could be extrapolated to determine potential risk in other wetlands in that group. The same rationale was used to develop the NOECs and LOECs. Tables 3 through 6 present the analytical data for each of the samples where toxicity tests were conducted as follows:

- Table 3: Wetlands 3 and 5A
- Table 4: Wetland 5B
- Table 5: Wetlands 16 and 18B
- Table 6: Wetland 64

On each of the tables, the columns are shaded green if the samples are considered non-toxic and they are shaded yellow if they are considered toxic. Also, individual cells are shaded red, blue, or black, for the following reasons:

- ***Red:*** The cell is shaded red if the value is the maximum detected concentration and it occurred in a non-toxic sample. The concentration in the red cell is considered the NOEC for that parameter; a LOEC could not be calculated for that parameter.
- ***Blue:*** The cell is shaded blue if the maximum detected concentration for the data set occurred in a toxic sample. The concentration in the blue cell is the maximum detected concentration in a non-toxic sample and is considered the NOEC for that parameter.
- ***Black:*** The cell is shaded black if the maximum detected concentration for the data set occurred in a toxic sample. The concentration in the black cell (considered the LOEC) is the minimum detected concentration in a toxic sample that is greater than the maximum detected concentration in a non-toxic sample. This was done to ensure that the LOEC was not lower than the NOEC.

It is recognized that there is considerable uncertainty and limitations in NOECs and LOECs developed with this methodology, given the limited data set for each group of samples and that fact that samples from different wetlands were grouped together. As discussed above, differences in physical characteristics of the sediment (i.e., TOC and grain size) are discussed in the uncertainty section. This approach identifies the lowest chemical concentrations that are associated with a toxic response (LOEC) (which must be greater than the NOEC), but it is not known whether the LOEC for that chemical was actually responsible for the observed toxic response. It is possible that concentrations of some chemicals are greater in a sample that did not exhibit a toxic response that they were in a sample that did exhibit a toxic response. This indicates that those chemicals were not likely responsible for causing the toxic response. In several cases, the LOEC is less than the reference or refinement values used in the BERA or the NOEC is less than the screening level. Also, in some cases, the difference in concentrations between the NOEC and LOEC are well within the range of sampling and laboratory errors so it is unlikely that the LOEC for that chemical is responsible for the toxic effect.

Tables 3 through 6 present the NOECs and LOECs for each group of samples where toxicity tests were conducted. Only the parameters that were retained as COPCs for the wetlands within each group are presented in the tables except in Table 4 (see below). When the maximum detected chemical concentration occurs in a non-toxic sample, that value becomes the NOEC. However, in those cases, a LOEC cannot be developed so the NOEC is considered an "unbounded" NOEC. The following describes the development of the NOECs and LOECs for each group.

Table 3 presents the NOECs and LOECs for the sediment samples collected at Wetlands 3 and 5A. For most of the organic chemicals, the maximum detected concentrations were in the non-toxic samples or the parameters were not detected in any of the samples. The only organic chemicals for which NOECs and LOECs could be developed were 4,4'-DDT and endosulfan sulfate. The differences in concentrations between these NOECs and LOECs were very small for both chemicals, well within the range of laboratory and sampling error. Also, it is not likely that the very low concentrations of 0.0072 mg/kg (for endosulfan sulfate) and 0.0093 mg/kg (for 4,4'-DDT) are responsible for the observed toxicity in that sample. No metals had their maximum detected concentrations in a toxic sample. Therefore, the maximum detected concentrations in the samples used for the toxicity tests were considered the NOECs; LOECs could not be developed for metals.

Table 4 presents the NOECs for the sediment samples collected at Wetland 5B. None of the samples in this wetland were classified as toxic so the maximum detected concentrations in the samples used for the toxicity tests were considered the NOECs. All of the chemicals that were detected in at least one of the samples where toxicity tests were conducted were presented on Table 4 because although this wetland is not being considered in the FS, toxicity data from this wetland can be used to evaluate other freshwater wetlands at the site. Note that the BERA indicated that the sediment in both Wetland 5A and 5B were fine-grained sand to silt and clay.

Table 5 presents the NOECs and LOECs for the sediment samples collected at Wetlands 16 and 18B. None of the samples in this wetland were classified as toxic so the maximum detected concentrations in the samples used for the toxicity tests were considered the NOECs. The chemical concentrations were generally low in the samples tested in these wetlands. In fact, most organic chemicals were not detected in the sediment samples.

Table 6 presents the NOECs and LOECs for the sediment samples collected at Wetland 64. For most chemicals, there was a small difference between the values for the NOECs and LOECs so it is difficult to determine which chemicals are responsible for the observed toxicity.

Compilation of Reference Values

As presented in Section 6.1 of the RI (EnSafe, 2007a), reference concentrations for inorganic chemicals were developed by collecting sediment samples from reference wetlands that were not impacted by any Installation Restoration sites. Two of the reference wetlands were freshwater wetlands and two were estuarine wetlands. The reference concentrations for sediment were calculated in EnSafe (2007a) by summing valid detections and one-half of each non-detected value. As presented in Section 6.1 of the RI (EnSafe, 2007a), the mean detection was calculated, multiplied by two, and the resulting multiplier was used as the reference concentration. Tables 7 and 8 present the freshwater and estuarine inorganic sediment reference concentrations, respectively, for the parameters retained as COCs in the RI.

In addition, because 4,4'-DDT and its metabolites are present throughout the Base from the legal application of these pesticides, levels indicative of widespread use versus elevated concentrations were established in the RI (EnSafe, 2007a). These basewide levels are presented in Tables 7 and 8 (the same values were used for freshwater and estuarine wetlands).

Update of Refinement Values

Section 8.3 of the RI report describes the refinement values that were used to refine the list of COPCs that were selected using screening levels (EnSafe, 2007a). The refinement values are generally considered "higher-effects levels", which are concentrations above which impacts to sediment invertebrates are expected. Tables 7 and 8 present the freshwater and marine refinement values for the parameters retained as COCs in the RI. In the RI report, saltwater screening and refinement values were used to evaluate both the freshwater and saltwater sediment samples because most of the sediment screening levels were United States Environmental Protection Agency (USEPA) Region IV values. However, to be consistent with current methodology for evaluating ecological risks to chemicals in sediment, freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the saltwater wetlands, when available. However, for some chemicals, freshwater refinement values were used for the saltwater wetlands, and vice-versa, when no other values were available. The following presents a brief discussion of the refinement values that were selected.

Freshwater Values

USEPA Ecotox Thresholds (USEPA, January 1996): Ecotox thresholds are a compilation of sediment screening levels that have been developed in other documents. The sediment Ecotox Thresholds used in this evaluation were the Sediment Quality Benchmarks (SQBs) that were developed using equilibrium partitioning. The SQBs are based on an assumption of 1 percent organic carbon [10,000 mg/kg total organic carbon (TOC)] so they are somewhat conservative for use at Site 41, because most of the sediment samples have TOC concentrations greater than 1 percent.

Probable Effects Concentrations (FDEP, 2003): Probable Effects Concentrations (PECs) are concentrations above which adverse effects to sediment invertebrates are expected to occur more often than not.

Upper Effects Thresholds (Buchman, 2008): Upper Effects Thresholds (UETs) are the lowest AET on a 1 percent total organic carbon basis.

Saltwater Values

Probable Effects Levels (MacDonald, 1994): Probable Effects Levels are concentrations above which adverse effects to sediment invertebrates are expected to occur more often than not.

Apparent Effects Thresholds (Buchman, 2008): The refinement values for several parameters are Apparent Effects Thresholds (AETs). AETs are defined as concentrations of a given chemical above which statistically significant ($p<0.05$) biological effects are always expected to occur (Cubbage et al., 1997).

Development of Ecological PRGs

Tables 9 through 12 present the overall PRGs for the Group A, B, C, and E wetlands. The tables also include the screening level, the refinement value, and the reference level. Because of the very limited data set and the very low chemical concentrations in most of the sediment samples, there is a considerable amount of uncertainty associated with the developing NOECs and LOECs and identifying the chemical(s) causing toxicity. Therefore, many of the NOECs and LOECs are very low and are likely not responsible for the observed effects in the samples. In order to ensure that wetlands are not excavated when there may only be marginal risks, the greater of the LOEC, the reference level, or the refinement value was selected as the PRG. Because toxicity testing was not conducted at Wetland 48, the final PRGs consisted of the greater of the saltwater reference value or the refinement value. These final PRGs are listed in the last column in Tables 9 through 12.

At Wetland 64, mercury was retained as a COC for risks to the red drum consuming forage fish. The risks were based on using actual fish tissue data, and estimated crustacean and invertebrate concentrations using literature biota-sediment accumulation factors (BSAFs). Mercury was detected in four of the eight forage fish samples collected during the RI at concentrations ranging from 0.028 mg/kg to 0.096 mg/kg (whole body). The mercury data were not used to develop sediment to fish BSAFs in the RI report, which is why the literature BSAFs were used to calculate risks. Using average mercury concentrations in sediment and fish, hazard quotients using the no observed adverse effects level was just slightly greater than 1.0 and hazard quotients using the lowest observed adverse effects level was less than 1.0. Therefore, risks to the red drum were marginal. For that reason, mercury is not a risk driver for the site and a PRG, other than a reference concentration, was not developed for mercury. Mercury is discussed in more detail in the Wetland 64 portion of the "Refinement of Chemicals of Concern Section" of this Technical Memorandum.

PRGs were developed for aluminum and iron; however, these metals are not likely bioavailable when pH levels are close to neutral. Aluminum and iron are not considered risk drivers at the wetlands where the pH levels are neutral. For the wetlands, pH levels ranged from 5.02-5.47 at Wetland 18, 5.76-6.41 at Wetland 3, 6.01-6.98 at Wetland 15, 6.03-6.31 at Wetland 5A, 6.86-7.01 at Wetland 16, and 6.81-8.29 at Wetland 64.

Development of Human Health PRGs

Risks to humans from the consumption of fish were evaluated at Wetlands 15, 16, 64. In addition, risks to maintenance workers were evaluated at most of the wetlands. For both scenarios, conservative assumptions were used in the RI to calculate initial risks to ensure that potential risks were not underestimated. More representative assumptions were used to calculate human health PRGs; however, the assumptions are still protective of humans. Although risks were evaluated for the subsistence fisherman, this is not a realistic exposure pathway for these wetlands, because the amount of open water in most of the wetlands is small, and there are not likely to be adequate numbers of fish to support a subsistence fisherman. Although Wetland 64 is larger, it is not likely that subsistence fisherman, if present, would obtain all of their fish from this area. For these reasons, PRGs were only developed for recreational fishermen.

The human health PRGs are summarized in Table 13 and the calculation sheets are presented in Attachment B.

Calculation of PRGs for the Recreational Fisherman

The first step conducted for evaluating risks to humans consuming fish was to estimate fish tissue concentrations. Only small forage fish were collected as part of the remedial investigations; large, edible-sized fish were not collected. To estimate fish tissue concentrations, chemical concentrations in the forage fish samples collected from the various wetlands were divided by the sediment concentrations in the various wetlands where the fish were collected. This ratio is termed the BSAF. The BSAFs were multiplied by trophic transfer factors to estimate the chemical concentration in larger fish from the forage fish. However, as presented in Appendix M of the RI report, several chemicals were not detected in any (or most of) the fish or sediment samples, so those BSAFs were calculated by dividing non-detected tissue concentrations by non-detected sediment concentrations. This resulted in very conservative BSAFs with a lot of uncertainty associated with the values. Because of that, BSAFs presented in USEPA (2004) were used to estimate fish tissue concentrations for developing human health PRGs. In accordance with USEPA (2004), the BSAFs were multiplied by the percent lipids of the fish (3 percent wet weight) and divided by the percent TOC of the sediment (specific to each site) to account for site-specific bioavailability. The following text describes the development of human health PRGs for the consumption of fish.

Carcinogenic PRGs for ingestion of fish were calculated from:

$$PRG_{fish} = \frac{(TCR)(BW)(AT)}{(IR)(FI)(EF)(ED)(CSF_{oral})}$$

Noncarcinogenic PRGs for the ingestion of fish were calculated from:

$$PRG_{fish} = \frac{(THI)(BW)(AT)(RfD_{oral})}{(IR)(FI)(EF)(ED)}$$

Where:

TCR	=	target cancer risk level
THI	=	target hazard index
IR	=	ingestion rate of fish (meals/day)
FI	=	fraction ingested from site
EF	=	exposure frequency (meals/yr)
ED	=	exposure duration (years)

BW	=	body weight (kg)
AT	=	averaging time (days)
	=	25,550 days for carcinogens
	=	ED x 365 days for noncarcinogens
CSF_{oral}	=	oral cancer slope factor $(mg/kg/day)^{-1}$
RfD_{oral}	=	oral reference dose (mg/kg/day)

The chemical concentration in fish was related to the chemical concentration in sediment, C_{sed} by:

$$C_{fish} = BSAF \times (C_{sed}/f_{oc}) \times f_{i}$$

Where:

C_{fish}	=	estimated chemical concentration in fish tissue (mg/kg)
C_{sed}	=	chemical concentration in sediment (mg/kg)
BSAF	=	biota-sediment accumulation factor
f_{oc}	=	TOC of sediment expressed as a decimal fraction
f_{i}	=	organism lipid content expressed as a decimal fraction.

Substituting the above equation in the equation for the calculation PRGs results in:

$$PRG_{sed} = \frac{(TCR)(BW)(AT)}{(BSAF/f_{foc})(f_{i})(IR)(FI)(EF)(ED)(CSF_{oral})} \quad \text{for carcinogens}$$

and

$$PRG_{fish} = \frac{(THI)(BW)(AT)(RfD_{oal})}{(BSAF/f_{foc})(f_{i})(IR)(FI)(EF)(ED)} \quad \text{for noncarcinogens.}$$

The above equations were used to calculate PRGs for sediment that would be protective of a young child trespasser. The target cumulative cancer risk level used in this calculation is 1×10^{-4}. This cancer risk level is the basis for fish advisories for carcinogenic chemicals according to the Florida Department of Health, Environmental Health Division (Goff 2010). The target hazard index is one. If there is more than one COC within a wetland, then the PRGs must be calculated so the sum of the target risks for all COCs is equal to a cumulative risk of 1×10^{-4}. This can be simply addressed by dividing the target cumulative cancer risk level by the number of COCs within a wetland or by assigning target risk levels to each COC as long as the sum of the target risk levels equal 1×10^{-4}.

The USEPA Region 4 suggested default value of 0.145 kg-fish per meal for site-specific evaluations was used for fish ingestion rate. The same exposure frequency (52 meals/year), exposure duration (10 years), and body weight (45 kg) used in the HHRA were used in the calculation of the PRGs. It was assumed that 10 percent of the fish ingested by a child trespasser came from the site. BSAFs were obtained from *The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, National Sediment Quality Survey* (USEPA, November 2004). As discussed above a value of 0.03 was assumed for the percent lipids and site-specific values were used for f_{oc}. This value is presented in USEPA (November 2004). The PRG calculations are presented in Attachment B.

<u>Calculation of PRGs for the Maintenance Worker</u>

PRGS for the maintenance worker exposed to sediment were calculated by:

$$PRG_{sed} = \frac{TCR}{(Intake_{oral})(CSF_{oral}) + (Intake_{derm})(CSF_{derm})} \quad \text{for carcinogens}$$

and

$$PRG_{sed} = \frac{THI}{\left(\frac{Intake_{oral}}{RfD_{oral}}\right) + \left(\frac{Intake_{derm}}{RfD_{derm}}\right)} \quad \text{for noncarcinogens}$$

The oral and dermal intakes were calculated by:

$$Intake_{oral} = \frac{(IR)(FI)(EF)(ED)(CF)}{(BW)(AT)}$$

$$Intake_{derm} = \frac{(SA)(AF)(ABS)(EF)(ED)(CF)}{(BW)(AT)}$$

Where:

TCR	=	target cancer risk level
THI	=	target hazard index
IR	=	incidental ingestion rate of soil (mg/day)
FI	=	fraction ingested from site
SA	=	exposed skin area (cm^2)
AF	=	soil adherence factor (mg/cm^2)
ABS	=	absorption factor (unitless)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (years)

CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
	=	25,550 days for carcinogens
	=	ED x 365 days for noncarcinogens
CSF_{derm}	=	dermal cancer slope factor $(mg/kg/day)^{-1}$
RfD_{derm}	=	dermal reference dose (mg/kg/day)

The target cancer risk level for the maintenance worker is 1 x 10^{-6} and the target hazard index is one. USEPA standard default values for soil were used for the incidental sediment ingestion rate (100 mg/day), exposure duration (25 years), and body weight (70 kg). The exposed skin area was assumed to be 10,400 cm^2. A value of 0.1 mg/cm^2 was used for the soil adherence factor. Dermal absorption factors were obtained from USEPA's Supplemental Guidance for Dermal Risk Assessment (2004). The exposure frequency was assumed to be one day every other week or 26 days a year. All of the exposure assumptions were the same as those used in the HHRA with the exception of the exposure frequency. The HHRA assumed a maintenance worker would be at a site one day a week or 52 days a year. The PRG calculations are presented in Attachment B.

Refinement of Chemicals of Concern

The information presented above, in addition to the following items, were used to refine the list of COCs from the RI:

- Magnitude of PRG exceedence and basis of the PRG
- Likelihood of the chemical being related to site activities
- Frequency of detection

Tables 14 through 21 present the chemicals retained as COCs in the revised Table 16.1 (see Attachment A), whether it was a human health or ecological COC, a summary of the analytical data, the ecological PRG, whether it was retained as a final COC, and the rationale for its elimination as a final COC. Note that both the Phase II and Phase III results are presented, when available, but whether it was retained as a final COC and the rationale for its elimination as a final COC are only presented for the combined data set. Also, because the objective of this Technical Memorandum is to refine the list of COCs, the discussion below only focuses on chemicals that are eliminated as COCs.

Wetland 3: Four chemicals were retained as COCs in the revised Table 16.1; two human health COCs and two ecological COCs. Methylene chloride was retained as a human health COC because it caused a potential risk via dermal contact to surface water. Methylene chloride was not detected in any of the sediment samples (see Table 14). Therefore, a PRG was not developed for methylene chloride. Also, because surface water will not be included in the FS, methylene chloride is eliminated as a COC for evaluation in the FS. Endosulfan sulfate was retained as an ecological COC because it caused a potential risk to sediment invertebrates. This pesticide was only detected in 3 of 12 samples and had a low maximum detected concentration (0.0072 mg/kg). Although this concentration was identified as the LOEC, it is only slightly greater than the NOEC of 0.0023 mg/kg. Also, these low concentrations are more indicative of typical legal application of pesticides rather than disposal activities. For these reasons, endosulfan sulfate is eliminated as a COC for evaluation in the FS.

Wetland 5A: Four chemicals were retained as ecological COCs in the revised Table 16.1. No chemicals were retained as human health COCs. Endosulfan I was retained as an ecological COC because it caused a potential risk to sediment invertebrates. This pesticide was only detected in 1 of 10 samples and had a low maximum detected concentration (0.0052 mg/kg) see Table 15). This concentration was identified as the NOEC; a LOEC could not be determined. This low concentration is more indicative of typical legal application of pesticides rather than disposal activities. For these reasons, endosulfan I is eliminated as a COC for evaluation in the FS.

Wetland 15: Nineteen chemicals were retained as COCs in the revised Table 16.1; four human health COCs, 14 ecological COCs, and one human health and ecological COC. Eight chemicals were eliminated as COCs because their maximum detected concentrations were less than their ecological or human health PRGs (see Table 16). Beryllium was detected in 1 of 4 samples at a concentration of 0.34 mg/kg (at 41M1504). This concentration is just slightly greater than its NOEC (0.26 mg/kg). The average concentration was 0.259 mg/kg, which is just less than its NOEC. Also, because the NOEC is a no-effects level, an exceedence of that level does not indicate that an effect will occur. Although the level where effects would be observed is not known, the very high TOC concentration in the sediment sample from 41M1504 (almost 40 percent), would decrease the bioavailability of beryllium at this location. Therefore, beryllium is not likely to impact sediment invertebrates and it is eliminated as a COC. Iron is eliminated as a COC because its maximum detected concentration (223,000 mg/kg) just slightly exceeded its PRG (220,000 mg/kg). Also, the pH levels from Wetland 15 were just slightly acidic (6.01-6.98 S.U.); therefore, iron is not likely bioavailable.

Although four of the five SVOCs were detected at concentrations that exceeded their ecological PRGs [a PRG could not be developed for 2,2'-oxybis(1-Chloropropane)/bis(2-chlor)], these SVOCs do not appear related to site activities. They were only detected in one of the four samples and were not detected in the sample collected in the area where runoff was entering the wetland (location 41M1503) (EnSafe, 2007a). Also, the RI report indicated that groundwater from Site 1 entering Wetland 15 was being monitored for certain parameters, but none of the SVOCs selected as COCs for sediment were included in the list of those groundwater parameters. Therefore, it does not appear that these constituents were chemicals of interest in the groundwater from Site 1. For this reason, the five SVOCs are eliminated as COCs for evaluation in the FS.

Delta-BHC and heptachlor were detected in 1 of 4 samples and had a low maximum detected concentration (0.0055 mg/kg and 0.0011 mg/kg, respectively). Although the heptachlor concentration is greater that its PRG (0.0003 mg/kg), the concentrations of both pesticides are more indicative of typical legal application of pesticides rather than disposal activities because they were detected in the low part per billion range. Therefore, these two pesticides are eliminated as COCs for evaluation in the FS.

Wetland 16: Six chemicals were retained as COCs in the revised Table 16.1; one human health COC and five ecological COCs. Four metals were eliminated as COCs because their maximum detected concentrations were less than their ecological PRGs (see Table 17). Beryllium was detected in 3 of 5 samples at a maximum concentration of 0.47 mg/kg. The maximum detected was found in the sample collected in 1995 at location 41M1603. This location was re-sampled in 1997 and was the sediment from this sample was selected for toxicity testing. The concentration in 1997 sample was 0.26 mg/kg (the NOEC). Therefore, beryllium is not likely to impact sediment invertebrates and it is eliminated as a COC.

Aroclor-1254 was retained as a human health COC. It was detected in 3 of 5 samples at a maximum concentration of 0.078 mg/kg. The maximum detected concentration was found in the sample collected in 1995 at location 41M1603. This location was re-sampled in 1997 and Aroclor-1254 was not detected in that sample. The other two detections of Aroclor-1254 were 0.0021 mg/kg and 0.011 mg/kg, both of which were less than its human health PRG. Therefore, Aroclor-1254 is eliminated as a COC for evaluation in the FS.

Because no chemicals were retained as COCs at Wetland 16 for evaluation in the FS, this wetland will not be included in the FS.

Wetland 18A: Nine chemicals were retained as COCs in the revised Table 16.1; two human health COCs and seven ecological COCs. Six chemicals were eliminated as COCs because their maximum detected concentrations were less than their PRGs (see Table 18).

The two SVOCs (1,4-dichlorobenzene and 4-methylphenol) were detected at concentrations that exceeded their ecological PRGs, but these SVOCs do not appear related to site activities. They were detected in one or two of the four samples but were not detected in Wetland 18B, which is immediately downgradient of 18A. Also, the RI report indicated that groundwater entering Wetland 18A was being monitored for certain parameters, but neither 1,4-dichlorobenzene or 4-methyphenol were included in the list of those groundwater parameters. Therefore, both SVOCs are eliminated as COCs for evaluation in the FS.

Wetland 18B: Four chemicals were retained as COCs in the revised Table 16.1; one human health COC and three ecological COCs. Two metals were eliminated as COCs because their maximum detected concentrations were less than their ecological PRGs (see Table 19). Selenium was detected at its maximum concentration of 2.2 mg/kg in the sample collected in 1995. This location was re-sampled in 1997 and was the sediment from this sample was selected for toxicity testing. The concentration in 1997 sample was 0.74 mg/kg and the sample was not considered toxic. Therefore, selenium is not likely to impact sediment invertebrates and it is eliminated as a COC.

Wetland 48: Three pesticides (plus total DDT) were retained as ecological COCs in the revised Table 16.1. No chemicals were retained as human health COCs. Because toxicity testing was not conducted at Wetland 48, and because it was not included in any of the other groups, the PRGs presented in Table 20 were the greater of the freshwater reference concentrations or refinement values from Table 7. None of the pesticides were eliminated as COCs for evaluation in the FS.

Wetland 64: Twenty-eight chemicals were retained as COCs in the revised Table 16.1; ten human health COCs, 17 ecological COCs, and one human health and ecological COC. Fifteen chemicals were eliminated as COCs because their maximum detected concentrations were less than their ecological PRGs (see Table 21). The maximum concentration of bis(2-ethylhexyl)phthalate (3.9 mg/kg) was less than its human health PRG (174 mg/kg) (see Attachment B) and was only slightly greater than its ecological PRG (3.3 mg/kg). The location with the maximum detected concentration was resampled in 2001 and the concentration was 1.3 mg/kg and no other detections exceeded its PRG. Also, bis(2-ethylhexyl)phthalate is a common laboratory contaminant. For these reasons, bis(2-ethylhexyl)phthalate is eliminated as a COC for evaluation in the FS.

Barium was detected at its maximum concentration of 1,280 mg/kg in the sample collected in 1995. This location was re-sampled in 2001 and concentration was 5.5 mg/kg. No other samples had detections of barium that exceeded its PRG so it is eliminated as a COC for evaluation in the FS.

Beryllium and selenium were detected at concentrations that exceeded their respective PRGs in several samples across the site. Their maximum detected concentrations were not extremely elevated (1.3 mg/kg for beryllium and 3.1 mg/kg for selenium) and no distinct pattern to their contamination was noted. The PRG for beryllium is a NOECs (a LOEC could not be calculated) (see Table 11). The PRG for selenium is a LOEC, but it is just slightly greater than its NOEC so it is not likely to be responsible for any observed toxicity. Therefore, it is not likely that these three metals are risk drivers, and there is uncertainty in whether they are site related. For these reasons, they are eliminated as COCs for evaluation in the FS.

As discussed above, the PRG for mercury is the reference concentration. Mercury was detected at its maximum concentration of 0.88 mg/kg in the sample collected in 1995. This location was re-sampled in 2001 and concentration was 0.18 mg/kg. The next greatest mercury concentration was a value of 0.66 mg/kg collected in 1996. All other samples had mercury detections equal to or lower than 0.5 mg/kg. Although Wetland 64 is saltwater, a comparison was made to the freshwater reference concentration for mercury (0.55 mg/kg) to help determine whether mercury is likely related to site activities. Mercury concentrations in only 2 of 34 samples (one of which was had a lower concentration in another sample collected from that location) exceeded the freshwater reference concentration for mercury. Also, there was not pattern in the distribution of the data. Mercury is present in many fish across the State of Florida and mercury contamination in fish appears to be a statewide problem. In fact, the State of Florida has established fish consumption advisories for mercury in most species of freshwater fish and for selected marine species (CEDB, September 2009). Mercury concentrations in largemouth bass collected from rivers in Northwestern Florida were generally greater than 0.4 mg/kg and samples from one lake exceeded 1.5 mg/kg (fillet samples) (CEDB, September 2009). Although to is difficult to compare mercury results in whole body forage fish samples to mercury concentrations in largemouth bass fillet samples, the relatively low concentrations in the forage fish (0.028 mg/kg to 0.096 mg/kg), coupled with the fact that risks to the red drum were only marginal (see discussion above), indicates that mercury in fish is not a concern for the site. For these reasons, mercury is not likely to be a risk driver and it is eliminated as a COC for evaluation in the FS.

Aroclor 1254 was detected in one sample at a concentration greater than its PRG in the first phase of sampling. In subsequent rounds of sampling, Aroclor 1254 was not detected in any sediment sample. Moreover, Aroclor 1254 was not detected in any fish tissue samples. The average sediment concentration, represented by the 95 percent upper confidence limit of the mean as derived by FDEP's FLUCL software (modified version of EPA's ProUCL software for calculating upper confidence limits), was less than its human health PRG, based on the first three rounds of sampling. However, when evaluating all four rounds of samples, the UCL is greater than the PRG. This increase in the UCL, despite the absence of detections of Aroclor 1254 in the additional samples, is likely attributable to elevated detection limits in the Phase IV samples (Attachment B). Although the UCL concentration for Aroclor 1254 using all four rounds of samples is greater than its human health PRG, the evidence indicates that Aroclor 1254 concentrations would not significantly impact human health.

Uncertainties

There are several areas of uncertainty associated with the development of the PRGs. These areas include:

- Differences in physical parameters of the sediment across the wetlands
- Selection of which samples are considered toxic
- Small data sets at some wetlands
- Selection of exposure assumptions

Each of these areas or uncertainty are discussed in the following sections.

<u>Physical Characteristics of the Sediment</u>

As presented above, the wetlands were placed into groups in the RI report (Ensafe 2007a) based on contaminants, physical characteristics, and whether they were impacted by IR sites. Therefore, toxicity test data from wetlands within the same group were combined for developing NOECs and LOECs. In some cases, these NOECs and LOECs were then applied to other wetlands within the same group where toxicity tests were not conducted. There is uncertainty in doing this because of differences in physical characteristic between the wetlands. For example, Table 22 presents the percent TOC, grain size, and sediment descriptions for the wetlands grouped to develop NOECs and LOECs from the toxicity tests (Wetlands 3 and 5A and Wetlands 16 and 18B). There was a wide range of percent TOC values and sediment grain size within each wetland, and across the wetlands. The Phase III samples were the ones that were used for toxicity testing and although there was less variability in TOC and grain size among these samples, those parameters varied across each group. Therefore, there is uncertainty in grouping the samples together for evaluating the toxicity test data, and in using the developed NOECs and

LOECs to evaluate other samples with different TOC and grain size values. Even with these uncertainties, though, having site-specific toxicity test data typically reduces the uncertainty in evaluating sediment data than using only literature sediment benchmarks.

Selection of Toxic and Non-Toxic Samples

Another uncertainty in developing NOECs and LOECs for Site 41 was selecting which samples would be considered toxic. Test organisms in Sample 041M5A0501 from Wetland 5A and Sample 041M640501 from Wetland 64 were found to have significantly lower growth compared to the test organisms in laboratory control samples. However, these samples were not considered toxic for developing PRGs because both samples had the greatest benthic community for those wetlands and survival was very high in both samples (see Attachment C – Table 2). Also, the conclusions were consistent with those in the RI (Ensafe, 2007a). Because of the lower growth, there is uncertainty in whether those samples should be considered toxic for developing NOECs and LOECs. Therefore, to evaluate that uncertainty, and to address regulator concerns, the ecological PRGs were developed in Attachment C by considering these samples as toxic to see how the PRGs and resulting conclusions would have changed if those samples were considered toxic.

Attachment C presents the revised versions of Tables 2, 3, 6, 9, 11, 14, 15, 18, and 21. The NOECs and LOECs for some of the chemicals in Tables 3 and 6 would have changed if Samples 041M5A0501 and 041M640501 were considered toxic. Those values are shown in red font in the NOEC and LOEC columns in Tables 3 and 6. For Wetlands 3 and 5A, only the NOECs and LOECs for five of the metals would have changed (see Attachment C - Table 3). For Wetland 64, because all of the samples are now considered toxic, NOECs could not be developed so the minimum detected concentration in any of the three samples would be the LOEC (see Attachment C - Table 6).

Attachment C – Tables 9 and 11 present the PRGs that would have been developed based on considering Samples 041M5A0501 and 041M640501 as toxic. Because the overall ecological PRG is based on the greater of the reference concentrations, screening levels, and refinement values, in addition to the NOECs and LOECs, the overall ecological PRG did not change for all chemicals which would have different NOECs and LOECs. For example, the only change in the PRGs for Wetlands 3, 5A, and 18A would be for cadmium (see Attachment C – Table 9). However, for Wetland 64, the PRGs would be different for most chemicals on Attachment C – Table 11).

The next step was to determine whether the overall conclusions of whether to consider a chemical in the FS would have changed if the PRGs were based on considering Samples

041M5A0501 and 041M640501 as toxic. Attachment C – Tables 14, 15, 18, and 21 present the initial refinement table with two additional columns: the PRG developed as part of this uncertainty analysis and whether there would be a change in which chemicals would be selected for consideration in the FS. As can be seen from Attachment C – Tables 14, 15, and 18, there would be no changes to the chemicals selected for consideration in the FS at Wetlands 3, 5A, or 18A based on the PRG for cadmium.

Even though the overall ecological PRGs developed for Wetland 64 would have changed for most chemicals; however, these differences did not impact the list of chemicals that would be considered in the FS. For example, the PRGs for several of the chemicals would have decreased, but in most cases the chemicals were already retained as final COCs for consideration in the FS or the PRGs were still lower than the maximum detected concentration of the chemicals (see Attachment C – Table 21). A few chemicals do require further discussion, where this trend was not observed. For carbazole, the PRG would decrease from 0.8 mg/kg to 0.32 mg/kg, while the maximum detected result was 0.8 mg/kg. For dibenzofuran, the PRG would decrease from 0.35 mg/kg to 0.13 mg/kg, while the maximum detected result was 0.35 mg/kg. Neither of these chemicals appear to be indicative of widespread contamination across the site. Carbazole was detected in 5 of 27 samples while dibenzofuran was detected in 4 of 34 samples. Therefore, these chemicals are not considered risk drivers and would not have been carried forward through the FS.

Small Data Sets

Also, as discussed earlier in this document, there is uncertainty in the NOECs and LOECs developed for the wetlands due to the limited data set available for each wetland which does not allow for good dose-response relationships to be developed. Even though the data from similar wetlands were combined, the data sets were still considered small and did not allow for good dose-response curves. Because of this, the differences in concentrations between the NOEC and LOEC were very small (i.e, within the range of sampling variability and laboratory error) In several cases, so there is uncertainty in whether the NOECs and LOECs are true NOECs and LOECs.

Also, because of the small data sets, some sites may not have been adequately characterized. Although it is believed that biased sampling was conducted to evaluate potential sources of contamination to the wetlands, the extent of contamination may not be known in some wetlands.

Exposure Assumptions

There are uncertainties in the exposure assumptions that were selected to calculate the human health PRGs, primarily with the number of fish meals per year and number of days maintenance workers were exposed to the sediment per year. The exposure factors were based on best professional judgment and took into consideration, site access, availability of fish, and restrictions on fishing in the area. However, it is recognized that changes in these assumptions would affect the final PRGs.

Summary and Conclusions

After a re-evaluation of the data from the RI report, and by using some more representative exposure assumptions, sediment PRGs were developed for ecological and human receptors. In addition, reference concentrations were compiled from the RI report and refinement values from the RI report were updated. The PRGs, in conjunction with the reference concentrations and the refinement values were used to refine the list of COCs from the RI report, to allow the FS to focus on the chemicals most likely to be the risk drivers (see Table 23 for refined list of COCs). The following presents the key conclusions from the refinement:

- Several initial COCs were eliminated as COCs for evaluation in the FS at all wetlands except Wetland 48. None of the initial COCs from Wetland 48 were eliminated.
- All of the ecological COCs were eliminated from Wetlands 16 and 18A
- All of the human health COCs were eliminated from Wetlands 16 and 64
- Wetland 16 does not have any remaining COCs and will not be included in the FS.

This draft Technical Memorandum was submitted to the regulatory agencies and the agencies provided comments on the document. A Response to Comments document and Meeting Minutes summary was completed by the Navy and is provided in Appendix D.

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TABLE 1

LIST OF CHEMICALS OF CONCERN FROM THE REMEDIAL INVESTIGATION REPORT[(1)]
SITE 41 WETLANDS
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland	Saltwater/Freshwater	Ecological COCs	Human Health COCs
3	Freshwater	Cadmium Endosulfan Sulfate	Arsenic Methylene Chloride
5A	Freshwater	Copper Lead Zinc Endosulfan I	None
15	Saltwater	Aluminum Arsenic Barium Beryllium Iron Manganese Selenium Vanadium Endosulfan I Heptachlor 2,2'-oxybis(1-Chloropropane)/bis(2-chlor) 2,4-Dimethylphenol 2-Methylphenol (o-Cresol) 4-Methylphenol (p-Cresol) Phenol	Arsenic Aroclor 1260 delta-BHC 4,4'-DDD 4,4'-DDE
16	Saltwater	Aluminum Beryllium Iron Manganese Vanadium	Aroclor 1254
18A	Freshwater	Barium Iron Manganese Selenium Aldrin 1,4-Dichlorobenzene 4-Methylpenol (p-Cresol)	Arsenic Benzene
18B	Saltwater	Arsenic Iron Manganese Selenium	Arsenic
48	Freshwater	4,4'-DDD 4,4'-DDE 4,4'-DDT Total DDT	None

TABLE 1

LIST OF CHEMICALS OF CONCERN FROM THE REMEDIAL INVESTIGATION REPORT[1]
SITE 41 WETLANDS
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland	Saltwater/Freshwater	Ecological COCs	Human Health COCs
64	Saltwater	Bis(2-ethylhexyl)phthalate Carbazole Dibenzofuran Endosulfan I Aluminum Barium Beryllium Cadmium Chromium Cobalt Copper Lead Manganese Mercury Selenium Silver Vanadium Zinc	4,4'-DDD 4,4'-DDE 4,4'-DDT Aldrin Alpha-BHC Alpha-Chlordane Aroclor-1254 Aroclor-1260 Delta-BHC Gamma-Chlordane Bis(2-ethylhexyl)phthalate

1 - EnSafe refined the list of COCs after the RI report and revised Table 16.1. This revised table is presented in Attachment A. The list of COCs in this table came from the revised Table 16.1.

TABLE 2

SUMMARY OF IMPACTS TO SEDIMENT INVERTEBRATES IN THE BERA
SITE 41 - NAS PENSACOLA

Wetland	Sample Location	Toxicity Test Information				Benthic Community Analysis			Overall Conclusion of the Baseline Ecological Risk Assessment
		Species[1]	Survival (percent)	Growth (mg/organism, dry weight)	Emergence (percent)	Diversity	Evenness	Richness	
3	041M030201	*C. tentans*	83	2.9	60	2.24	0.97	9.77	
	041M030701	*C. tentans*	91	2 *	70	1.92	1.39	3.38	potential impact around this location
5A	041M5A0401	*C. tentans*	100	2.6	75	2.56	1.11	9.76	
	041M5A0501	*C. tentans*	100	1.6 *(2)	50	3.16	1.37	9.74	potential impact around this location based on the toxicity tests but this location had the highest levels of benthic diversity
	041M5A0601	*C. tentans*	83	2.8	75	2.43	1.25	6.88	
5B	041M5B02	*H. azteca*	97.5	0.06					no impacts
	041M5B03	*H. azteca*	97.5	0.07					no impacts
	041M5B03 Dup	*H. azteca*	97.5	0.1					no impacts
	041M5B04	*H. azteca*	96.25	0.06					no impacts
	041M5B05	*H. azteca*	100	0.08					no impacts
	041M5B06	*H. azteca*	100	0.1					no impacts
16	041M160301	*N. arenaceodentata*	100	8		1.69	1.05	4.72	little or no impact
	041M160301	*L. plumulosus*	93						no statistical differences
64	041M640401	*L. plumulosus*	78 *			2.42	1.01	10.76	toxic chemicals likely stressing system; petroleum odors
		N. arenaceodentata	100	8					
	041M640501	*L. plumulosus*	96			3.3	1.22	14.76	
		N. arenaceodentata	96	7.2 *(2)					
	041M640601	*L. plumulosus*	74 *			2.64	1.14	9.79	toxic chemicals likely stressing system; petroleum odors
		N. arenaceodentata	88	8.5					
18B	041M18B101	*N. arenicola*	100	8.4		2.36	1.03	9.73	sediment not influencing flora and fauna
		L. plumulosus	100						

* Indicates that the endpoint was statistically lower than the laboratory control sample and is considered impacted.
Shaded cells are considered to be toxic.

1 - Species Abbreviations
- *C. tentans - Chironomus tentans*
- *H. azteca - Hyalella azteca*
- *N. arenaceodentata - Nereis arenaceodentata*
- *L. plumulosus - Leptocheirus plumulosus*

2 - Although the growth endpoint from this location was statistically lower than the laboratory control sample, it had the highest levels of benthic diversity. Therefore, this location is not considered impacted for development of the PRGs.

Source of information: EnSafe, November 2007.

TABLE 3

DEVELOPMENT OF NOECS AND LOECS FOR WETLANDS 3 AND 5A
SITE 41 - NAS PENSACOLA

WETLAND EVENT LOCATION SAMPLE SAMPLE DATE	3 03 41M0302 041M030201 19970827	3 03 41M0307 041M030701 19970827	5A 03 41M5A04 041M5A0401 19970828	5A 03 41M5A05 041M5A0501 19970828	5A 03 41M5A06 041M5A0601 19970828	No Observed Effects Concentration	Lowest Observed Effects Concentration
VOLATILES (MG/KG)							
CARBON DISULFIDE	0.017 J	0.011 U	0.0076 U	0.0079 U	0.0082 U	0.017	NA[1]
PESTICIDES (MG/KG)							
4,4'-DDD	0.014 J	0.049	0.10	0.10 U	0.0013 J	0.1	NA[1]
4,4'-DDE	0.016 U	0.011	0.057	0.10 U	0.0036 J	0.057	NA[1]
4,4'-DDT	0.0037 J	0.0093	0.0072	0.10 U	0.0032 J	0.0072	0.0093
ALPHA-BHC	0.0085 U	0.0036 U	0.0026 U	0.054 U	0.0028 U	NA[2]	NA[2]
ALPHA-CHLORDANE	0.0085 U	0.0036 U	0.0045	0.054 U	0.00026 U	0.0045	NA[1]
BETA-BHC	0.0085 U	0.0036 U	0.0026 U	0.054 U	0.0028 U	NA[2]	NA[2]
DELTA-BHC	0.0085 U	0.0036 U	0.0026 U	0.054 U	0.0028 U	NA[2]	NA[2]
ENDOSULFAN I	0.0085 U	0.0036 U	0.0052	0.054 U	0.0003 U	0.0052	NA[1]
ENDOSULFAN SULFATE	0.016 U	0.0072 J	0.0023 J	0.10 U	0.00066 J	0.0023	0.0072
ENDRIN	0.0028 J	0.007 U	0.00069 U	0.0024 U	0.0011 J	0.0028	NA[1]
GAMMA-BHC (LINDANE)	0.0047 U	0.0036 U	0.00024 J	0.054 U	0.0028 U	0.00024	NA[1]
GAMMA-CHLORDANE	0.0085 U	0.00074 J	0.0079 J	0.054 U	0.00014 U	0.0079	NA[1]
INORGANICS (MG/KG)							
ANTIMONY	4.9 UJ	2.1 UJ	1.5 UJ	27.7 J	2 J	27.7	NA[1]
BARIUM	87	18.7	12.5	17.2	6.9	87	NA[1]
CADMIUM	2 UJ	9.3	0.42 J	3.2	1.2	3.2	9.3
COPPER	2 U	4	21.5	108	25.6	108	NA[1]
IRON	246000	67100	1090	3020	546	246000	NA[1]
LEAD	20.6	35.6	54.5	258	75.5	258	NA[1]
MANGANESE	236	42.6	15.4	21.3	8.6	236	NA[1]
SELENIUM	5.4	2 J	0.26 U	0.60 J	0.28 U	5.4	NA[1]
ZINC	45.8	234	77.1	394	103	394	NA[1]
MISCELLANEOUS PARAMETERS							
TOTAL ORGANIC CARBON (MG/KG)	100000	NA	7000	7400	10000	NA	NA

Shading:
Green: Signifies non-toxic sample
Yellow: Signifies toxic sample
Blue: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a toxic sample.
Red: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a non-toxic sample.
Black: LOEC based on lowest concentration in toxic sample above the NOEC when maximum detected concentration for the parameter is in a toxic sample.

1 - Not applicable because the maximum detected concentration of the parameter was in a non-toxic sample.
2 - Not applicable because the parameter was not detected in any of the samples.

NOEC - No Observed Effects Concentration
LOEC - Lowest Observed Effects Concentration
NA - Not Applicable

TABLE 4

DEVELOPMENT OF NOECS AND LOECS FOR WETLAND 5B
SITE 41 - NAS PENSACOLA

WETLAND EVENT LOCATION SAMPLE SAMPLE DATE	5B 04 041M5B02 041M5B0202 20040406	5B 04 041M5B03 041M5B0301 20040406	5B 04 041M5B04 041M5B0401 20040406	5B 04 041M5B05 041M5B0501 20040406	5B 04 041M5B06 041M5B0601 20040406	No Observed Effects Concentration	Lowest Observed Effects Concentration
VOLATILES (MG/KG)							
ACETONE	[redacted]	0.021 I	0.012 U	0.013 U	0.02 U	0.028	NA(1)
CIS-1,2-DICHLOROETHENE	0.0024 U	0.0019 U	0.0017 U	0.0018 U	[redacted]	0.0077	NA(1)
VINYL CHLORIDE	[redacted]	0.0024 U	0.0021 U	0.0023 U	0.0035 U	0.0037	NA(1)
SEMIVOLATILES (MG/KG)							
3&4-METHYLPHENOL	0.089 U	0.073 I	0.058 U	0.062 U	[redacted]	0.2	NA(1)
BENZO(A)ANTHRACENE	[redacted]	0.098 I	0.0044 U	0.012 U	0.017 U	0.12	NA(1)
BIS(2-ETHYLHEXYL)PHTHALATE	[redacted]	[redacted]	0.064 U	0.068 U	0.15 I	0.19	NA(1)
CHRYSENE	[redacted]	0.12	0.0058 U	0.015 U	0.056 I	0.16	NA(1)
DI-N-BUTYL PHTHALATE	0.087 U	[redacted]	0.056 U	0.06 U	0.089 U	0.33	NA(1)
FLUORANTHENE	[redacted]	0.20	0.015 I	0.039 I	0.069 I	0.29	NA(1)
PYRENE	[redacted]	0.16	0.013 I	0.037 I	0.059 I	0.21	NA(1)
PESTICIDES/PCBs (MG/KG)							
4,4'-DDE	0.018 I	0.023 I	0.0078 U	0.0083 U	[redacted]	0.024	NA(1)
AROCLOR-1260	[redacted]	0.06	0.0064 U	0.02 I	0.096	0.15	NA(1)
BETA-BHC	0.00064 U	0.00052 U	0.00042 U	0.00045 U	[redacted]	0.0029	NA(1)
DIELDRIN	0.029	0.014	0.0086	0.009	[redacted]	0.1	NA(1)
INORGANICS (MG/KG)							
ALUMINUM	[redacted]	860 J	300	420	760	3400	NA(1)
ANTIMONY	[redacted]	2.2 I	1.8 I	1.1 I	2.5 I	3.6	NA(1)
ARSENIC	[redacted]	0.56 U	0.46 U	0.46 U	0.66 U	0.84	NA(1)
BARIUM	[redacted]	3.3 J	1.5	1.8	4.5	18	NA(1)
BERYLLIUM	[redacted]	0.068 I	0.038 I	0.036 I	0.066 I	31	NA(1)
CADMIUM	[redacted]	1 J	0.95	1.1	5.1	31	NA(1)
CHROMIUM	[redacted]	24 J	14	23	55	470	NA(1)
COBALT	[redacted]	0.40 I	0.30 I	0.39 I	1.1 I	4.1	NA(1)
COPPER	[redacted]	12 J	5.3	7.8	16	90	NA(1)
IRON	[redacted]	470 J	210	290	800	1800	NA(1)
LEAD	[redacted]	38 J	19	24	48	420	NA(1)
MANGANESE	11	2.8	1.1 I	4.7	[redacted]	21	NA(1)
MERCURY	[redacted]	0.086	0.0068 U	0.019 I	0.12	0.22	NA(1)
NICKEL	[redacted]	1.2 I	0.61 I	0.97 I	3 I	20	NA(1)
SILVER	[redacted]	0.18 UJ	0.15 U	0.15 U	0.38 I	6.4	NA(1)
VANADIUM	[redacted]	1.1 I	0.55 I	0.86 I	1.2 I	6.7	NA(1)
ZINC	[redacted]	45 J	28	19	60	200	NA(1)
MISCELLANEOUS PARAMETERS							
TOTAL ORGANIC CARBON (MG/KG)	15000	3800	3500	14000	4100	NA	NA

Shading:
Green: Signifies non-toxic sample
Red: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a non-toxic sample.

1 - Not applicable because the maximum detected concentration of the parameter was in a non-toxic sample.

NOEC - No Observed Effects Concentration
LOEC - Lowest Observed Effects Concentration
NA - Not Applicable

TABLE 5

DEVELOPMENT OF NOECS AND LOECS FOR WETLANDS 16 AND 18B
SITE 41 - NAS PENSACOLA

WETLAND EVENT LOCATION SAMPLE SAMPLE DATE	16 03 41M1603 041M160301 19970904	18B 03 41M18B1 041M18B101 19970829	No Observed Effects Concentration	Lowest Observed Effects Concentration
SEMIVOLATILES (MG/KG)				
2,2'-OXYBIS(1-CHLOROPROPANE)	0.87 UJ	0.67 U	NA(1)	NA(1)
2,4-DIMETHYLPHENOL	0.87 U	0.67 U	NA(1)	NA(1)
2-METHYLPHENOL	0.87 U	0.67 U	NA(1)	NA(1)
4-METHYLPHENOL			NA(1)	NA(1)
PHENOL	0.87 U	0.67 U	NA(1)	NA(1)
PESTICIDES (MG/KG)				
4,4'-DDD	0.0069 J	0.036	0.036	NA(2)
4,4'-DDT	0.016	0.11	0.11	NA(2)
ALDRIN	0.0045 U	0.0035 U	NA(1)	NA(1)
ALPHA-BHC	0.0045 U	0.0035 U	NA(1)	NA(1)
ALPHA-CHLORDANE	0.0045 U	0.0035 U	NA(1)	NA(1)
BETA-BHC	0.0045 U	0.0035 U	NA(1)	NA(1)
DELTA-BHC	0.0045 U	0.0035 U	NA(1)	NA(1)
ENDOSULFAN I	0.0045 U	0.0035 U	NA(1)	NA(1)
ENDRIN	0.0013 J	0.0067 U	0.0013	NA(2)
ENDRIN ALDEHYDE	0.0087 U	0.0067 U	NA(1)	NA(1)
ENDRIN KETONE	0.0087 U	0.0067 U	NA(1)	NA(1)
GAMMA-BHC (LINDANE)	0.0045 U	0.0035 U	NA(1)	NA(1)
GAMMA-CHLORDANE	0.0045 U	0.0035 U	NA(1)	NA(1)
HEPTACHLOR	0.0045 U	0.0035 U	NA(1)	NA(1)
INORGANICS (MG/KG)				
ALUMINUM	5320 J	605	5320	NA(2)
ARSENIC	5.5	13.8	13.8	NA(2)
BARIUM	4.7	1.8 J	4.7	NA(2)
BERYLLIUM	0.26	0.07 J	0.26	NA(2)
IRON	17000	20800	20800	NA(2)
LEAD	29.4	5.9	29.4	NA(2)
MANGANESE	39	10.8	39	NA(2)
SELENIUM	1 J	0.74 J	1	NA(2)
VANADIUM	15.3	6.3	15.3	NA(2)
MISCELLANEOUS PARAMETERS				
TOTAL ORGANIC CARBON (MG/KG)	17000	9000	NA	NA

Shading:
Green: Signifies non-toxic sample
Red: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a non-toxic sample.
1 - Not applicable because the parameter was not detected in any of the samples.
2 - Not applicable because the maximum detected concentration of the parameter was in a non-toxic sample.

NOEC - No Observed Effects Concentration
LOEC - Lowest Observed Effects Concentration
NA - Not Applicable

TABLE 6

DEVELOPMENT OF NOECS AND LOECS FOR WETLAND 64
SITE 41 - NAS PENSACOLA

WETLAND EVENT LOCATION SAMPLE SAMPLE DATE	64 03 41M6404 41M640401 19970904	64 03 41M6405 41M640501 19970904	64 03 41M6406 41M640601 19970903	No Observed Effects Concentration	Lowest Observed Effects Concentration
SEMIVOLATILES (MG/KG)					
BIS(2-ETHYLHEXYL)PHTHALATE	3.3	2	3.9	2	3.3
CARBAZOLE	0.32 J	0.35 J	0.80 J	0.35	0.8
DIBENZOFURAN	1.3 U	0.13 J	0.35 J	0.13	0.35
PESTICIDES/PCBs (MG/KG)					
4,4'-DDD	0.089	0.03	0.053	0.03	0.053
AROCLOR-1260	0.30	0.28	0.18	0.28	0.3
DIELDRIN	0.02 J	0.017 J	0.0077 J	0.017	0.02
ENDOSULFAN I	0.0024 J	0.00086 U	0.0013 J	NA(2)	0.0013
INORGANICS (MG/KG)					
ALUMINUM	8890 J	7600 J	8900 J	7600	8890
BARIUM	17.1	17	15.2	17	17.1
BERYLLIUM	0.30 J	0.34	0.34	0.34	NA(1)
CADMIUM	20.2	17.7	21	17.7	20.2
CHROMIUM	774	592	868	592	774
COBALT	3	3.4	2.7	3.4	NA(1)
COPPER	102	146	115	146	NA(1)
IRON	13600	13300	12100	13300	13600
LEAD	346	330	339	330	339
MANGANESE	44.9	65.8	48.8	65.8	NA(1)
SELENIUM	1.6 J	1.5 J	1.3 J	1.5	1.6
SILVER	2 J	3	1.9 J	3	NA(1)
VANADIUM	18.4	15.9	17.3	15.9	17.3
ZINC	468	306	330	306	330
MISCELLANEOUS PARAMETERS					
TOTAL ORGANIC CARBON (MG/KG)	70000	60000	86000	NA	NA

Shading:
Green: Signifies non-toxic sample
Yellow: Signifies toxic sample
Blue: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a toxic sample.
Red: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a non-toxic sample.
Black: LOEC based on lowest concentration in toxic sample above the NOEC when maximum detected concentration for the parameter is in a toxic sample.

1 - Not applicable because the maximum detected concentration of the parameter was in a non-toxic sample.
2 - Not applicable because parameter was not detected in the non-toxic sample.

NOEC - No Observed Effects Concentration
LOEC - Lowest Observed Effects Concentration
NA - Not Applicable

TABLE 7

REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR FRESHWATER WETLAND SEDIMENT
SITE 41 - NAS PENSACOLA

Parameter	Reference Concentrations (mg/kg)(1)	Screening Level (mg/kg)(2)	Refinement Value (mg/kg)	Source of Refinement Value
VOLATILES				
BENZENE	NA	NA	0.057	ECOTOX
CARBON DISULFIDE	NA	NA	NA	
SEMIVOLATILES				
1,4-DICHLOROBENZENE	NA	NA	0.35	ECOTOX
4-METHYLPENOL (P-CRESOL)	NA	NA	0.1	AET(4)
PESTICIDES				
4,4'-DDD	0.05(3)	0.00122	0.028	PEC
4,4'-DDE	0.04(3)	0.00207	0.031	PEC
4,4'-DDT	0.02(3)	0.00119	0.063	PEC
TOTAL DDT	0.11(3)	0.00033	0.57	PEC
ALDRIN	NA	NA	0.04	UET
ALPHA-BHC	NA	0.00032	0.005	PEC
ALPHA-CHLORDANE	NA	0.0017	0.018	PEC
BETA-BHC	NA	0.00032	0.005	PEC
DELTA-BHC	NA	0.00032	0.005	PEC
ENDOSULFAN I	NA	NA	0.0029	ECOTOX
ENDOSULFAN SULFATE	NA	NA	0.0054	ECOTOX
ENDRIN	NA	0.0033	0.21	PEC
GAMMA-BHC (LINDANE)	NA	0.00032	0.005	PEC
GAMMA-CHLORDANE	NA	0.0017	0.0018	PEC
INORGANICS				
ARSENIC	6.62	7.24	33	PEC
ANTIMONY	4.43	12	NA	
BARIUM	14	NA	60	PEC
CADMIUM	1.8	0.68	5	PEC
COPPER	19.5	18.7	150	PEC
IRON	11912	NA	40000	UET
LEAD	82.5	30.2	130	PEC
MANGANESE	38	NA	1100	UET
SELENIUM	3.45	NA	1	AET(4)
ZINC	36.73	124	460	PEC

1 - As presented in Section 6.1 of the RI (EnSafe, 2007a), the mean detection was calculated, multiplied by two, and the resulting multiplier was used as the reference concentration.
2 - Source of screening level is provided in the RI Report (EnSafe, 2007a).
3 - Freshwater and saltwater reference concentrations for pesticides are the same.
4 - Saltwater refinement value.

AET - Apparent Effects Thresholds (Buchman, 2008)
ECOTOX - USEPA Ecotox Thresholds (USEPA, January 1996)
NA - Not Available
PEC - Probable Effects Concentrations (FDEP, January 2003)
UET - Upper Effects Thresholds (Buchman, 2008)

TABLE 8

REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR SALTWATER WETLAND SEDIMENT
SITE 41 - NAS PENSACOLA

Parameter	Reference Concentrations (mg/kg)[1]	Screening Level (mg/kg)[2]	Refinement Value (mg/kg)	Source of Refinement Value
SEMIVOLATILES				
2,2'-OXYBIS(1-CHLOROPROPANE)/BIS(2-CHLOR)	NA	NA	NA	
2,4-DIMETHYLPHENOL	NA	NA	0.018	AET
2-METHYLPHENOL (O-CRESOL)	NA	NA	0.008	AET
4-METHYLPHENOL (P-CRESOL)	NA	NA	0.1	AET
BIS(2-ETHYLHEXYL)PHTHALATE	NA	0.182	2.647	PEL
CARBAZOLE	NA	NA	NA	
DIBENZOFURAN	NA	NA	0.11	AET
PHENOL	NA	NA	0.13	AET
PESTICIDES/PCBs				
4,4'-DDD	0.05[3]	0.00122	0.00781	PEL
4,4'-DDE	0.04[3]	0.00207	0.374	PEL
4,4'-DDT	0.02[3]	0.00119	0.00477	PEL
TOTAL DDT	0.11[3]	0.00033	0.0517	PEL
ALDRIN	NA	NA	0.0095	AET
ALPHA-BHC	NA	0.00032	0.00099	PEL
ALPHA-CHLORDANE	NA	0.0017	0.00479	PEL
AROCLOR-1260	NA	0.0216	0.189	PEL
BETA-BHC	NA	0.00032	0.00099	PEL
DELTA-BHC	NA	0.00032	0.00099	PEL
DIELDRIN	NA	0.000715	0.0043	PEL
ENDOSULFAN I	NA	NA	0.0029	ECOTOX[4]
ENDRIN	NA	0.0033	0.207	PEC[4]
ENDRIN ALDEHYDE	NA	0.0033	0.207	PEC[4]
ENDRIN KETONE	NA	0.0033	0.207	PEC[4]
GAMMA-BHC (LINDANE)	NA	0.00032	0.00099	PEL
GAMMA-CHLORDANE	NA	0.0017	0.00479	PEL
HEPTACHLOR	NA	NA	0.0003	AET
INORGANICS				
ALUMINUM	4274	NA	18000	AET
ARSENIC	2.14	7.24	41.6	PEL
BARIUM	3.84	NA	48	AET
BERYLLIUM	0.13	NA	NA	
CADMIUM	0.39	0.68	4.21	PEL
CHROMIUM	13.1	52.3	160	PEL
COBALT	0.91	NA	10	AET
COPPER	8.44	18.7	108	PEL
IRON	2684	NA	220000	AET
LEAD	21	30.2	112	PEL
MANGANESE	9.8	NA	260	AET
MERCURY	0.11	---[5]	---[5]	---[5]
SELENIUM	0.66	NA	1	AET
SILVER	0.52	0.73	1.77	PEL
VANADIUM	8.59	NA	57	AET
ZINC	14.36	124	271	PEL

1- As presented in Section 6.1 of the RI (EnSafe, 2007a), the mean detection was calculated, multiplied by two, and the resulting multiplier was used as the reference concentration.
2 - Source of screening level is provided in the RI Report (EnSafe, 2007a).
3 - Freshwater and saltwater reference concentrations for pesticides are the same.
4 - Freshwater refinement value.
5 - Not applicable because mercury was not selected as a COC for risks to sediment invertebrates. It was selected as a COC because of risks to the red drum via the food chain pathway.

AET - Apparent Effects Thresholds (Buchman, 2008)
COC - Chemical of Concern
ECOTOX - USEPA Ecotox Thresholds (USEPA, January 1996)
NA - Not Available
PEC - Probable Effects Concentrations (FDEP, January 2003)
PEL - Probable Effects Levels (Buchman, 2008)

TABLE 9

DEVELOPMENT OF ECOLOGICAL PRGS FOR FRESHWATER WETLANDS 3, 5A, AND 18A
SITE 41 - NAS PENSACOLA

Chemical	Freshwater Reference Concentration	Screening Level	Refinement Value	No Observed Effects Concentration	Lowest Observed Effects Concentration	Overall Ecological PRG
VOLATILES (MG/KG)						
1,4-DICHLOROBENZENE	NA	NA	0.35	NA	NA	0.35
CARBON DISULFIDE	NA	NA	NA	0.017	NA	0.017
SEMIVOLATILES (MG/KG)						
4-METHYLPENOL (P-CRESOL)	NA	NA	0.1	NA	NA	0.1
PESTICIDES (MG/KG)						
4,4'-DDD	0.05	0.00122	0.028	0.1	NA	0.1
4,4'-DDE	0.04	0.00207	0.031	0.057	NA	0.057
4,4'-DDT	0.02	0.00119	0.063	0.0072	0.0093	0.02
ALDRIN	NA	NA	0.04	NA	NA	0.04
ALPHA-BHC	NA	0.00032	0.005	NA	NA	0.005
ALPHA-CHLORDANE	NA	0.0017	0.018	0.0045	NA	0.018
BETA-BHC	NA	0.00032	0.005	NA	NA	0.005
DELTA-BHC	NA	0.00032	0.005	NA	NA	0.005
ENDOSULFAN I	NA	NA	0.0029	0.0052	NA	0.0052
ENDOSULFAN SULFATE	NA	NA	0.0054	0.0023	0.0072	0.0072
ENDRIN	NA	0.0033	0.21	0.0028	NA	0.21
GAMMA-BHC (LINDANE)	NA	0.00032	0.005	0.00024	NA	0.005
GAMMA-CHLORDANE	NA	0.0017	0.018	0.0079	NA	0.018
INORGANICS (MG/KG)						
ANTIMONY	4.43	12	NA	27.7	NA	27.7
BARIUM	14	NA	60	87	NA	87
CADMIUM	1.8	0.68	5	3.2	9.3	9.3
COPPER	19.5	18.7	150	108	NA	150
IRON	11912	NA	40000	246000	NA	246000
LEAD	82.5	30.2	130	258	NA	258
MANGANESE	38	NA	1100	236	NA	1100
SELENIUM	3.45	NA	1	5.4	NA	5.4
ZINC	36.73	124	460	394	NA	460

NA - Not Available
PRG - Preliminary Remediation Goal

TABLE 10

DEVELOPMENT OF ECOLOGICAL PRGS FOR SALTWATER WETLANDS 15, 16 AND 18B
SITE 41 - NAS PENSACOLA

Chemical	Saltwater Reference Concentration	Screening Level	Refinement Value	No Observed Effects Concentration	Lowest Observed Effects Concentration	Overall Ecological PRG
SEMIVOLATILES (MG/KG)						
2,2'-OXYBIS(1-CHLOROPROPANE)/BIS(2-CHLOR)	NA	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	NA	NA	0.018	NA	NA	0.018
2-METHYLPHENOL (O-CRESOL)	NA	NA	0.008	NA	NA	0.008
4-METHYLPHENOL (P-CRESOL)	NA	NA	0.1	NA	NA	0.1
PHENOL	NA	NA	0.13	NA	NA	0.13
PESTICIDES (MG/KG)						
4,4'-DDD	0.05	0.00122	0.00781	0.036	NA	0.05
4,4'-DDT	0.02	0.00119	0.00477	0.11	NA	0.11
ALDRIN	NA	NA	0.0095	NA	NA	0.0095
ALPHA-BHC	NA	0.00032	0.00099	NA	NA	0.00099
ALPHA-CHLORDANE	NA	0.0017	0.00479	NA	NA	0.00479
BETA-BHC	NA	0.00032	0.00099	NA	NA	0.00099
DELTA-BHC	NA	0.00032	0.00099	NA	NA	0.00099
ENDOSULFAN I	NA	NA	0.0029	NA	NA	0.0029
ENDRIN	NA	0.0033	0.207	0.0013	NA	0.207
ENDRIN ALDEHYDE	NA	0.0033	0.207	NA	NA	0.207
ENDRIN KETONE	NA	0.0033	0.207	NA	NA	0.207
GAMMA-BHC (LINDANE)	NA	0.00032	0.00099	NA	NA	0.00099
GAMMA-CHLORDANE	NA	0.0017	0.00479	NA	NA	0.00479
HEPTACHLOR	NA	NA	0.0003	NA	NA	0.0003
INORGANICS (MG/KG)						
ALUMINUM	4274	NA	18000	5320	NA	18000
ARSENIC	2.14	7.24	41.6	13.8	NA	41.6
BARIUM	3.84	NA	48	4.7	NA	48
BERYLLIUM	0.13	NA	NA	0.26	NA	0.26
IRON	2684	NA	220000	20800	NA	220000
LEAD	21	30.2	112	29.4	NA	112
MANGANESE	9.8	NA	260	39	NA	260
SELENIUM	0.66	NA	1	1	NA	1
VANADIUM	8.59	NA	57	15.3	NA	57

NA - Not Available
PRG - Preliminary Remediation Goal

TABLE 11

DEVELOPMENT OF ECOLOGICAL PRG FOR WETLAND 64
SITE 41 - NAS PENSACOLA

Chemical	Saltwater Reference Concentration	Screening Level	Refinement Value	No Observed Effects Concentration	Lowest Observed Effects Concentration	Overall Ecological PRG
SEMIVOLATILES (MG/KG)						
BIS(2-ETHYLHEXYL)PHTHALATE	NA	0.182	2.647	2	3.3	3.3
CARBAZOLE	NA	NA	NA	0.35	0.8	0.8
DIBENZOFURAN	NA	NA	0.11	0.13	0.35	0.35
PESTICIDES/PCBs (MG/KG)						
4,4'-DDD	0.05	0.00122	0.00781	0.03	0.053	0.053
AROCLOR-1260	NA	0.0216	0.189	0.28	0.3	0.3
DIELDRIN	NA	0.000715	0.0043	0.017	0.02	0.02
ENDOSULFAN I	NA	NA	0.0029	NA	0.0013	0.0029
INORGANICS (MG/KG)						
ALUMINUM	4274	NA	18000	7600	8890	18000
BARIUM	3.84	NA	48	17	17.1	48
BERYLLIUM	0.13	NA	NA	0.34	NA	0.34
CADMIUM	0.39	0.68	4.21	17.7	20.2	20.2
CHROMIUM	13.1	52.3	160	592	774	774
COBALT	0.91	NA	10	3.4	NA	10
COPPER	8.44	18.7	108	146	NA	146
IRON	2684	NA	220000	13300	13600	220000
LEAD	21	30.2	112	330	339	339
MANGANESE	9.8	NA	260	65.8	NA	260
MERCURY	0.11	---(1)	---(1)	---(1)	---(1)	0.11
SELENIUM	0.66	NA	1	1.5	1.6	1.6
SILVER	0.52	0.73	1.77	3	NA	3
VANADIUM	8.59	NA	57	15.9	17.3	57
ZINC	14.36	124	271	306	330	330

1 - Not applicable because mercury was not selected as a COC for risks to sediment invertebrates.
It was selected as a COC because of risks to the red drum via the food chain pathway.

NA - Not Available

PRG - Preliminary Remediation Goal

TABLE 12

DEVELOPMENT OF ECOLOGICAL PRG FOR WETLAND 48
SITE 41 - NAS PENSACOLA

Chemical	Saltwater Reference Concentration	Screening Level	Refinement Value	No Observed Effects Concentration	Lowest Observed Effects Concentration	Overall Ecological PRG
PESTICIDES (MG/KG)						
4,4'-DDD	0.05	0.00122	0.028	NA(1)	NA(1)	0.05
4,4'-DDE	0.04	0.00207	0.031	NA(1)	NA(1)	0.04
4,4'-DDT	0.02	0.00119	0.063	NA(1)	NA(1)	0.063
TOTAL DDT	0.11	0.00033	0.57	NA(1)	NA(1)	0.57

1 - Not available because no toxicity test data was collected in this wetland and habitat is different than other wetlands.
NA - Not Available
PRG - Preliminary Remediation Goal

TABLE 13

SUMMARY OF HUMAN HEALTH PRGS
SITE 41 - NAS PENSACOLA

Chemical	Maintenance Worker PRG (mg/kg)	Recreational Fisherman PRGs Wetland 15 (mg/kg)	Wetland 16 (mg/kg)	Wetland 64 (mg/kg)
4,4'-DDD	---	374	---	1.4
4,4'-DDE	---	9.6	---	0.37
4,4'-DDT	---	---	---	0.37
Aldrin	---	---	---	0.03
alpha-BHC	---	---	---	0.08
alpha-Chlordane	---	---	---	0.58
Aroclor-1254	---	---	0.18	0.16
Aroclor-1260	---	6.8	---	0.82
delta-BHC	---	2.2	---	0.80
gamma-Chlordane	---	---	---	0.12
Bis(2-ethylhexyl)phthalate	---	---	---	69
Arsenic	14	---	---	---
Benzene	500	---	---	---

Attachment B presents the calculation sheets for these PRGs.
-- - Not a COC in that wetland
PRG - Preliminary Remediation Goal

TABLE 14

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 3
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA	9/10	35.5	041M030301	14	NA	NA
Cadmium	Eco	7/10	72.7	041M030701	9.3	NA	NA
Endosulfan Sulfate	Eco	2/10	0.0017	041M030701	0.0072	NA	NA
Methylene Chloride	HHRA	0/10	ND	ND	NA	NA	NA
Average TOC = 56,736							

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA	2/2	14.6	041M030201	14	NA	NA
Cadmium	Eco	1/2	9.3	041M030701	9.3	NA	NA
Endosulfan Sulfate	Eco	1/2	0.0072	041M030701	0.0072	NA	NA
Methylene Chloride	HHRA	0/2	ND	ND	NA	NA	NA
Average TOC = 56,000							

Phases II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA	11/12	35.5	041M030301	14	Yes	
Cadmium	Eco	8/12	72.7	041M030701	9.3	Yes	
Endosulfan Sulfate	Eco	3/12	0.0072	041M030701	0.0072	No	Low detection frequency. Concentrations indicative of legal application not disposal activities.
Methylene Chloride	HHRA	0/12	ND	ND	NA	No	Not detected; COC for surface water, not sediment
Average TOC = 56,572							

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC.

NA - Not applicable

ND - Not detected

TOC - Total organic carbon

COC - Chemical of concern

TABLE 15

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 5A
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Copper	Eco	7/7	317	041M5A0501	150	NA	NA
Lead	Eco	7/7	427	041M5A0101	258	NA	NA
Zinc	Eco	7/7	2,290	041M5A0101	460	NA	NA
Endosulfan I	Eco	0/7	ND	ND	0.0052	NA	NA
Average TOC = 137,389							

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Copper	Eco	3/3	108	041M5A0501	150	NA	NA
Lead	Eco	3/3	258	041M5A0501	258	NA	NA
Zinc	Eco	3/3	394	041M5A0501	460	NA	NA
Endosulfan I	Eco	1/3	0.0052	041M5A0401	0.0052	NA	NA
Average TOC = 8,133							

Phase II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Copper	Eco	10/10	317	041M5A0501	150	Yes	
Lead	Eco	10/10	427	041M5A0101	258	Yes	
Zinc	Eco	10/10	2,290	041M5A0101	460	Yes	
Endosulfan I	Eco	1/10	0.0052	041M5A0401	0.0052	No	Low detection frequency. Concentrations indicative of legal application not disposal activities.
Average TOC = 98,612							

1 - PRG - Preliminary remediation goal is the ecological PRG; no chemicals were retained as human health COCs.
NA - Not applicable
ND - Not detected
TOC - Total organic carbon
COC - Chemical of concern

TABLE 16

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 15
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Aluminum	Eco	4/4	15,800	041M150201	18000	No	Max result < PRG
Arsenic	HHRA/Eco	4/4	141	041M150301	14/41.6	Yes	
Barium	Eco	4/4	40.9	041M150301	48	No	Max result < PRG
Beryllium	Eco	1/4	0.34	041M150401	0.26	No	Max result ~ PRG
Iron	Eco	4/4	223,000	041M150301	220000	No	Max result ~ PRG
Manganese	Eco	4/4	520	041M150301	260	Yes	
Selenium	Eco	3/4	2.7	041M150201	1	Yes	
Vanadium	Eco	4/4	36	041M150201	57	No	Max result < PRG
2,2'-oxybis(1-Chloropropane)/bis(2-chlor)	Eco	1/4	0.082	041M150401	NA	No	Not site-related
2,4-Dimethylphenol	Eco	1/4	0.63	041M150101	0.018	No	Not site-related
2-Methylphenol (o-Cresol)	Eco	1/4	0.33	041M150101	0.008	No	Not site-related
4-Methylphenol (p-Cresol)	Eco	1/4	4.8	041M150101	0.1	No	Not site-related
Phenol	Eco	1/4	0.28	041M150101	0.13	No	Not site-related
Aroclor-1260	HHRA	3/4	0.032	041M150301	6.8	No	Max result < PRG
4,4'-DDD	HHRA	4/4	0.2	041M150301	374	No	Max result < PRG
4,4'-DDE	HHRA	4/4	0.34	041M150101	9.6	No	Max result < PRG
delta-BHC	HHRA	1/4	0.0055	041M150301	2.2	No	Max result < PRG
Endosulfan I	Eco	1/4	0.0017	041M150301	0.0029	No	Max result < PRG
Heptachlor	Eco	1/4	0.0011	041M150201	0.0003	No	Not site-related
Average TOC = 194,250							

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC. If the chemical was both a human health and ecological COC, both of the two PRGs are presented.
NA - Not applicable
TOC - Total organic carbon
COC - Chemical of concern

TABLE 17

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 16
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Aroclor-1254	HHRA	3/4	0.078	041M160301	0.18	NA	NA
Aluminum	Eco	4/4	8,880	041M160301	18000	NA	NA
Beryllium	Eco	2/4	0.47	041M160301	0.26	NA	NA
Iron	Eco	4/4	39,500	041M160301	220000	NA	NA
Manganese	Eco	4/4	211	041M160301	260	NA	NA
Vanadium	Eco	4/4	34	041M160301	57	NA	NA
Average TOC = 23,113.30							

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Aroclor-1254	HHRA	0/1	----	----	0.18	NA	NA
Aluminum	Eco	1/1	5,320	041M160301	18000	NA	NA
Beryllium	Eco	1/1	0.26	041M160301	0.26	NA	NA
Iron	Eco	1/1	17,000	041M160301	220000	NA	NA
Manganese	Eco	1/1	39	041M160301	260	NA	NA
Vanadium	Eco	1/1	15.3	041M160301	57	NA	NA
Average TOC = 17,000							

Phases II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Aroclor-1254	HHRA	3/5	0.078	041M160301	0.18	No	Max result < PRG
Aluminum	Eco	5/5	8,880	041M160301	18000	No	Max result < PRG
Beryllium	Eco	3/5	0.47	041M160301	0.26	No	Recent results < PRG and sediment not-toxic
Iron	Eco	5/5	39,500	041M160301	220000	No	Max result < PRG
Manganese	Eco	5/5	211	041M160301	260	No	Max result < PRG
Vanadium	Eco	5/5	34	041M160301	57	No	Max result < PRG
Average TOC = 21,585							

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC.
NA - Not applicable
TOC - Total organic carbon
COC - Chemical of concern

TABLE 18

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 18A
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA	4/4	31.4	041M18A201	14	Yes	
Barium	Eco	4/4	35.9	001M001801	87	No	Max result < PRG
Iron	Eco	4/4	48,200	041M18A201	246000	No	Max result < PRG
Manganese	Eco	4/4	105	001M001801	1100	No	Max result < PRG
Selenium	Eco	2/4	3.8	041M18A101	5.4	No	Max result < PRG
Benzene	HHRA	2/3	0.05	041M18A301	500	No	Max result < PRG
Aldrin	Eco	1/4	0.0037	041M18A201	0.04	No	Max result < PRG
1,4-Dichlorobenzene	Eco	1/4	1.1	041M18A201	0.35	No	Not site-related
4-Methylpenol (p-Cresol)	Eco	2/4	0.33	041M18A201	0.1	No	Not site-related
Average TOC = 223,333							

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC.

NA - Not applicable

TOC - Total organic carbon

COC - Chemical of concern

TABLE 19

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 18B
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA/Eco	1/1	83.8	041M18B101	14/41.6	NA	NA
Iron	Eco	1/1	128,000	041M18B101	220,000	NA	NA
Manganese	Eco	1/1	46.7	041M18B101	260	NA	NA
Selenium	Eco	1/1	2.2	041M18B101	1	NA	NA
Average TOC = 118,000							

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA/Eco	1/1	13.8	041M18B101	14/41.6	NA	NA
Iron	Eco	1/1	20,800	041M18B101	220,000	NA	NA
Manganese	Eco	1/1	10.8	041M18B101	260	NA	NA
Selenium	Eco	1/1	0.74	041M18B101	1	NA	NA
Average TOC = 9,000							

Phases II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Arsenic	HHRA/Eco	2/2	83.8	041M18B101	14/41.6	Yes	
Iron	Eco	2/2	128,000	041M18B101	220,000	No	Max result < PRG
Manganese	Eco	2/2	46.7	041M18B101	260	No	Max result < PRG
Selenium	Eco	2/2	2.2	041M18B101	1	No	Recent results < PRG and sediment not-toxic
Average TOC = 63,500							

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC.
NA - Not applicable
TOC - Total organic carbon
COC - Chemical of concern

TABLE 20

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 48
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
4,4'-DDD	Eco	1/1	2.6	041M4801	0.05	NA	NA
4,4'-DDE	Eco	1/1	0.62	041M4801	0.04	NA	NA
4,4'-DDT	Eco	1/1	0.24	041M4801	0.063	NA	NA
Total DDT	Eco	1/1	3.46	041M4801	0.57	NA	NA
Average TOC = 44,300							

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
4,4'-DDD	Eco	9/9	13	041M4802	0.05	NA	NA
4,4'-DDE	Eco	9/9	0.93	041M4802	0.04	NA	NA
4,4'-DDT	Eco	5/9	7.1	041M4801	0.063	NA	NA
Total DDT	Eco	9/9	14.4	041M4802	0.57	NA	NA
Average TOC = NA							

Phase II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
4,4'-DDD	Eco	10/10	13	041M4802	0.05	Yes	
4,4'-DDE	Eco	10/10	0.93	041M4802	0.04	Yes	
4,4'-DDT	Eco	6/10	7.1	041M4801	0.063	Yes	
Total DDT	Eco	10/10	14.4	041M4802	0.57	Yes	
Average TOC = NA							

NA - Not applicable
1 - PRG - Preliminary remediation goal is the ecological PRG; no chemicals were retained as human health COCs.
TOC - Total organic carbon
COC - Chemical of concern

TABLE 21

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 64
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Bis(2-ethylhexyl)phthalate	HHRA/Eco	3/24	0.53	041M641901	69/3.3	NA	NA
Carbazole	Eco	2/24	0.4	041M640501	0.8	NA	NA
Dibenzofuran	Eco	2/24	0.085	041M640501	0.35	NA	NA
Endosulfan I	Eco	1/24	0.0008	041M641401	0.0029	NA	NA
Aluminum	Eco	24/24	26,800	041M641601	18000	NA	NA
Barium	Eco	22/24	1,280	041M640301	48	NA	NA
Beryllium	Eco	10/24	1.3	041M641601 041M641901	0.34	NA	NA
Cadmium	Eco	22/24	38.6	041M640301	20.2	NA	NA
Chromium	Eco	24/24	1,800	041M640301	774	NA	NA
Cobalt	Eco	15/24	6.1	041M640301	10	NA	NA
Copper	Eco	22/24	255	041M640301	146	NA	NA
Lead	Eco	23/24	634	041M640301	339	NA	NA
Manganese	Eco	24/24	203	041M641601	260	NA	NA
Mercury	Eco	14/24	0.88	041M640301	0.11	NA	NA
Selenium	Eco	11/34	3.1	041M640301	1.6	NA	NA
Silver	Eco	4/24	5.1	041M640301	3	NA	NA
Vanadium	Eco	22/24	43.4	041M641601	57	NA	NA
Zinc	Eco	23/24	481	041M640301	330	NA	NA
4,4'-DDD	HHRA	14/24	0.14	041M640201	1.4	NA	NA
4,4'-DDE	HHRA	14/24	0.078	041M640301	0.37	NA	NA
4,4'-DDT	HHRA	6/24	0.014	041M640101 041M640301	0.37	NA	NA
Aldrin	HHRA	6/24	0.004	041M640301	0.031	NA	NA
Alpha-BHC	HHRA	9/24	0.00094	041M641401	0.08	NA	NA
Alpha-Chlordane	HHRA	4/24	0.01	041M640301	0.58	NA	NA
Aroclor-1254	HHRA	8/24	0.37	041M640201	0.16	NA	NA
Aroclor-1260	HHRA	12/24	0.05	041M641901	0.82	NA	NA
Delta-BHC	HHRA	0/24	ND	ND	0.8	NA	NA
Gamma-Chlordane	HHRA	5/24	0.0085	041M640301	0.12	NA	NA

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Rationale for Elimination as a Final COC
Bis(2-ethylhexyl)phthalate	HHRA/Eco	3/3	3.9	041M640601	69/3.3	NA	NA
Carbazole	Eco	3/3	0.8	041M640601	0.8	NA	NA
Dibenzofuran	Eco	2/3	0.35	041M640601	0.35	NA	NA
Endosulfan I	Eco	2/3	0.0024	041M640401	0.0029	NA	NA
Aluminum	Eco	3/3	8,900	041M640601	18000	NA	NA
Barium	Eco	3/3	17.1	041M640401	48	NA	NA
Beryllium	Eco	3/3	0.34	041M640501 041M640601	0.34	NA	NA
Cadmium	Eco	3/3	21	041M640601	20.2	NA	NA
Chromium	Eco	3/3	868	041M640601	774	NA	NA
Cobalt	Eco	3/3	3.4	041M640501	10	NA	NA
Copper	Eco	3/3	146	041M640501	146	NA	NA
Lead	Eco	3/3	346	041M640401	339	NA	NA
Manganese	Eco	3/3	65.8	041M640501	260	NA	NA
Mercury	Eco	3/3	0.26	041M640401 041M640501	0.11	NA	NA
Selenium	Eco	3/3	1.6	041M640401	1.6	NA	NA
Silver	Eco	3/3	3	041M640501	3	NA	NA
Vanadium	Eco	3/3	18.4	041M640401	57	NA	NA
Zinc	Eco	3/3	468	041M640401	330	NA	NA
4,4'-DDD	HHRA	3/3	0.089	041M640401	1.4	NA	NA
4,4'-DDE	HHRA	3/3	0.089	041M640401	0.37	NA	NA
4,4'-DDT	HHRA	2/3	0.019	041M640601	0.37	NA	NA
Aldrin	HHRA	0/3	ND	ND	0.03	NA	NA
Alpha-BHC	HHRA	0/3	ND	ND	0.08	NA	NA
Alpha-Chlordane	HHRA	2/3	0.0037	041M640401	0.58	NA	NA
Aroclor-1254	HHRA	0/3	ND	ND	0.16	NA	NA
Aroclor-1260	HHRA	3/3	0.3	041M640401	0.82	NA	NA
Delta-BHC	HHRA	2/3	0.00094	041M640601	0.8	NA	NA
Gamma-Chlordane	HHRA	0/3	ND	ND	0.12	NA	NA

TABLE 21

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 64
SITE 41 - NAS PENSACOLA

Phase IV Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Bis(2-ethylhexyl)phthalate	HHRA/Eco	4/7	1.5	041M640502	69/3.3	NA	NA
Carbazole	Eco	----	----	----	0.8	NA	NA
Dibenzofuran	Eco	0/7	ND	ND	0.35	NA	NA
Endosulfan I	Eco	0/7	ND	ND	0.0029	NA	NA
Aluminum	Eco	7/7	18,000	041M641102	18000	NA	NA
Barium	Eco	7/7	18	041M640502 041M641102	48	NA	NA
Beryllium	Eco	5/7	1.1	041M641102	0.34	NA	NA
Cadmium	Eco	6/7	23	041M640502	20.2	NA	NA
Chromium	Eco	7/7	700	041M640502	774	NA	NA
Cobalt	Eco	5/7	4.8	041M640502	10	NA	NA
Copper	Eco	6/7	200	041M640502	146	NA	NA
Lead	Eco	7/7	430	041M640502	339	NA	NA
Manganese	Eco	7/7	230	041M641102	260	NA	NA
Mercury	Eco	6/7	0.46	041M641102	0.11	NA	NA
Selenium	Eco	0/7	ND	ND	1.6	NA	NA
Silver	Eco	5/7	4	041M640502	3	NA	NA
Vanadium	Eco	7/7	37	041M641102	57	NA	NA
Zinc	Eco	6/7	380	041M640502	330	NA	NA
4,4'-DDD	HHRA	1/7	0.1	041M640602	1.4	NA	NA
4,4'-DDE	HHRA	4/7	0.043	041M640202	0.37	NA	NA
4,4'-DDT	HHRA	0/7	ND	ND	0.37	NA	NA
Aldrin	HHRA	0/7	ND	ND	0.03	NA	NA
Alpha-BHC	HHRA	0/7	ND	ND	0.08	NA	NA
Alpha-Chlordane	HHRA	0/7	ND	ND	0.58	NA	NA
Aroclor-1254	HHRA	0/7	ND	ND	0.16	NA	NA
Aroclor-1260	HHRA	0/7	ND	ND	0.82	NA	NA
Delta-BHC	HHRA	5/7	0.0069	041M641102	0.8	NA	NA
Gamma-Chlordane	HHRA	0/7	ND	ND	0.12	NA	NA

Phase II, III, and IV Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Rationale for Elimination as a Final COC
Bis(2-ethylhexyl)phthalate	HHRA/Eco	10/34	3.9	041M640601	69/3.3	No	Recent results<PRG
Carbazole	Eco	5/27	0.8	041M640601	0.8	No	Max result < PRG
Dibenzofuran	Eco	4/34	0.35	041M640601	0.35	No	Max result = PRG
Endosulfan I	Eco	3/34	0.0024	041M640401	0.0029	No	Max result < PRG
Aluminum	Eco	34/34	26,800	041M641601	18000	No	Not site-related
Barium	Eco	34/34	1,280	041M640301	48	No	Recent results<PRG
Beryllium	Eco	18/34	1.3	041M641601 041M641901	0.34	No	Not risk driver and may not be site-related
Cadmium	Eco	31/34	38.6	041M640301	20.2	Yes	
Chromium	Eco	34/34	1,800	041M640301	774	Yes	
Cobalt	Eco	23/34	6.1	041M640301	10	No	Max result < PRG
Copper	Eco	31/34	255	041M640301	146	Yes	
Lead	Eco	33/34	634	041M640301	339	Yes	
Manganese	Eco	34/34	230	041M641102	260	No	Max result < PRG
Mercury	Eco	23/34	0.88	041M640301	0.11	No	Not risk driver and may not be site-related
Selenium	Eco	14/34	3.1	041M640301	1.6	No	Not risk driver and may not be site-related
Silver	Eco	12/34	5.1	041M640301	3	Yes	
Vanadium	Eco	32/34	43.4	041M641601	57	No	Max result < PRG
Zinc	Eco	32/34	481	041M640301	330	Yes	
4,4'-DDD	HHRA	18/34	0.14	041M640201	1.4	No	Max result < PRG
4,4'-DDE	HHRA	21/34	0.089	041M640401	0.37	No	Max result < PRG
4,4'-DDT	HHRA	8/34	0.019	041M640601	0.37	No	Max result < PRG
Aldrin	HHRA	6/34	0.004	041M640301	0.03	No	Max result < PRG
Alpha-BHC	HHRA	9/34	0.00094	041M641401	0.08	No	Max result < PRG
Alpha-Chlordane	HHRA	6/34	0.01	041M640301	0.58	No	Max result < PRG
Aroclor-1254	HHRA	8/34	0.37	041M640201	0.16	No	Max result < PRG
Aroclor-1260	HHRA	15/34	0.3	041M640401	0.82	No	Max result < PRG
Delta-BHC	HHRA	7/34	0.0069	041M641102	0.80	No	Max result < PRG
Gamma-Chlordane	HHRA	5/34	0.0085	041M640301	0.12	No	Max result < PRG

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC. If the chemical was both a human health and ecological COC, the lower of the two PRGs are presented.

NA - Not applicable

ND - Not detected

TOC - Total organic carbon

COC - Chemical of concern

TABLE 22

TOTAL ORGANIC CARBON AND GRAIN SIZE IN WETLANDS
SITE 41 WETLANDS
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland 3 and Wetland 5A

Wetland	Investigation	Sample	TOC (%)	Grain size					Description
				Fine gravel	Coarse sand	Medium sand	Fine sand	Silt and Clay	
Wetand 3	Phase II	001M000301	NA	NA	NA	NA	NA	NA	NA
		001M000302	NA	NA	NA	NA	NA	NA	NA
		001M000303	NA	NA	NA	NA	NA	NA	NA
		041M030101	0.815	6	3	12	71	8	Brown silty medium to fine sand
		041M030201	24.1	0	0	6	11	83	Black sandy organic silt
		041M030301	5.18	0	0	29	59	12	dark brown silty sand with organics
		041M030401	0.0478	0	0	30	65	5	brown medium to fine sand with silt
		041M030501	1.08	0	0	46	23	31	dark brown silty sand with organics
		041M030601	0.672	0	0	32	63	5	brown medium to fine sand with silt, organics
		041M030701	7.39	0	21	38	19	22	black silty sand with organics
	Phase III	041M030201	10	4.2	4.7	27.4	30.8	32.9	Poorly graded fine sands
		041M030701	1.2	1.9	0.9	16.9	66.3	14	Poorly graded fine sands
Wetland 5A	Phase II	041M5A0101	25.4	0	6	21	52	21	dark brown silty fine sand with organics
		041M5A0201	3.75	1	1	38	58	2	dark brown medium to fine sand with organics
		041M5A0301	9.97	0	1	11	51	37	dark brown silty fine sand with organics
		041M5A0401	40.9	0	0	36	30	34	dark brown silty fine sand with organics
		041M5A0501	15.3	0	0	22	28	50	dark brown sandy silt with organics
		041M5A0601	0.642	0	1	30	67	2	brown poorly graded sand with little organics
		041M5A0701	0.21	0	4	40	56	0	gray medium sand with some organics, shells
	Phase III	041M5A0401	0.7	0.3	0.4	18.9	75.9	4.5	fine sand to very fine silt and clay
		041M5A0501	0.74	1.2	1.4	21.7	70.7	5	fine sand to very fine silt and clay
		041M5A0601	1	2	0.8	19.4	74.1	3.7	fine sand to very fine silt and clay

Wetland 16 and Wetland 18B

Wetland	Investigation	Sample	TOC (%)	Grain size					Description
				Fine gravel	Coarse sand	Medium sand	Fine sand	Silt and Clay	
Wetand 16	Phase II	041M160101	0.144	0	0	34	64	2	brown poorly graded sand, medium to fine
		041M160201	1.26	0	0	27	60	13	black silty sand with organics
		041M160301	5.53	0	0	4	41	55	black sandy organic silt
	Phase III	041M160301	1.7	0	0	9.8	58	32.2	fine sand to very fine silt and clay
Wetland 18B	Phase II	041M18B101	18.8	0	0	6	36	58	black sandy organic silt
	Phase III	041M18B101	0.9	9.4	3.6	17.1	42.6	27.3	fine sand to very fine silt and clay

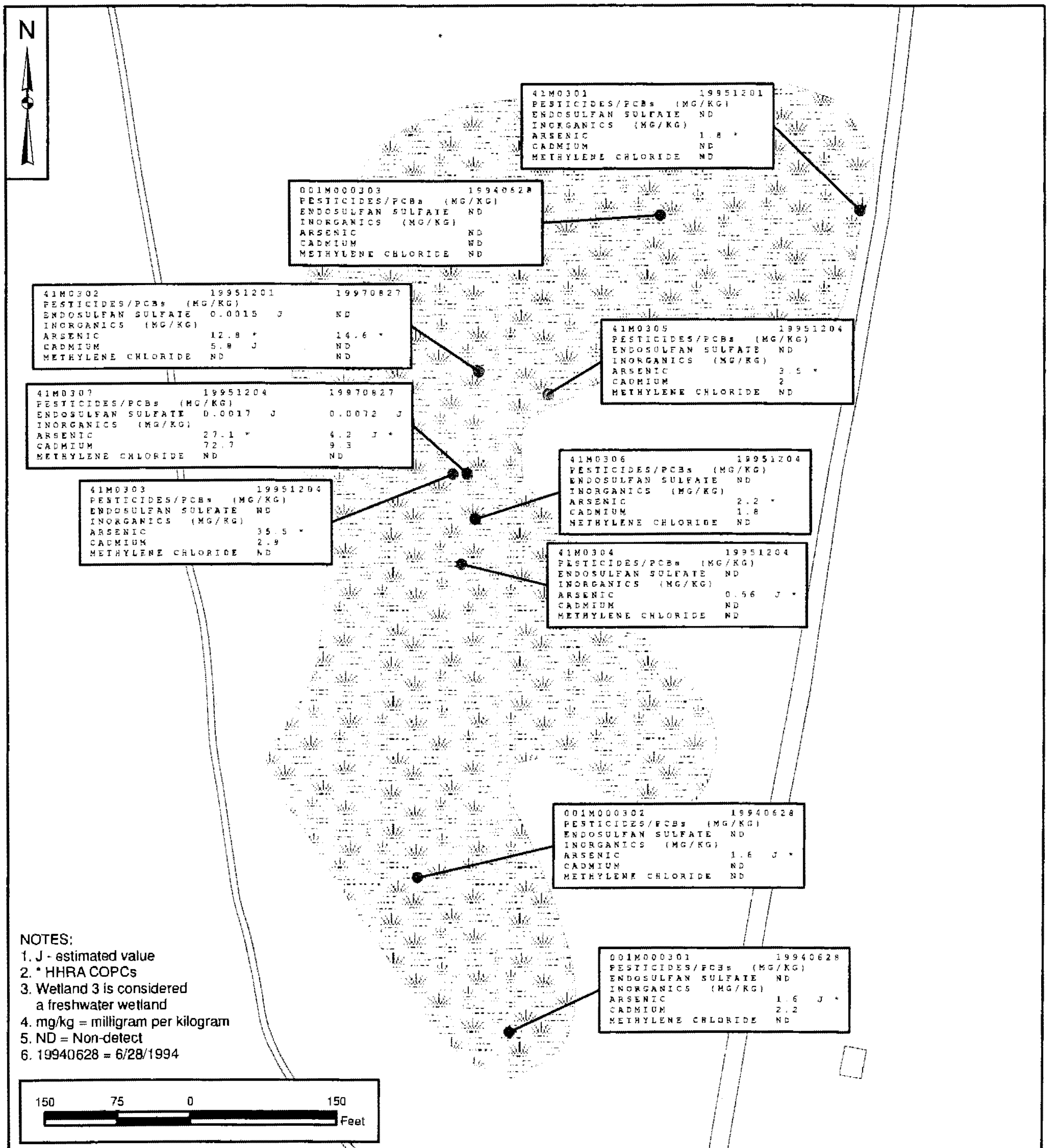
NA - Not available

TOC - Total Organic Carbon

TABLE 23

REFINED LIST OF CHEMICALS OF CONCERN FOR EVALUATION IN THE FEASIBILITY STUDY
SITE 41 WETLANDS
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland	Saltwater/Freshwater	Ecological COCs	Human Health COCs
3	Freshwater	Cadmium	Arsenic
5A	Freshwater	Copper Lead Zinc	None
15	Saltwater	Arsenic Manganese Selenium	Arsenic
16	Saltwater	None	None
18A	Freshwater	None	Arsenic
18B	Saltwater	Arsenic	Arsenic
48	Freshwater	4,4'-DDD 4,4'-DDE 4,4'-DDT Total DDT	None
64	Saltwater	Cadmium Chromium Copper Lead Silver Zinc	None



NAVFAC
Naval Facilities Engineering Command

Figure 1
Wetland 3
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

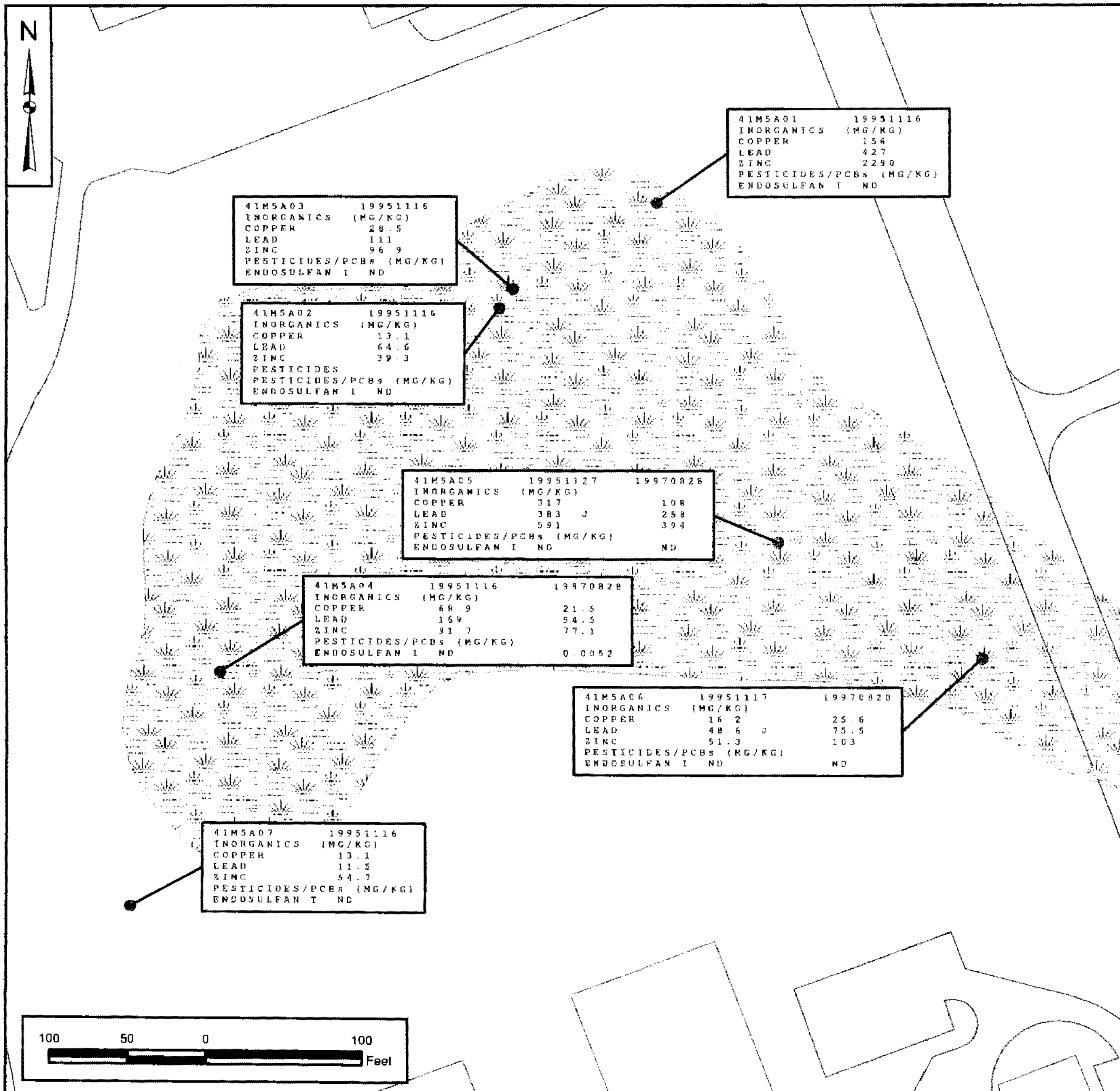
- ● Sample Location
- —— Road
- ☐ Building
- Wetland

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

P:\GIS\PENSACOLA_NAS\MXD\WETLAND03_COPC_TAG.MXD 11/23/09 KM



NAVFAC
Naval Facilities Engineering Command

Figure 2
Wetland 5A
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Building
- Wetland

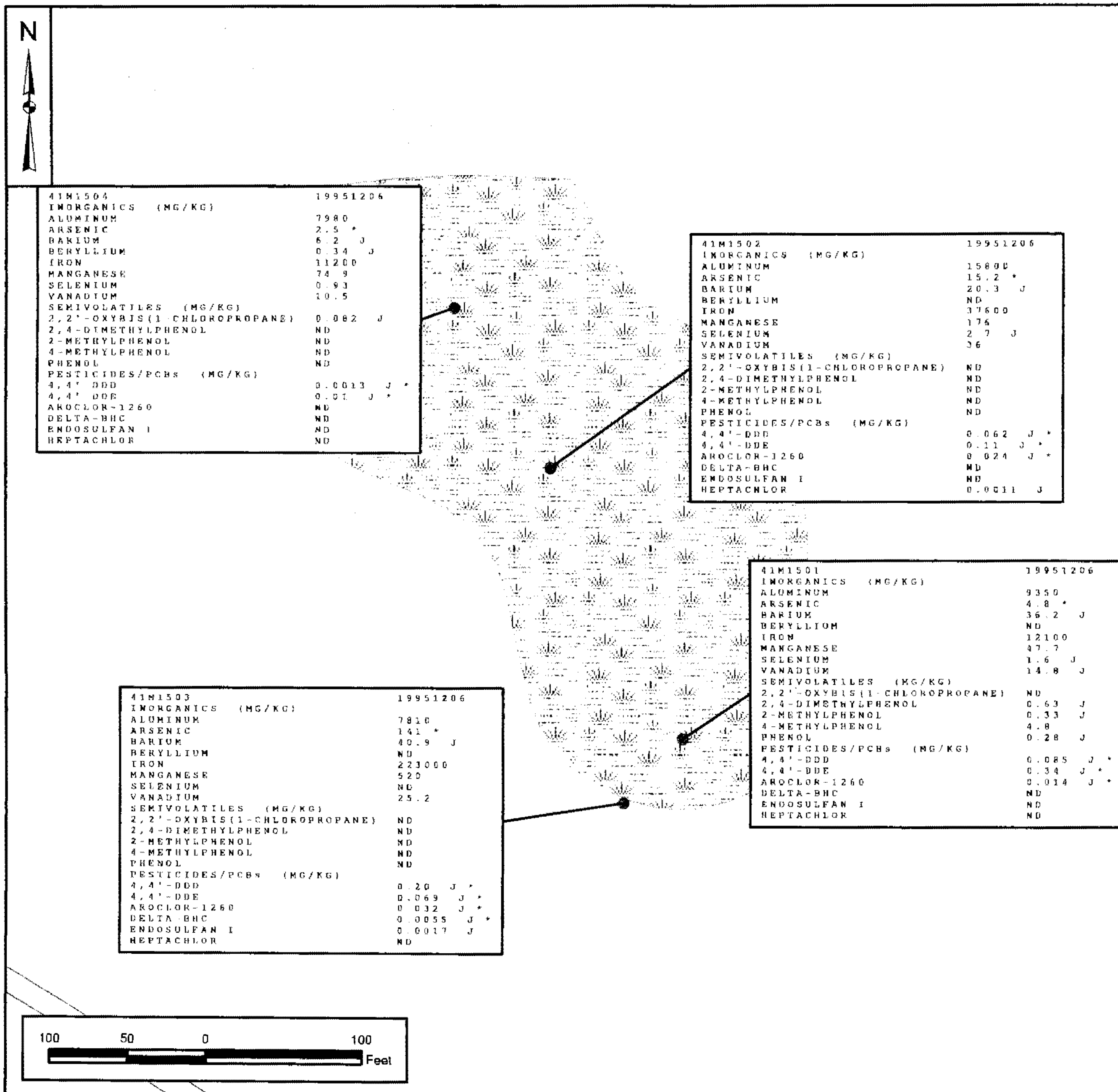
NOTES:
1. J - estimated value
2. Wetland 5A is considered a freshwater wetland
3. mg/kg = milligram per kilogram
4. ND = Non-detect
5. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

P:\GIS\PENSACOLA_NAS\MXD\WETLAND5A_COPC_TAG.MXD 11/23/09 KM



41M1504	19951206
INORGANICS (MG/KG)	
ALUMINUM	7980
ARSENIC	2.5 *
BARIUM	6.2 J
BERYLLIUM	0.34 J
IRON	11200
MANGANESE	74 9
SELENIUM	0.93
VANADIUM	10.5
SEMIVOLATILES (MG/KG)	
2,2'-OXYBIS(1 CHLOROPROPANE)	0.082 J
2,4-DIMETHYLPHENOL	ND
2-METHYLPHENOL	ND
4-METHYLPHENOL	ND
PHENOL	ND
PESTICIDES/PCBs (MG/KG)	
4,4' DDD	0.0013 J *
4,4' DDE	0.01 J *
AROCLOR-1260	ND
DELTA-BHC	ND
ENDOSULFAN I	ND
HEPTACHLOR	ND

41M1502	19951206
INORGANICS (MG/KG)	
ALUMINUM	15800
ARSENIC	15.2 *
BARIUM	20.3 J
BERYLLIUM	ND
IRON	37600
MANGANESE	176
SELENIUM	2 7 J
VANADIUM	36
SEMIVOLATILES (MG/KG)	
2,2'-OXYBIS(1-CHLOROPROPANE)	ND
2,4-DIMETHYLPHENOL	ND
2-METHYLPHENOL	ND
4-METHYLPHENOL	ND
PHENOL	ND
PESTICIDES/PCBs (MG/KG)	
4,4'-DDD	0.062 J *
4,4'-DDE	0.11 J *
AROCLOR-1260	0 024 J *
DELTA-BHC	ND
ENDOSULFAN I	ND
HEPTACHLOR	0.0011 J

41M1501	19951206
INORGANICS (MG/KG)	
ALUMINUM	9350
ARSENIC	4.8 *
BARIUM	36.2 J
BERYLLIUM	ND
IRON	12100
MANGANESE	47.7
SELENIUM	1.6 J
VANADIUM	14.8 J
SEMIVOLATILES (MG/KG)	
2,2'-OXYBIS(1-CHLOROPROPANE)	ND
2,4-DIMETHYLPHENOL	0.63 J
2-METHYLPHENOL	0.33 J
4-METHYLPHENOL	4.8
PHENOL	0.28 J
PESTICIDES/PCBs (MG/KG)	
4,4'-DDD	0.085 J *
4,4'-DDE	0.34 J *
AROCLOR-1260	0.014 J *
DELTA-BHC	ND
ENDOSULFAN I	ND
HEPTACHLOR	ND

41M1503	19951206
INORGANICS (MG/KG)	
ALUMINUM	7810
ARSENIC	141 *
BARIUM	40.9 J
BERYLLIUM	ND
IRON	223000
MANGANESE	520
SELENIUM	ND
VANADIUM	25.2
SEMIVOLATILES (MG/KG)	
2,2'-OXYBIS(1-CHLOROPROPANE)	ND
2,4-DIMETHYLPHENOL	ND
2-METHYLPHENOL	ND
4-METHYLPHENOL	ND
PHENOL	ND
PESTICIDES/PCBs (MG/KG)	
4,4'-DDD	0.20 J *
4,4'-DDE	0.069 J *
AROCLOR-1260	0 032 J *
DELTA-BHC	0.0055 J *
ENDOSULFAN I	0.0017 J
HEPTACHLOR	ND

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Figure 3
Wetland 15
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

- TAG15 Events
- Road
- Building
- Wetland
- Water

NOTES:
1. J - estimated value
2. * HHRA COPCs
3. Wetland 15 is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. ND = Non-detect
6. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

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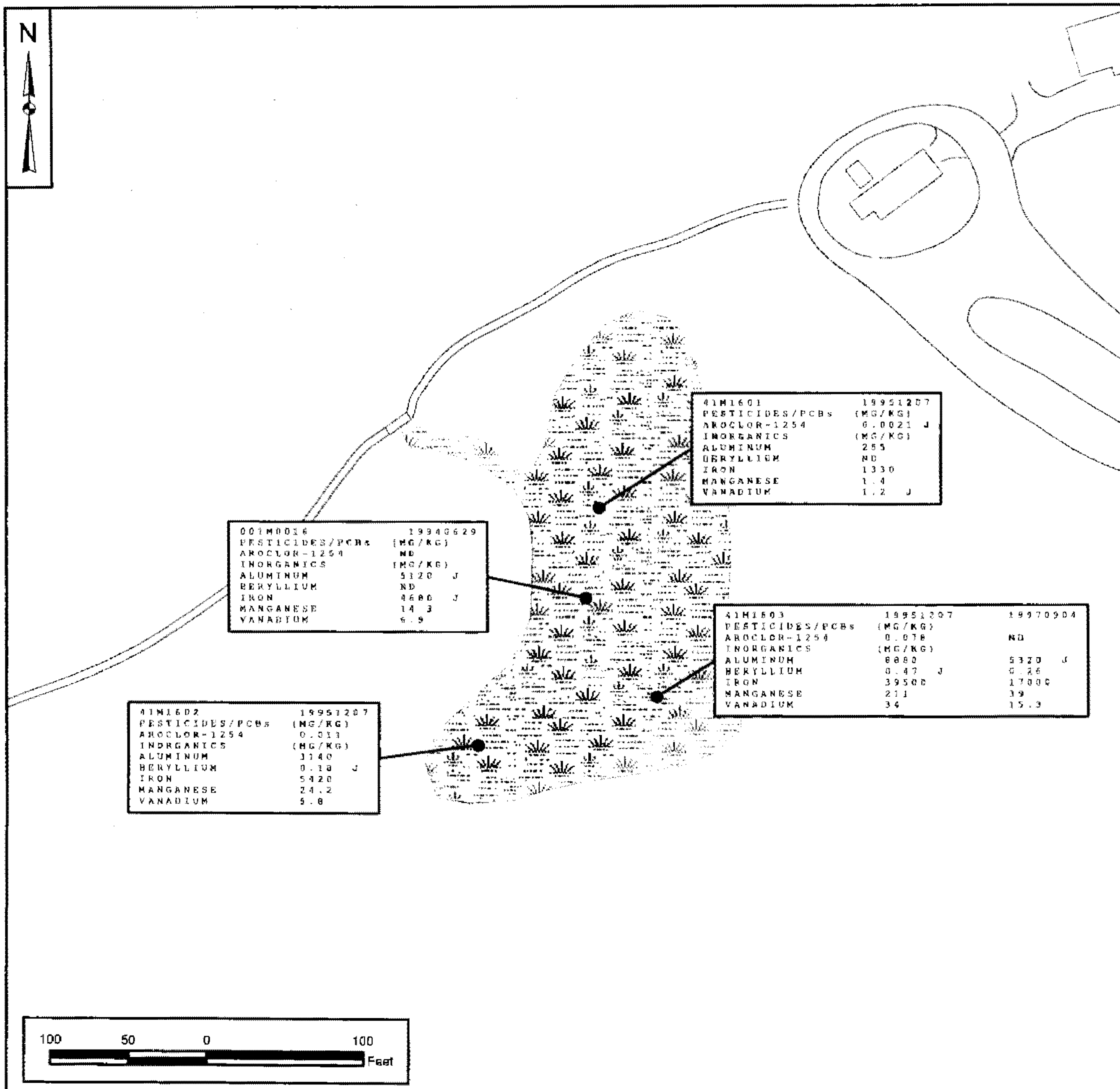

41M1601	19951207
PESTICIDES/PCBs	(MG/KG)
AROCLOR-1254	0.0021 J
INORGANICS	(MG/KG)
ALUMINUM	255
BERYLLIUM	ND
IRON	1330
MANGANESE	1.4
VANADIUM	1.2 J

001M0016	19940629
PESTICIDES/PCBs	(MG/KG)
AROCLOR-1254	ND
INORGANICS	(MG/KG)
ALUMINUM	5120 J
BERYLLIUM	ND
IRON	4680 J
MANGANESE	14.3
VANADIUM	6.9

41M1603	19951207	19970904
PESTICIDES/PCBs	(MG/KG)	
AROCLOR-1254	0.078	ND
INORGANICS	(MG/KG)	
ALUMINUM	6880	5320 J
BERYLLIUM	0.47 J	0.26
IRON	39500	17000
MANGANESE	211	39
VANADIUM	34	15.3

41M1602	19951207
PESTICIDES/PCBs	(MG/KG)
AROCLOR-1254	0.031
INORGANICS	(MG/KG)
ALUMINUM	3140
BERYLLIUM	0.18 J
IRON	5420
MANGANESE	24.2
VANADIUM	5.8

NAVFAC

Figure 4
Wetland 16
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Building
- Wetland
- Water

NOTES:
1. J - estimated value
2. Wetland 16 is considered a saltwater wetland
3. mg/kg = milligram per kilogram
4. ND = Non-detect
5. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

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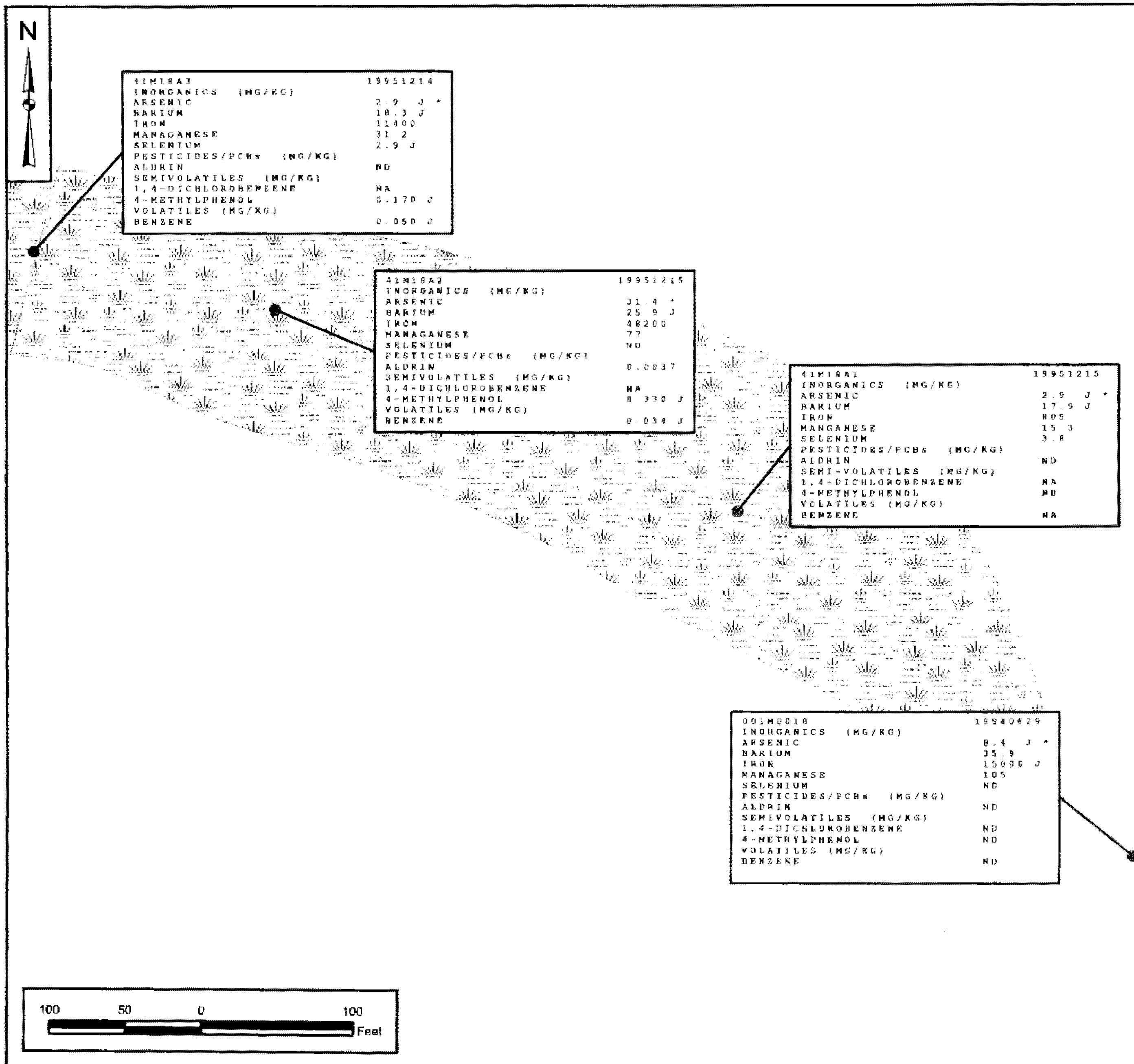

NAVFAC
Naval Facilities Engineering Command

Figure 5
Wetland 18A
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

● Sample Location

Wetland

NOTES:
1. J - estimated value
2. * HHRA COPCs
3. Wetland 18A is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. ND = Non-detect
6. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

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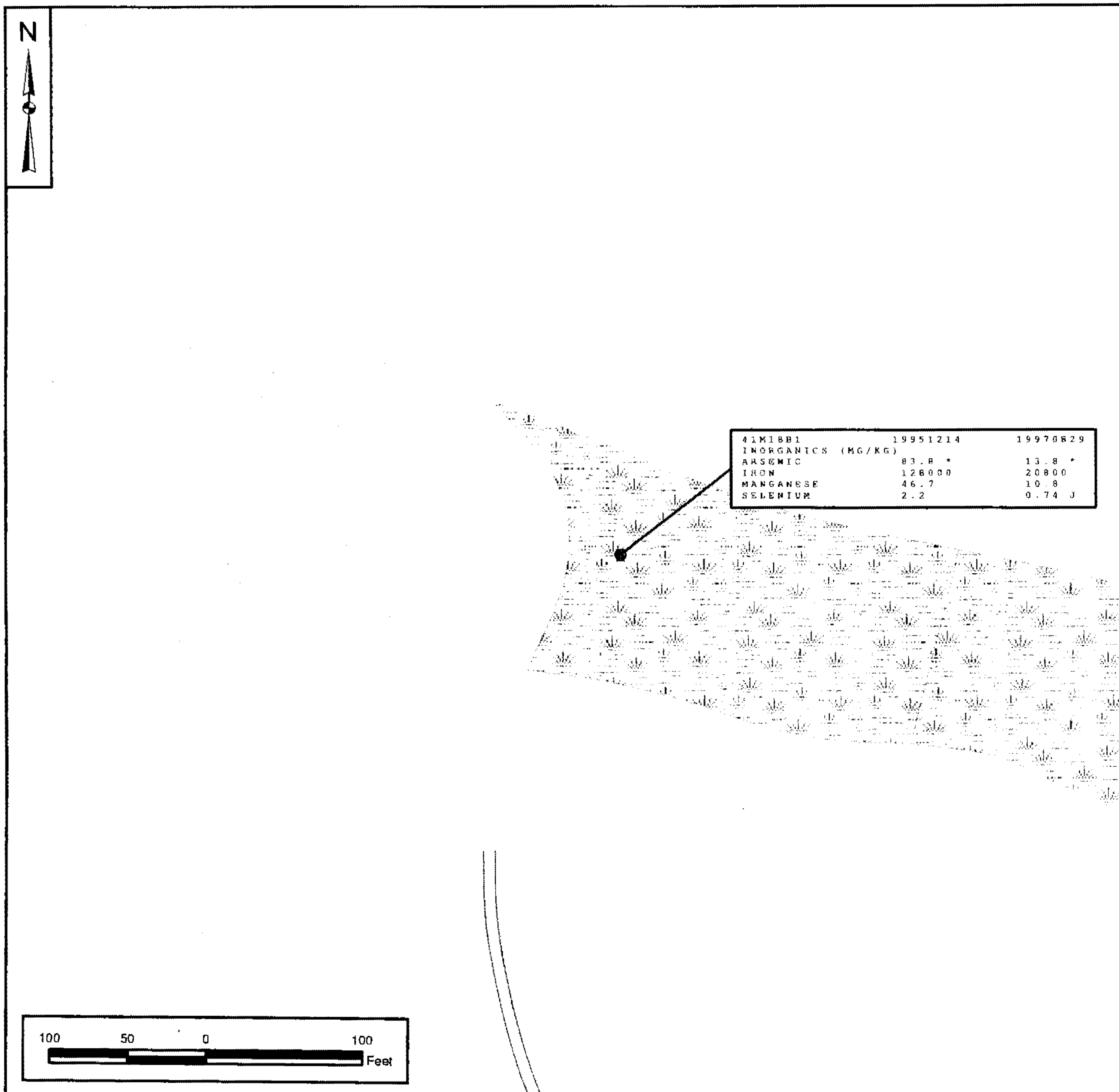

NAVFAC

Figure 6
Wetland 18B
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Building
- Wetland
- Water

NOTES:
1. J - estimated value
2. * HHRA COPCs
3. Wetland 18B is considered a saltwater wetland
4. mg/kg = milligram per kilogram
5. ND = Non-detect
6. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

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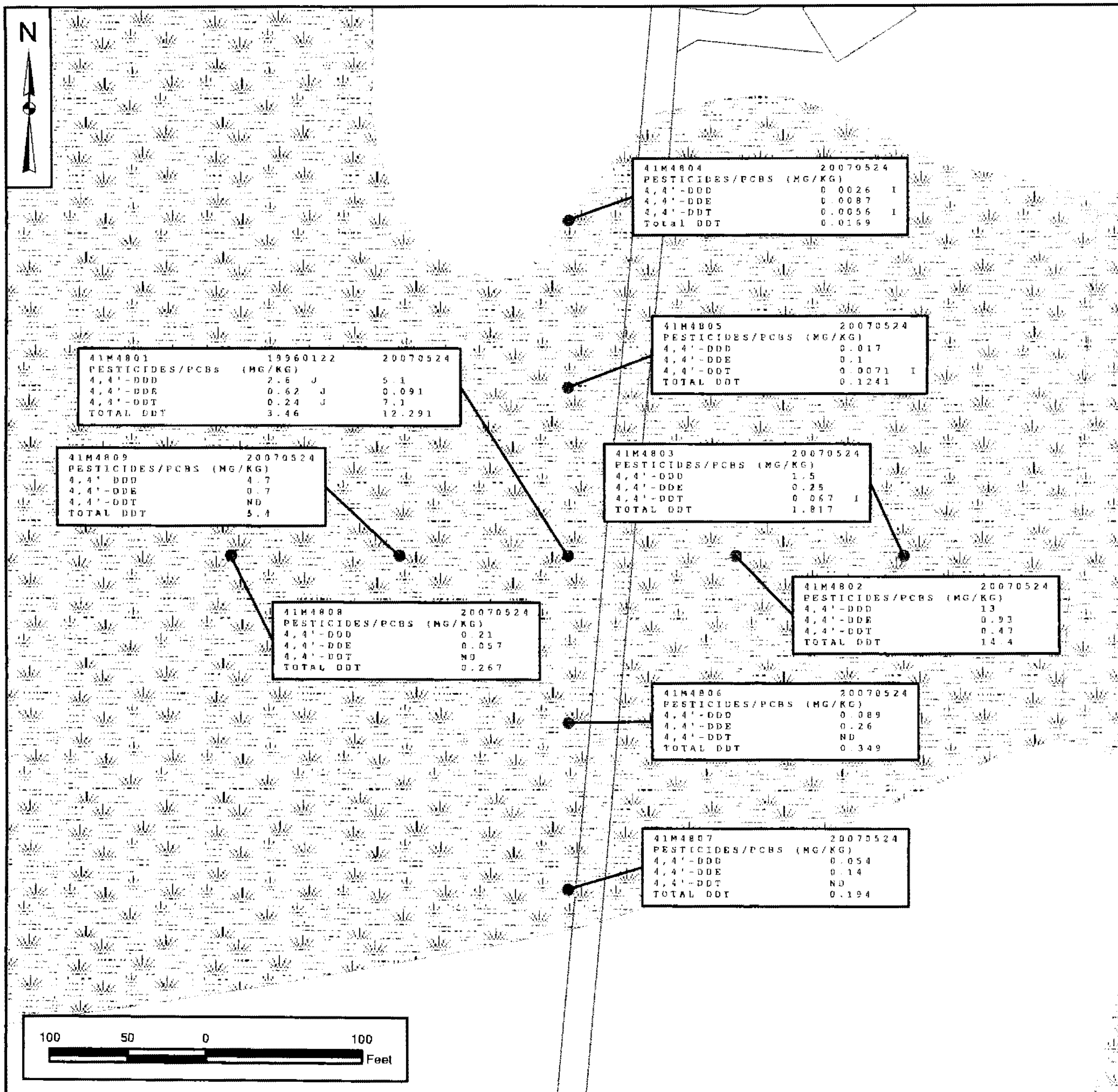

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Naval Facilities Engineering Command

Figure 7
Wetland 48
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Building
- Wetland

NOTES:
1. Wetland 48 is considered a freshwater wetland
2. mg/kg = milligram per kilogram
3. ND = Non-detect
4. 19940628 = 6/28/1994

TETRA TECH

Drawn By: K. MOORE 11/23/09
Checked By: N. ROCHNA 11/23/09
Approved By:

Contract Number: 112G00390
CTO 030

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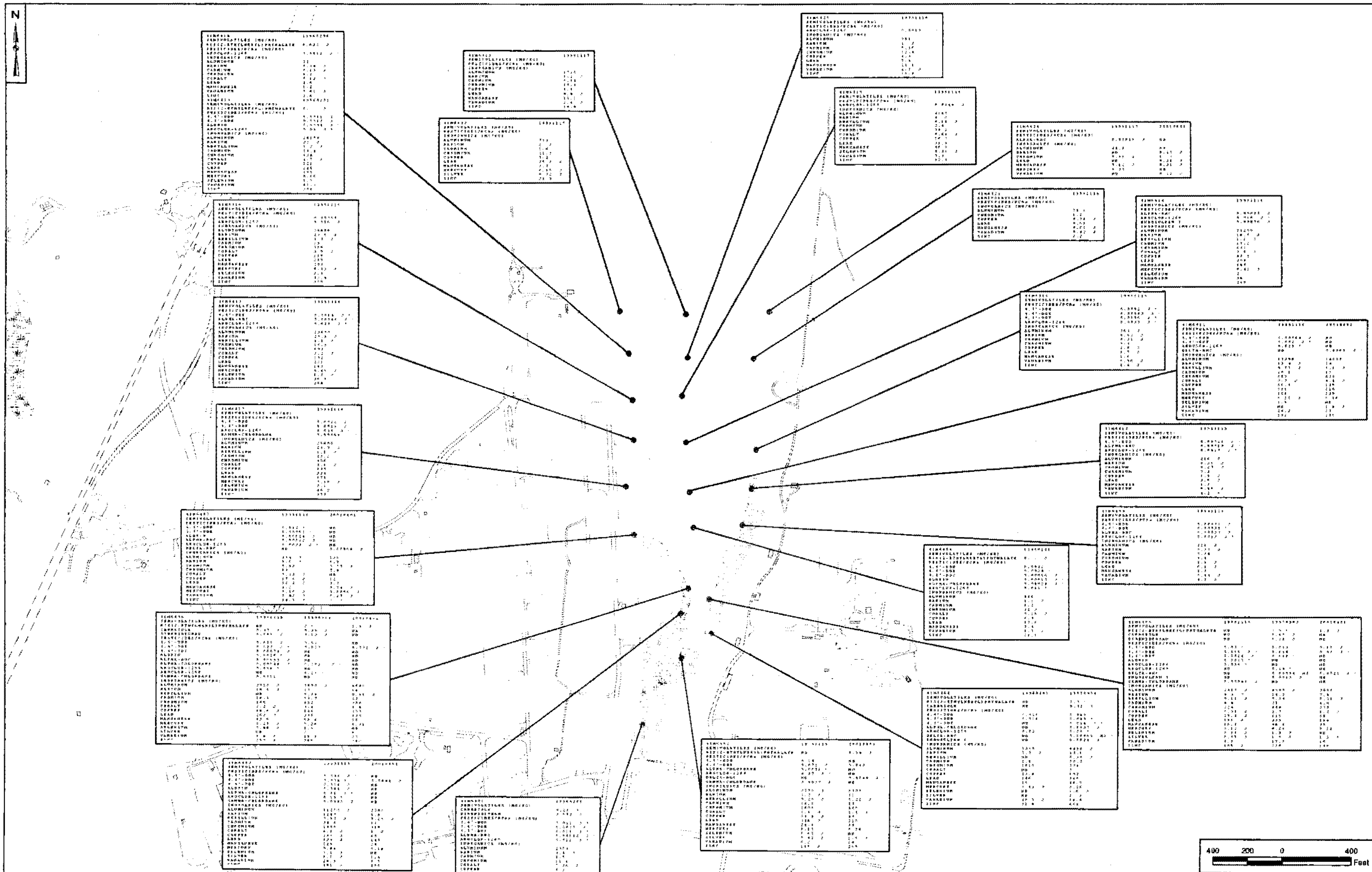

NAVFAC

TETRA TECH

Figure 8
Wetland 64
COPCs in Sediment
Site 41
NAS Pensacola
Pensacola, Florida

Legend

- Sample Location
- Road
- Building
- Wetland
- Water

NOTES:
1. J - estimated value
2. * HHRA COPCs
3. Wetland 64 considered a saltwater wetland

Drawn By: K. MOORE 7/22/09
Checked By: N. ROCHNA 7/30/09
Approved By:

Contract Number: 112G00390
CTO 030

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ATTACHMENT A

REVISED TABLE 16.1 FROM THE REMEDIAL INVESTIGATION

Table 16-1
Weight of Evidence

OU/Group	Wetland	Total Sediment Samples Locations	Phase Summarized	Eco Sediment COPCs Retained After Refinement	Max Refinement HQs > 1	Sample Locations Exceeding BV	ERM Quotient Categories	Exceeds TEC normalized PAH value	Exceeds Site-wide DDT level	Stat Sig Acute Tox	Stat Sig Sublethal Tox	Location of Tox Results	FCM Results	VOC Exceeds SQG	HHRA COCs	Recommendation	Identification of Risk Drivers Based on Lines of Evidence Analysis for Wetlands Recommended for FS	Rationale
											PHASE III/PHASE IV							
1	3	2	III	Barium	No	NA		No PAHs Detected	No	No	Yes - Growth	041M0310701		None	Arsenic	FS		Section 4 of the RI identifies this wetland as a Red-coded wetland included in Group B.
				Cadmium	2.2	041M0310701	Cat. 1 0								Petroleum Chloride		Cadmium	
				Iron	No	NA	Cat. 2 2											FS should be focused on determining if toxicity is related to constituents related to Site 1 Landfill.
				Manganese	No	NA	Cat. 3 0											
				Selenium	No	NA	Cat. 4 0											
				Endosulfan sulfate	No	NA											Endosulfan Sulfate	
				Total Endrin	No	NA							Total Endrin FCM Max. NOAEL HQ<1					
				Carbon Disulfide	No	NA												
	16	1	III	Aluminum	No	NA		Exceeds TEC; Less than MEC	No	No	No	NA		None	Aroclor 1254	FS	Aluminum	Section 4 of the RI identifies this wetland as a Red-coded wetland included in Group C. Wetland 16 served as one representative wetlands identified to represent all wetlands in Group C.
				Barium	No	NA												
				Beryllium	No	NA	Cat. 1 0										Beryllium	
				Iron	No	NA	Cat. 2 1										Iron	
				Manganese	No	NA	Cat. 3 0										Manganese	Because the Phase II/III sediment chemistry results were variable, uncertainty related to the Phase III toxicity results is high. Therefore, this wetland is recommended for an FS. FS should focus on determining if potential toxicity from metals is related to Site 1 landfill. Based on Phase II results, lead, silver and zinc should also be evaluated for toxicity.
				Selenium	No	NA	Cat. 4 0											
				Vanadium	No	NA											Vanadium	
				Endrin	No	NA												
				Total Endrin	No	NA							Total Endrin FCM Max. NOAEL HQ<1					
	16B	1	III					No PAHs Detected	Yes	No	No	NA				FS		Section 4 of the RI identifies this wetland as a Red-coded wetland included in group C. Wetland 16 served as one representative wetlands identified to represent all wetlands in Group C.
				Iron	No	NA								None	Arsenic		Iron	
				Manganese	No	NA	Cat. 1 0										Manganese	
				Selenium	No	NA	Cat. 2 1										Selenium	
							Cat. 3 0						Total DDT FCM Max. NOAEL HQ <1					Because the Phase II/III sediment chemistry results were variable, uncertainty related to the Phase III toxicity results is high. Therefore, this wetland is recommended for an FS. FS should focus on determining if potential toxicity from metals is related to Site 1 landfill. Based on Phase II data, aluminum, arsenic, barium, beryllium, cyanide and vanadium should also be evaluated for
				4,4'-DDT	23.1	041M16B101	Cat. 4 0											
				Total DDT	2.9	041M16B101												
2	5A	3	III					Exceeds TEC; Less than MEC	Yes	No	Yes - Weight	041M5A0505 041M5A0506				FS		
				Antimony	No	NA								None	None			
				Barium	No	NA												
				Copper	1	041M5A0501											Copper	
				Lead	2.3	041M5A0501											Lead	
				Zinc	1.5	041M5A0501	Cat. 1 0										Zinc	
							Cat. 2 3											
				Endosulfan I	No	NA	Cat. 3 0						Total Chlordane FCM Max NOAEL				Endosulfan I	
				Endosulfan sulfate	No	NA	Cat. 4 0											
				gamma-Chlordane	1.65	041M5A0401												
				Total Chlordane	2.59	041M5A0401							Total Endrin FCM Max. NOAEL HQ<1					
				Endrin	No	NA												
				Total Endrin	No	NA												
				Total BHC	4.18	041M5A0401							Total BHC FCM Max. NOAEL HQ<1					
				4,4'-DDD	12.8	041M5A0401												
				4,4'-DDT	1.51	041M5A0401							Total DDT FCM Max. NOAEL HQ<1					
				Total DDT	5.18	041M5A0401												
	5B	5	IV					No	Yes	No	No	NA		None	N-Nitroso-di-n-propylamine	NFA	None	Section 4 of the RI report identifies this wetland as a Red-coded wetland included in Group D.
				Barium	No	NA									Pyrene			
				Cadmium	7.4	041M5B1202 041M5B0601									Trichloroethene			Phase IV site specific toxicity tests do not indicate constituents present are causing adverse acute or chronic effects on benthic macroinvertebrates. Phase IV constituent levels do not warrant further investigation.
				Chromium	2.9	041M5B1202	Cat. 1 2											
				Cobalt	No	NA	Cat. 2 3											
				Lead	3.8	041M5B0202	Cat. 3 0											
				Silver	3.6	041M5B0202	Cat. 4 0						Total PCBs FCM Max. NOAEL HQ<1					
				Total PCBs	1.1	041M5B0601												
				Dieldrin	23.3	041M5B0601 041M5B0202 041M5B0301 041M5B0401 041M5B0601							Dieldrin FCM Max. NOAEL HQ<1					
				beta-BHC	2.9	041M5B0601												
				Total BHC	3.5	041M5B0601							Total BHC FCM Max. NOAEL HQ<1					
				3-Methylphenol/4-Methylphenol	No	NA												
				Vinyl Chloride	No	NA												

Table 16-1
Weight of Evidence

OU/Group	Wetland	Total Sediment Samples Locations	Phase Summarized	Eco Sediment COPCs Retained After Refinement	Max Refinement HQs > 1	Sample Locations Exceeding RV	PAH Quotient Categories	Exceeds TOC normalized PAH value	Exceeds Site-wide DDT level	Stat Sig Acute Tox	Stat Sig Sublethal Tox	Location of Tox Results	FCM Results	VOC Exceeds SQG	HHRA COCs	Recommendation	Justification of Risk Drivers Based on Lines of Evidence Analysis for Wetlands Recommended for FS	Rationale
	64	3	III					Less than TEC	Yes	Yes	Yes - Weight	041M6404 (Acute) 041M6405 (Acute) 041M6405 (Weight)		None	4,4'-DDE	FS	Aluminum	Section 4 of the RI identifies this wetland as a Red-coded wetland included as Group A. The FS for Wetland 64 should focus on 1) direct toxicity to benthic invertebrates in the proximity of sample IDs 041M6404, 041M6405 and 041M6406; and 2) uptake of mercury in predatory fish.
				Aluminum	No	NA									4,4'-DDD		Barium	
				Barium	No	NA	Cat. 1 0								4,4'-DDT		Beryllium	
				Beryllium	No	NA	Cat. 2 0								Aldrin		Cadmium	
				Cadmium	5	041M640601 041M640401 041M640501	Cat. 3 2								alpha-BHC		Chromium	
				Chromium	5.4	041M640601 041M640401 041M640502	Cat. 4 1								delta-BHC		Cobalt	
				Cobalt	No	NA									alpha-Chlordane		Copper	
				Copper	1.4	041M640501 041M640601									Aroclor 1254			
				Iron	No	NA									Aroclor 1260		Lead	
				Lead	3.1	041M640401 041M640601 041M640501									gamma-Chlordane		Manganese	
				Manganese	No	NA									BEHP		Mercury uptake in predatory fi	
				Selenium	No	NA											Selenium	
				Silver	1.7	041M640501 041M640401 041M640601							Mercury FCM Max. and Avg. NOAEL HQ > 1				Silver	
				Vanadium	No	NA											Vanadium	
				Zinc	1.7	041M640401 041M640601 041M640501											Zinc	
																	Endosulfan I	
				Aroclor-1260	1.6	041M640401 041M640501							Total PCBs FCM Max. NOAEL HQ<1					
				Total PCBs	6.5	041M640401 041M640501 041M640601											bis(2-Ethylhexyl)phthalate (	
				Dieldrin	4.7	041M640401 041M640501 041M640601							Total Dieldrin FCM Max. NADEL HQ<1				Carbazole Dibenzofuran	
				Endosulfan I														
				Total Chlordane	2.4	041M640401							Total Chlordane FCM Max. NOAEL HQ<1					
				Total BHC	21.9	041M640401 041M640601												
				4,4'-DDD	11.4	041M640401 041M640601 041M640501												
				Total DDT	3.8	041M640401 041M640501 041M640601							Total DDT FCM Max. NOAEL HQ<1					
				bis(2-Ethylhexyl)phthalate (BEHP)	1.6	041M640601 041M640401							Total BHC FCM Max. NOAEL HQ<1					
				Carbazole	No	NA												
				Dibenzofuran	No	NA												
											PHASE II							
1	1A	3	II					No PAHs Detected	No	Not Collected	Not Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as an Orange-coded wetland included in Group O. Constituent levels in this wetland do not warrant further investigation.
				Aluminum	No	NA	Cat. 1 0						Dieldrin FCM Max NOAEL HQ =1.2					
				Barium	No	NA	Cat. 2 3											
				Vanadium	No	NA	Cat. 3 0 Cat. 4 0						Dieldrin FCM Avg NOAEL HQ < 1					
				Dieldrin	1.6	041M010201												
	1B	2	II					Greater than TEC; less than MEC	No	Not Collected	Not Collected	NA				NFA		Section 4 of the RI identifies this wetland as an Orange-coded wetland included in Group O. This wetland is permitted under the base NPDES permit and should be regulated under that program.
				Barium	No	NA								None	Benzo(a)pyrene Benzo(b)fluoranthene		N/A	
				Lead	1.4	041M010401	Cat. 1 0											
				Zinc	1.1	041M010401	Cat. 2 1 Cat. 3 1											
				Endosulfan sulfate	No	NA	Cat. 4 0											
				Methoxychlor	No	NA												
				alpha-Chlordane	1.3	041M010401							Total Chlordane FCM Max. NOAEL HQ<1					
				gamma-Chlordane	2	041M010401												
				Total Chlordane	3.3	041M010401												
				bis(2-Ethylhexyl)phthalate (BEHP)	1.3	041M010401												
				Carbazole	No	NA												

Table 16-1
Weight of Evidence

OU/Group	Wetland	Total Sediment Samples Locations	Phase Summarized	Eco Sediment COPCs Retained After Refinement	Max Refinement HQs > 1	Sample Locations Exceeding RV	ERM Quotient Categories	Exceeds TOC normalized PAH value	Exceeds Site-wide DDT level	Stat Sig Acute Tox	Stat Sig Sublethal Tox	Location of Tox Results	FCM Results	VOC Exceeds SQG	HHRA COCs	Recommendation	Identification of Risk Drivers Based on Lines of Evidence Analysis for Wetlands Recommended for FS	Rationale
	40	5	II					Exceeded TEC; Less than MEC	Yes	Not Collected	Not Collected	NA		None	Arsenic	NFA	N/A	Section 4 of the RI identifies this wetland as a Red-coded wetland included in Group C. During Phase III Wetlands 16 and 18 were sampled to represent all Group C wetlands and results of the Phase III sampling indicate no need for further evaluation.
				Aluminum	No	NA												
				Barium	No	NA												
				Beryllium	No	NA	Cat. 1 2											
				Cobalt	No	NA	Cat. 2 2											
				Iron	No	NA	Cat. 3 1											
				Lead	3.1	041M4D201 041M4D101 041M4D401	Cat. 4 0											
				Manganese	No	NA												
				Selenium	No	NA												
				Vanadium	No	NA												
				Endosulfan sulfate	No	NA												
				delta-BHC	15.2	041M4D101 041M4D401 041M4D201												
				Total BHC	16.7	041M4D101 041M4D401 041M4D201 041M4D301							Total BHC FCM Max. NOAEL HQ<1					
				4,4'-DDD	14.1	041M4D401 041M4D101 041M4D201												
				Total DDT	3.5	041M4D401 041M4D101							Total DDT FCM Max NOAEL HQ = 9.7					
				Diethylphthalate	26.8	041M4D401							Total DDT FCM Avg NOAEL HQ < 1					
				Carbon Disulfide	No	NA												
				Carbazole	No	NA												
	15	4	II					Less than TEC	Yes	Not Collected	Not Collected	NA		None	Arsenic Aroclor 1260 delta-BHC 4,4'-DDD 4,4'-DDE	FS	Aluminum Arsenic Barium Beryllium Iron Manganese Selenium Vanadium Endosulfan I Heptachlor 2,2'-oxybis(1-Chloroprop 2,4-Dimethylphenol 2-Methylphenol (o-Cresol) 4-Methylphenol (p-Cresol) Phenol	Section 4 of the RI identifies this wetland as a Orange-coded wetland included in Group C. Because the Phase II/III sediment chemistry results were variable, uncertainty related to the Phase III toxicity results is high. Therefore, this wetland is recommended for an FS. The FS should focus on determining if the potential toxicity of metals is related to the landfill.
				Aluminum	No	NA												
				Arsenic	3.4	041M15D301												
				Barium	No	NA	Cat. 1 0											
				Beryllium	No	NA	Cat. 2 3											
				Cobalt	No	NA	Cat. 3 1											
				Iron	No	NA	Cat. 4 0											
				Lead	1.9	041M15D201												
				Manganese	No	NA												
				Selenium	No	NA												
				Vanadium	No	NA												
				Endosulfan I	No	NA												
				Heptachlor	No	NA												
				Endrin	No	NA												
				Endrin aldehyde	No	NA												
				Endrin ketone	No	NA												
				Total Endrin	No	NA							Total Endrin FCM Max. NOAEL HQ<1					
				beta-BHC	1.4	041M15D201												
				delta-BHC	5.6	041M15D301												
				Total BHC	6.5	041M15D301 041M15D201 041M15D101							Total BHC FCM Max. NOAEL HQ<1					
				4,4'-DDD	25.6	041M15D301 041M15D101 041M15D201												
				Total DDT	8.4	041M15D101 041M15D301 041M15D201							Total DDT FCM Max NOAEL HQ = 9.7					
				2,2'-oxybis(1-Chloropropane)/bis(2-chlor	No	NA							Total DDT FCM Avg NOAEL HQ < 1					
				2,4-Dimethylphenol	No	NA												
				2-Methylphenol (o-Cresol)	No	NA												
				4-Methylphenol (p-Cresol)	No	NA												
				Phenol	No	NA												
					No	NA												
	17	3	II	None	No	NA	Cat. 1 3 Cat. 2 0 Cat. 3 0 Cat. 4 0	No PAHs Detected	No	Not Collected	Not Collected	NA		None	None	NFA	N/A	Section 4 identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	18A	4	II					Less than TEC	Yes	Not Collected	Not Collected	NA		None	Arsenic Benzene	FS	Barium Iron Manganese Selenium Aldrin 1,4-Dichlorobenzene 4-Methylphenol (p-Cresol)	Section 4 of the RI identifies this wetland as a Red-coded wetland in Group C. During Phase III Wetlands 16 and 18 were sampled to represent all Group C wetlands and results of the Phase III sampling indicate no need for further evaluation.
				Barium	No	NA												
				Iron	No	NA	Cat. 1 0											
				Manganese	No	NA	Cat. 2 3											
				Selenium	No	NA	Cat. 3 1											
							Cat. 4 0											
				Aldrin														
				alpha-Chlordane	2.5	001M1801 041M18A201												
				gamma-Chlordane	2	001M1801												
				Total Chlordane	4.5	001M1801 041M18A201							Total Chlordane FCM Max. NOAEL HQ <1					
				Endrin	No	NA												
				Endrin ketone	No	NA												
				Total Endrin	No	NA							Total Endrin FCM Max. NOAEL HQ<1					
				beta-BHC	1.3	041M18A201												
				Total BHC	3.1	041M18A201												
				4,4'-DDD	119	041M18A101 001M1801							Total BHC FCM Max. NOAEL HQ<1					
				4,4'-DDT	252	041M18A101 041M18A201												
				Total DDT	46.4	041M18A101 041M18A201 001M1801							Total DDT FCM Max NOAEL HQ = 9.7					
				1,4-Dichlorobenzene	No	NA							Total DDT FCM Avg NOAEL HQ <					
				4-Methylphenol (p-Cresol)	No	NA												

Table 16-1
Weight of Evidence

OU/Group	Wetland	Total Sediment Samples Locations	Phase Summarized	Eco Sediment COPCs Retained After Refinement	Max Refinement HQs > 1	Sample Locations Exceeding RV	ERM Quotient Categories	Exceeds TOC normalized PAH value	Exceeds Site-wide DDT level	Stat Sig Acute Tox	Stat Sig Sublethal Tox	Location of Tox Results	FCM Results	VOC Exceeds SQG	WHRA COCs	Recommendation	[illegible] Identification of Risk Drivers Based on Lines of Evidence Analysis for Wetlands Recommended for PS	Rationale
OU3	6	12	II	Barium Cadmium Cobalt Lead Aldrin Dieldrin Heptachlor Endrin Total Endrin beta-BHC Total BHC 4,4'-DDT Total DDT 1,1-Dichloroethane Chloroethane	No 1.3 No 1.1 No 2.3 No No No 2.6 3.4 54.5 7.8 No No	NA 041M060701 NA 041M060701 NA 041M060701 041M060801 041M060601 NA NA NA 041M060301 041M060701 041M060301 041M060701 041M060101 041M060301 010M000101 041M060701 041M060601 041M060101 041M060301 010M000101 041M060701 NA NA	Cat. 1 3 Cat. 2 9 Cat. 3 0 Cat. 4 0	Less than TEC	Yes	None Collected	None Collected	NA	Dieldrin FCM Max. NOAEL HQ<1 Total Endrin FCM Max. NOAEL HQ<1 Total BHC FCM Max. NOAEL HQ<1 Total DDT FCM Max. NOAEL HQ=1.1 Avg. DDT FCM Max. NOAEL HQ < 1	Acetone HQ = 1.4	BEHP	NFA	N/A	Section 4 of the RI identifies this wetland as a Orange-coded wetland included in Group D. Since this wetland functions primarily as a drainage ditch and FCMs indicate acceptable risk levels to receptors, there is no need for further investigation at this wetland.
OU10	10	7	II	Barium Cadmium Chromium Cobalt Lead Manganese Nickel Total PCBs Aldrin Endosulfan I Heptachlor Heptachlor epoxide Endrin Endrin aldehyde Total Endrin Total BHC 4,4'-DDD 4,4'-DDT Total DDT 1,2-Dichlorobenzene 1,4-Dichlorobenzene	No 8.2 7.4 No 1.4 No 1.2 1.1 No No No No No No No 3.6 15.4 10.1 5.1	NA 033M004001 033M004001 NA 033M004001 NA 033M004001 033M002001 NA NA NA NA NA NA NA 033M003001 033M001001 033M002001 033M003001 033M001001 033M002001 033M004001 033M003001 033M004001 033M002001 033M001001 033M003001 033M002001 033M001001	Cat. 1 2 Cat. 2 5 Cat. 3 0 Cat. 4 0	Greater than TEC; Less than MEC	Yes	None Collected	None Collected	NA	Total PCBs FCM Max. NOAEL HQ<1 Total Endrin FCM Max. NOAEL HQ<1 Total BHC FCM Max. NOAEL HQ<1 Total DDT FCM Max. NOAEL HQ =1.06 Avg DDT FCM Max. NOAEL HQ < 1	None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Red-coded wetland included in Group D. A pre-requisite to conducting the PS at this site is to verify the elevated levels of inorganics at location 033M004001 at the mouth of the drainage ditch and the bay. Additional sediment and toxicity sampling conducted at this wetland and reported in the RI Addendum do not support additional action. NFA
	12	2	II	Endosulfan I Endosulfan sulfate Endrin aldehyde Endrin ketone Total Endrin delta-BHC Total BHC	No No No No No 1.1 2.1	NA NA NA NA NA 041M120101 041M120101	Cat. 1 1 Cat. 2 0 Cat. 3 1 Cat. 4 0	Exceeds TEC; Less than MEC	No	None Collected	None Collected	NA	Total Endrin FCM Max. NOAEL HQ<1 Total BHC FCM Max. NOAEL HQ<1	None	None	Pursue under different regulatory program.	N/A	Section 4 of the RI identifies this wetland as a Red-coded wetland. PAH constituents detected; however, currently being investigated under the Florida Petroleum Program. No further investigation required for this RI.

Table 16-1
Weight of Evidence

OU/Group	Wetland	Total Sediment Samples Locations	Phase Summarized	Eco Sediment COPCs Retained After Refinement	Max Refinement HQs > 1	Sample Locations Exceeding RV	ERM Quotient Categories	Exceeds TOC normalized PAH value	Exceeds Site-wide DDT level	Stat Sig Acute Tox	Stat Sig Sublethal Tox	Location of Tox Results	FCM Results	VOC Exceeds SQG	NMRA COCs	Recommendation	Identification of Risk Drivers Based on Lines of Evidence Analysis for Wetlands Recommended for FS	Rationale
	13	1	II	None	No	NA	Cat. 1 1 Cat. 2 0 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
Chevalier Field	63A	5	II	Aluminum Barium Cadmium Iron Manganese Vanadium Aroclor-1260 Total PCBs Endosulfan sulfate	No No 1.8 No No No 1.4 1.5 No	NA NA 041M63A301 NA NA NA 041M63A501 041M63A501 NA	Cat. 1 4 Cat. 2 1 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA	Total PCBs FCM Max. NOAEL HQ<1	None	None	NFA	N/A	Section 4 of the RI identifies this wetland as an Orange-coded wetland included in Group C. During Phase III Wetlands 16 and 18 were sampled to represent all Group C wetlands and results of the Phase III sampling indicate no need for further evaluation.
	63B	4	II	Barium Endosulfan Sulfate Dibenzofuran	No No No	NA NA NA	Cat. 1 3 Cat. 2 2 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
UST 18	52	5	II	Barium Selenium Aldrin Dieldrin Endosulfan I Endosulfan sulfate 4-Methylphenol (p-Cresol) Carbazole Dibenzofuran	No No No 3.21 No No No No No	NA NA NA 041M52A101 NA NA NA NA NA	Cat. 1 3 Cat. 2 2 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA	Dieldrin FCM Max. NOAEL HQ<1	None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	72	2	II	None	No	NA	Cat. 1 1 Cat. 2 1 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	W1	3	II	Barium Lead Selenium Aldrin Endosulfan I Endosulfan sulfate Heptachlor Heptachlor epoxide Endrin Endrin aldehyde Endrin ketone Total Endrin beta-BHC Total BHC 1,2-Dichloroethane	No 4.7 No No No No No No No No No No 1.5 2.8 No	 003ME00101 NA NA NA NA NA NA NA NA NA 003ME00101 003ME00101 NA	Cat. 1 2 Cat. 2 0 Cat. 3 1 Cat. 4 0	Exceeds TEC; Less than MEC	No	None Collected	None Collected	NA	Total Endrin FCM Max. NOAEL HQ<1 Total BHC FCM Max. NOAEL HQ<1	None	Benzene	Investigated under the FDEP petroleum program	N/A	Section 4 of the RI identifies this wetland as a Red-coded wetland included in Group D. Refinement of constituents (primarily FCM) does not indicate further evaluation is necessary at this wetland. This wetland is currently being investigated under the FDEP Petroleum Program.
Remaining Wetlands	19A	2	II	Aluminum Barium Cobalt Iron Manganese Vanadium Endosulfan I Heptachlor epoxide	No No No No No No No No	NA NA NA NA NA NA NA NA	Cat. 1 3 Cat. 2 1 Cat. 3 0 Cat. 4 0	Exceeds TEC/Less than MEC	No	None Collected	None Collected	NA		None	Arsenic	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	19B	1	II	Heptachlor epoxide	No	NA	Cat. 1 1 Cat. 2 0 Cat. 3 0 Cat. 4 0	None Detected	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.

Table 16-1
Weight of Evidence

OU/Group	Wetland	Total Sediment Samples Locations	Phase Summarized	Eco Sediment COPCs Retained After Refinement	Max Refinement HQs > 1	Sample Locations Exceeding RV	ERM Quotient Categories	Exceeds TOC normalized PAH value	Exceeds Site-wide DDT level	Stat Sig Acute Tox	Stat Sig Sublethal Tox	Location of Tox Results	FCM Results	VOC Exceeds SQG	HHRA COCs	Recommendation	Identification of Risk Drivers Based on Lines of Evidence Analysis for Wetlands Recommended for FS	Rationale
	56	1	II	None	No	NA	Cat. 1 0 Cat. 2 1 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	57	1	II	Aldrin	No	NA	Cat. 1 0 Cat. 2 1 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	58	1	II	Carbazole Dibenzofuran	No No	NA NA	Cat. 1 1 Cat. 2 0 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA		None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	W2	3	II	Aluminum Barium Beryllium Cobalt Iron Selenium Vanadium Aldrin Total Endrin	No No No No No No No No No	NA NA NA NA NA NA NA NA NA	Cat. 1 1 Cat. 2 2 Cat. 3 0 Cat. 4 0	Less than TEC	No	None Collected	None Collected	NA	Total Endrin FCM Max. NOAEL HQ<1	None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels do not warrant further investigation.
	48	1	II	4,4'-DDD 4,4'-DDE 4,4'-DDT Total DDT	333 1.7 59.3 65.9	041M0480101 041M0480101 041M0480101 041M0480101	Cat. 1 0 Cat. 2 0 Cat. 3 1 Cat. 4 0	None Detected	Yes	None Collected	None Collected	NA	Total DDT Max. NOAEL HQ=14.0 Total DDT Actual NOAEL HQ=3.56	None	None	FS	4,4'-DDD 4,4'-DDE 4,4'-DDT Total DDT	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels indicate potential risk; however, the constituents driving risk are not attributable to nearby IR sites. Most likely source is application of road side pesticides (DDT). Additional sampling conducted in this wetland and reported in an addendum indicates DDT is a risk driver. An FS is recommended.
	49	3	II	Heptachlor epoxide 4,4'-DDD Total DDT	No 12 2.2	NA 041M0490101 041M0490201 041M0490101 041M0490201	Cat. 1 1 Cat. 2 2 Cat. 3 0 Cat. 4 0	Less than TEC	Yes	None Collected	None Collected	NA	Total DDT Max. NOAEL HQ=14.0 Total DDT Actual NOAEL HQ=3.56	None	None	NFA	N/A	Section 4 of the RI identifies this wetland as a Blue-coded wetland. Constituent levels indicate potential risk; however, the constituents driving risk are not attributable to nearby IR sites. Most likely source is application of road side pesticides (DDT). In accordance with Navy policy, this wetland is dropped from further consideration in the IR program (Navy 2002).

ATTACHMENT B

CALCULATION OF HUMAN HEALTH PRGS

CALCULATION OF SEDIMENT SCREENING LEVELS PROTECTIVE OF THE MAINTENANCE WORKER

SITE NAME: PENSACOLA
EXPOSURE POINT: WETLANDS
EXPOSURE SCENARIO: MAINTENANCE WORKER
MEDIA: SEDIMENT
DATE: OCTOBER 28, 2009

THIS SPREADSHEET CALCULATES SCREENING LEVELS FOR EXPOSURES TO SEDIMENT
VIA INCIDENTAL INGESTION AND DERMAL CONTACT AND INGESTION OF FISH

RELEVANT EQUATIONS:

Carcinogens

$$PRG_{sed} = \frac{TCR}{Intake_{oral} \cdot CSF_{oral} + Intake_{derm} \cdot CSF_{derm}}$$

Noncarcinogens

$$PRG_{sed} = \frac{THI}{\left(\frac{Intake_{oral}}{RfD_{oral}}\right) + \left(\frac{Intake_{derm}}{RfD_{derm}}\right)}$$

$$Intake_{oral} = \frac{IR \times EF \times ED \times FI \times CF}{BW \times AT}$$

$$Intake_{derm} = \frac{SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

INPUT ASSUMPTIONS:			
	Parameter	**Value**	**Definition**
General	PRG = :		Screening level in sediment (mg/kg)
	TCR = :	1.0E-06	Target Cancer Risk
	THI = :	1	Target Hazard Index
	EF = :	26	Exposure Frequency (days/year)
	ED = :	25	Exposure Duration (years)
	BW = :	70	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	9,125	Averaging time for noncarcinogenic exposures (days)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
Incidental Ingestion	IR = :	100	Sediment Ingestion Rate (mg/day)
	FI = :	1	Fraction from contaminated source (unitless)
Dermal Contact	SA = :	10,400	Skin surface available for contact (cm^2/day)
	AF = :	0.1	Sediment to skin adherence factor (mg/cm^2)
	ABS = :	Chemical Specific	Absorption factor (unitless)

CALCULATION OF SEDIMENT SCREENING LEVELS PROTECTIVE OF THE MAINTENANCE WORKER (PAGE 2)

SITE NAME: PENSACOLA
EXPOSURE POINT: WETLANDS
EXPOSURE SCENARIO: MAINTENANCE WORKER
MEDIA: SEDIMENT
DATE: OCTOBER 28, 2009

CHEMICAL	ABS	Cancer Slope Factor		Reference Dose	
		Oral $(mg/kg/day)^{-1}$	Dermal $(mg/kg/day)^{-1}$	Oral (mg/kg/day)	Dermal (mg/kg/day)
Arsenic	0.03	1.5E+00	1.5E+00	3.0E-04	3.0E-04
Benzene	0	5.5E-02	5.5E-02	4.0E-03	4.0E-03

CHEMICAL	Carcinogenic Intake Factors		Noncarcinogenic Intakes Factors	
	Oral (kg/kg/day)	Dermal (kg/kg/day)	Oral (kg/kg/day)	Dermal (kg/kg/day)
Arsenic	3.63E-08	1.13E-08	1.02E-07	3.17E-08
Benzene	3.63E-08	0.00E+00	1.02E-07	0.00E+00

CALCULATION OF SEDIMENT SCREENING LEVELS PROTECTIVE OF THE MAINTENANCE WORKER (PAGE 3)

SITE NAME: PENSACOLA
EXPOSURE POINT: WETLANDS
EXPOSURE SCENARIO: MAINTENANCE WORKER
MEDIA: SEDIMENT
DATE: OCTOBER 28, 2009

CHEMICAL	Soil Concentration		Risk-Based[1] Cleanup Level (mg/kg)
	Carcinogenic (mg/kg)	Noncarcinogenic (mg/kg)	
Arsenic	14	2200	14
Benzene	500	39000	500

Notes:
1 - Screening level is the lower of the carcinogenic sediment concentration and noncarcinogenic sediment concentration.

CALCULATION OF PRGS FOR SEDIMENT PROTECTIVE OF INGESTION OF FISH

SITE NAME: PENSACOLA
EXPOSURE POINT: WETLANDS 15
EXPOSURE SCENARIO: RECREATIONAL FISHERMAN
MEDIA: SEDIMENT
DATE: SEPTEMBER 24, 2010

For Carcinogens

$$C_{sed} = \frac{TR \times BW \times ATc}{BSAF \times fi/foc \times IR \times FI \times EF \times ED \times CSF_{oral}}$$

For Noncarcinogens

$$C_{sed} = \frac{THI \times BW \times ATn \times RfD_{oral}}{BSAF \times fi/foc \times IR \times FI \times EF \times ED}$$

Where:

C_{sed} =	Chemical Specific	Chemical concentration in sediment (mg/kg)
TR =	2.50E-05	Target risk level
THI =	1	Target hazard index
BW =	45	Body weight (kg)
ATc =	25,550	Averaging time - carcinogens (days)
ATn =	3650	Averaging time - noncarcinogens (days)
IR =	0.145	Fish ingestion rate (kg/meal)
FI =	1	Fraction ingested
EF =	5	Exposure frequency (meals/year)
ED =	10	Exposure duration (years)
BSAF =	Chemical Specific	biota-sediment accumulation factor
fi =	0.03	organism lipid content expressed as a decimal fraction
foc =	0.19	TOC of sediment expressed as a decimal fraction
CSF_{oral} =	Chemical Specific	Oral cancer slope factor $(mg/kg/day)^{-1}$
RfD_{oral} =	Chemical Specific	Oral reference dose (mg/kg/day)

Chemical	CSF_{oral} $(mg/kg/day)^{-1}$	RfD_{oral} (mg/kg/day)	BSAF	Sediment Concentration Carcinogenic (mg/kg)	Sediment Concentration Noncarcinogenic (mg/kg)	PRG[1] (mg/kg)
4,4'-DDD	2.4E-01	NA	0.28	374	NA	374
4,4'-DDE	3.4E-01	NA	7.7	9.6	NA	9.6
Aroclor-1260	2.0E+00	NA	1.85	6.8	NA	6.8
delta-BHC	6.3E+00	8.0E-03	1.8	2.2	638	2.2

Notes:
1 - Risk-based cleanup level is the lower of the carcinogenic sediment concentration and noncarcinogenic sediment concentration.

CALCULATION OF PRGS FOR SEDIMENT PROTECTIVE OF INGESTION OF FISH

SITE NAME: PENSACOLA
EXPOSURE POINT: WETLANDS 16
EXPOSURE SCENARIO: RECREATIONAL FISHERMAN
MEDIA: SEDIMENT
DATE: SEPTEMBER 24, 2010

For Carcinogens

$$Csed = \frac{TR \times BW \times ATc}{BSAF \times fi/foc \times IR \times FI \times EF \times ED \times CSF_{oral}}$$

For Noncarcinogens

$$Csed = \frac{THI \times BW \times ATn \times RfD_{oral}}{BSAF \times fi/foc \times IR \times FI \times EF \times ED}$$

Where:

TR =	1.0E-04	Target risk level
THI =	1	Target hazard index
BW =	45	Body weight (kg)
ATc =	25,550	Averaging time - carcinogens (days)
ATn =	3650	Averaging time - noncarcinogens (days)
IR =	0.145	Fish ingestion rate (kg/meal)
FI =	1	Fraction ingested
EF =	5	Exposure frequency (meals/year)
ED =	10	Exposure duration (years)
BSAF =	Chemical Specific	biota-sediment accumulation factor
fi =	0.03	organism lipid content expressed as a decimal fraction
foc =	0.022	TOC of sediment expressed as a decimal fraction
CSF_{oral} =	Chemical Specific	Oral cancer slope factor $(mg/kg/day)^{-1}$
RfD_{oral} =	Chemical Specific	Oral reference dose (mg/kg/day)

Chemical	CSF_{oral} $(mg/kg/day)^{-1}$	RfD_{oral} (mg/kg/day)	BSAF	Sediment Concentration Carcinogenic (mg/kg)	Sediment Concentration Noncarcinogenic (mg/kg)	PRG[1] (mg/kg)
Aroclor-1254	2.0E+00	2.0E-05	1.85	3.14	0.18	0.18

Notes:
1 - Risk-based cleanup level is the lower of the carcinogenic sediment concentration and noncarcinogenic sediment concentration.

CALCULATION OF PRGS FOR SEDIMENT PROTECTIVE OF INGESTION OF FISH

SITE NAME: PENSACOLA
EXPOSURE POINT: WETLANDS 64
EXPOSURE SCENARIO: RECREATIONAL FISHERMAN
MEDIA: SEDIMENT
DATE: SEPTEMBER 24, 2010

For Carcinogens

$$Csed = \frac{TR \times BW \times ATc}{BSAF \times fi/foc \times IR \times FI \times EF \times ED \times CSF_{oral}}$$

For Noncarcinogens

$$Csed = \frac{THI \times BW \times ATn \times RfD_{oral}}{BSAF \times fi/foc \times IR \times FI \times EF \times ED}$$

Where:

TR =	9.09E-06	Target risk level
THI =	1	Target hazard index
BW =	45	Body weight (kg)
ATc =	25,550	Averaging time - carcinogens (days)
ATn =	3650	Averaging time - noncarcinogens (days)
IR =	0.145	Fish ingestion rate (kg/meal)
FI =	1	Fraction ingested
EF =	12	Exposure frequency (meals/year)
ED =	10	Exposure duration (years)
BSAF =	Chemical Specific	biota-sediment accumulation factor
fi =	0.03	organism lipid content expressed as a decimal fraction
foc =	0.048	TOC of sediment expressed as a decimal fraction
CSF_{oral} =	Chemical Specific	Oral cancer slope factor $(mg/kg/day)^{-1}$
RfD_{oral} =	Chemical Specific	Oral reference dose (mg/kg/day)

Chemical	CSF_{oral} $(mg/kg/day)^{-1}$	RfD_{oral} (mg/kg/day)	BSAF	Sediment Concentration Carcinogenic (mg/kg)	Sediment Concentration Noncarcinogenic (mg/kg)	PRG[1] (mg/kg)
4,4'-DDD	2.4E-01	NA	0.28	14.3	NA	14.3
4,4'-DDE	3.4E-01	NA	7.7	0.37	NA	0.37
4,4'-DDT	3.4E-01	5.0E-04	7.7	0.37	1.0	0.37
Aldrin	1.7E+01	3.0E-05	1.8	0.031	0.25	0.031
alpha-BHC	6.3E+00	8.0E-03	1.8	0.08	67	0.08
alpha-Chlordane	3.5E-01	5.0E-04	4.77	0.58	1.6	0.58
Aroclor-1254	2.0E+00	2.0E-05	1.85	0.26	0.16	0.16
Aroclor-1260	2.0E+00	NA	1.85	0.26	NA	0.26
delta-BHC	6.3E+00	8.0E-03	1.8	0.08	67	0.08
gamma-Chlordane	3.5E-01	5.0E-04	2.22	1.2	3.4	1.2
bis(2-Ethylhexyl)phthalate	1.4E-02	2.0E-02	1	69	302	69

Corresponding Risk Level	Adjusted PRG (mg/kg)
9.09E-07	1.4
9.09E-06	0.37
9.09E-06	0.37
9.09E-06	0.031
9.09E-06	0.08
9.09E-06	0.58
5.71E-06	0.16
2.88E-05	0.16
9.09E-06	0.8
9.09E-07	0.12
9.09E-06	69

Notes:
1 - Risk-based cleanup level is the lower of the carcinogenic sediment concentration and noncarcinogenic sediment concentration.

WETLANDS 64, OPERABLE UNIT 2									
		Statistics WITHOUT Phase IV data				Statistics WITH Phase IV data			
Parameter	Site-Specific PRG (ug/kg)	FLUCL UCL (ug/kg)	ProUCL UCL (ug/kg)	Maximum Detection (ug/kg)	Maximum Nondetect (ug/kg)	FLUCL UCL (ug/kg)	ProUCL UCL (ug/kg)	Maximum Detection (ug/kg)	Maximum Nondetect (ug/kg)
alpha-BHC	80	2.2	0.4	0.94	14	17.3	0.4	0.94	68
gamma-BHC	800	8.9	0.7	0.94	8.9	4.9	1.6	6.9	22
Aldrin	31	1.5	0.8	4	1.7	17	0.8	4	68
4,4'-DDE	370	37	24	89	1	36	23	89	130
4,4'-DDD	1400	44	29	140	1	44	27	140	130
4,4'-DDT	370	8.1	5	19	7.7	34	4.7	19	130
alpha-Chlordane	580	3.2	1.6	10	7.1	17	1.5	10	68
gamma-Chlordane	120	4.4	1.7	8.5	16	17	1.6	8.5	68
Aroclor 1254	160	124	52	370	260	349	49	370	1300
Aroclor 1260	820	108	195	300	140	194	128	300	1300
Bis(2-ethylhexyl)phthalate	69000	8992	945	3900	27000	7994	965	3900	27000

UCL - Upper confidence limit

FLUCL - Florida upper confidence limit

PRG - Preliminary remediation goal

ATTACHMENT C

UNCERTAINTY ANALYSIS TABLES

ATTACHMENT C - TABLE 2

SUMMARY OF IMPACTS TO SEDIMENT INVERTEBRATES IN THE BERA - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Wetland	Sample Location	Toxicity Test Information: Species[1]	Survival (percent)	Growth (mg/organism, dry weight)	Emergence (percent)	Benthic Community Analysis: Diversity	Evenness	Richness	Overall Conclusion of the Baseline Ecological Risk Assessment
3	041M030201	*C. tentans*	83	2.9	60	2.24	0.97	9.77	
3	041M030701	*C. tentans*	91	2 *	70	1.92	1.39	3.38	potential impact around this location
5A	041M5A0401	*C. tentans*	100	2.6	75	2.56	1.11	9.76	
5A	041M5A0501[1]	*C. tentans*	100	1.6 *	50	3.16	1.37	9.74	potential impact around this location based on the toxicity tests but this location had the highest levels of benthic diversity
5A	041M5A0601	*C. tentans*	83	2.8	75	2.43	1.25	6.88	
5B	041M5B02	*H. azteca*	97.5	0.06					no impacts
5B	041M5B03	*H. azteca*	97.5	0.07					no impacts
5B	041M5B03 Dup	*H. azteca*	97.5	0.1					no impacts
5B	041M5B04	*H. azteca*	96.25	0.06					no impacts
5B	041M5B05	*H. azteca*	100	0.08					no impacts
5B	041M5B06	*H. azteca*	100	0.1					no impacts
16	041M160301	*N. arenaceodentata*	100	8		1.69	1.05	4.72	little or no impact
16	041M160301	*L. plumulosus*	93						no statistical differences
64	041M640401	*L. plumulosus*	78 *			2.42	1.01	10.76	toxic chemicals likely stressing system; petroleum odors
		N. arenaceodentata	100	8					
64	041M640501[1]	*L. plumulosus*	96			3.3	1.22	14.76	
		N. arenaceodentata	96	7.2 *					
64	041M640601	*L. plumulosus*	74 *			2.64	1.14	9.79	toxic chemicals likely stressing system; petroleum odors
		N. arenaceodentata	88	8.5					
18B	041M18B101	*N. arenicola*	100	8.4		2.36	1.03	9.73	sediment not influencing flora and fauna
		L. plumulosus	100						

* Indicates that the endpoint was statistically lower than the laboratory control sample and is considered impacted.
Shaded cells are samples considered to be toxic.

1 - Species Abbreviations

- *C. tentans - Chironomus tentans*
- *H. azteca - Hyalella azteca*
- *N. arenaceodentata - Nereis arenaceodentata*
- *L. plumulosus - Leptocheirus plumulosus*

Source of information: EnSafe, November 2007.

ATTACHMENT C - TABLE 3

DEVELOPMENT OF NOECS AND LOECS FOR WETLANDS 3 AND 5A - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

WETLAND EVENT LOCATION SAMPLE SAMPLE DATE	3 03 41M0302 041M030201 19970827	3 03 41M0307 041M030701 19970827	5A 03 41M5A04 041M5A0401 19970828	5A 03 41M5A05 041M5A0501 19970828	5A 03 41M5A06 041M5A0601 19970828	No Observed Effects Concentration	Lowest Observed Effects Concentration
VOLATILES (MG/KG)							
CARBON DISULFIDE	0.017 J	0.011 U	0.0076 U	0.0079 U	0.0082 U	0.017	NA[1]
PESTICIDES (MG/KG)							
4,4'-DDD	0.014 J	0.049	0.10	0.10 U	0.0013 J	0.1	NA[1]
4,4'-DDE	0.016 U	0.011	0.057	0.10 U	0.0036 J	0.057	NA[1]
4,4'-DDT	0.0037 J	0.0093	0.0072	0.10 U	0.0032 J	0.0072	0.0093
ALPHA-BHC	0.0085 U	0.0036 U	0.0026 U	0.054 U	0.0028 U	NA[2]	NA[2]
ALPHA-CHLORDANE	0.0085 U	0.0036 U	0.0045	0.054 U	0.00026 U	0.0045	NA[1]
BETA-BHC	0.0085 U	0.0036 U	0.0026 U	0.054 U	0.0028 U	NA[2]	NA[2]
DELTA-BHC	0.0085 U	0.0036 U	0.0026 U	0.054 U	0.0028 U	NA[2]	NA[2]
ENDOSULFAN I	0.0085 U	0.0036 U	0.0052	0.054 U	0.0003 U	0.0052	NA[1]
ENDOSULFAN SULFATE	0.016 U	0.0072 J	0.0023 J	0.10 U	0.00066 J	0.0023	0.0072
ENDRIN	0.0028 J	0.007 U	0.00069 U	0.0024 U	0.0011 J	0.0028	NA[1]
GAMMA-BHC (LINDANE)	0.0047 U	0.0036 U	0.00024 J	0.054 U	0.0028 U	0.00024	NA[1]
GAMMA-CHLORDANE	0.0085 U	0.00074 J	0.0079 J	0.054 U	0.00014 U	0.0079	NA[1]
INORGANICS (MG/KG)							
ANTIMONY	4.9 UJ	2.1 UJ	1.5 UJ	27.7 J	2 J	**2**	**27.7**
BARIUM	87	18.7	12.5	17.2	6.9	87	NA[1]
CADMIUM	2 UJ	9.3	0.42 J	3.2	1.2	**1.2**	**3.2**
COPPER	2 U	4	21.5	108	25.6	**25.6**	**108**
IRON	246000	67100	1090	3020	546	246000	NA[1]
LEAD	20.6	35.6	54.5	258	75.5	**75.5**	**258**
MANGANESE	236	42.6	15.4	21.3	8.6	236	NA[1]
SELENIUM	5.4	2 J	0.26 U	0.60 J	0.28 U	5.4	NA[1]
ZINC	45.8	234	77.1	394	103	**103**	**234**
MISCELLANEOUS PARAMETERS							
TOTAL ORGANIC CARBON (MG/KG)	100000	NA	7000	7400	10000	NA	NA

Shading:
Green: Signifies non-toxic sample
Yellow: Signifies toxic sample
Blue: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a toxic sample.
Red: NOEC based on maximum detected concentration in non-toxic sample when maximum detected concentration for the parameter is in a non-toxic sample.
Black: LOEC based on lowest concentration in toxic sample above the NOEC when maximum detected concentration for the parameter is in a toxic sample.

1 - Not applicable because the maximum detected concentration of the parameter was in a non-toxic sample.
2 - Not applicable because the parameter was not detected in any of the samples.

NOEC - No Observed Effects Concentration
LOEC - Lowest Observed Effects Concentration
NA - Not Applicable

ATTACHMENT C - TABLE 6

DEVELOPMENT OF NOECS AND LOECS FOR WETLAND 64 - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

WETLAND EVENT LOCATION SAMPLE SAMPLE DATE	64 03 41M6404 41M640401 19970904	64 03 41M6405 41M640501 19970904	64 03 41M6406 41M640601 19970903	No Observed Effects Concentration	Lowest Observed Effects Concentration
SEMIVOLATILES (MG/KG)					
BIS(2-ETHYLHEXYL)PHTHALATE	3.3	2	3.9	NA(1)	2
CARBAZOLE	0.32 J	0.35 J	0.80 J	NA(1)	0.32
DIBENZOFURAN	1.3 U	0.13 J	0.35 J	NA(1)	0.13
PESTICIDES/PCBs (MG/KG)					
4,4'-DDD	0.089	0.03	0.053	NA(1)	0.03
AROCLOR-1260	0.30	0.28	0.18	NA(1)	0.18
DIELDRIN	0.02 J	0.017 J	0.0077 J	NA(1)	0.0077
ENDOSULFAN I	0.0024 J	0.00086 U	0.0013 J	NA(1)	0.0013
INORGANICS (MG/KG)					
ALUMINUM	8890 J	7600 J	8900 J	NA(1)	7600
BARIUM	17.1	17	15.2	NA(1)	15.2
BERYLLIUM	0.30 J	0.34	0.34	NA(1)	0.3
CADMIUM	20.2	17.7	21	NA(1)	17.7
CHROMIUM	774	592	868	NA(1)	592
COBALT	3	3.4	2.7	NA(1)	2.7
COPPER	102	146	115	NA(1)	102
IRON	13600	13300	12100	NA(1)	12100
LEAD	346	330	339	NA(1)	330
MANGANESE	44.9	65.8	48.8	NA(1)	44.9
SELENIUM	1.6 J	1.5 J	1.3 J	NA(1)	1.3
SILVER	2 J	3	1.9 J	NA(1)	1.9
VANADIUM	18.4	15.9	17.3	NA(1)	15.9
ZINC	468	306	330	NA(1)	306
MISCELLANEOUS PARAMETERS					
TOTAL ORGANIC CARBON (MG/KG)	70000	60000	86000	NA	NA

Shading:
Yellow: Signifies toxic sample
Black: LOEC based on lowest concentration in toxic sample above the NOEC when maximum detected concentration for the parameter is in a toxic sample.

1 - Not applicable because all samples were toxic.

NOEC - No Observed Effects Concentration
LOEC - Lowest Observed Effects Concentration
NA - Not Applicable

ATTACHMENT C - TABLE 9

DEVELOPMENT OF ECOLOGICAL PRGS FOR FRESHWATER WETLANDS 3, 5A, AND 18A - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Chemical	Freshwater Reference Concentration	Screening Level	Refinement Value	No Observed Effects Concentration	Lowest Observed Effects Concentration	Overall Ecological PRG
VOLATILES (MG/KG)						
1,4-DICHLOROBENZENE	NA	NA	0.35	NA	NA	0.35
CARBON DISULFIDE	NA	NA	NA	0.017	NA	0.017
SEMIVOLATILES (MG/KG)						
4-METHYLPENOL (P-CRESOL)	NA	NA	0.1	NA	NA	0.1
PESTICIDES (MG/KG)						
4,4'-DDD	0.05	0.00122	0.028	0.1	NA	0.1
4,4'-DDE	0.04	0.00207	0.031	0.057	NA	0.057
4,4'-DDT	0.02	0.00119	0.063	0.0072	0.0093	0.02
ALDRIN	NA	NA	0.04	NA	NA	0.04
ALPHA-BHC	NA	0.00032	0.005	NA	NA	0.005
ALPHA-CHLORDANE	NA	0.0017	0.018	0.0045	NA	0.018
BETA-BHC	NA	0.00032	0.005	NA	NA	0.005
DELTA-BHC	NA	0.00032	0.005	NA	NA	0.005
ENDOSULFAN I	NA	NA	0.0029	0.0052	NA	0.0052
ENDOSULFAN SULFATE	NA	NA	0.0054	0.0023	0.0072	0.0072
ENDRIN	NA	0.0033	0.21	0.0028	NA	0.21
GAMMA-BHC (LINDANE)	NA	0.00032	0.005	0.00024	NA	0.005
GAMMA-CHLORDANE	NA	0.0017	0.018	0.0079	NA	0.018
INORGANICS (MG/KG)						
ANTIMONY	4.43	12	NA	2	27.7	27.7
BARIUM	14	NA	60	87	NA[(1)]	87
CADMIUM	1.8	0.68	5	1.2	3.2	5
COPPER	19.5	18.7	150	25.6	108	150
IRON	11912	NA	40000	246000	NA[(1)]	246000
LEAD	82.5	30.2	130	75.5	258	258
MANGANESE	38	NA	1100	236	NA[(1)]	1100
SELENIUM	3.45	NA	1	5.4	NA[(1)]	5.4
ZINC	36.73	124	460	103	234	460

Shaded cells indicate an difference between this PRG and the PRG in the primary Table 9 of the Technical Memorandum.
NA - Not Available
PRG - Preliminary Remediation Goal

ATTACHMENT C - TABLE 11

DEVELOPMENT OF ECOLOGICAL PRG FOR WETLAND 64 - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Chemical	Saltwater Reference Concentration	Screening Level	Refinement Value	No Observed Effects Concentration	Lowest Observed Effects Concentration	Overall Ecological PRG
SEMIVOLATILES (MG/KG)						
BIS(2-ETHYLHEXYL)PHTHALATE	NA	0.182	2.647	NA	2	2.647
CARBAZOLE	NA	NA	NA	NA	0.32	0.32
DIBENZOFURAN	NA	NA	0.11	NA	0.13	0.13
PESTICIDES/PCBs (MG/KG)						
4,4'-DDD	0.05	0.00122	0.00781	NA	0.03	0.05
AROCLOR-1260	NA	0.0216	0.189	NA	0.18	0.189
DIELDRIN	NA	0.000715	0.0043	NA	0.0077	0.0077
ENDOSULFAN I	NA	NA	0.0029	NA	0.0013	0.0029
INORGANICS (MG/KG)						
ALUMINUM	4274	NA	18000	NA	7600	18000
BARIUM	3.84	NA	48	NA	15.2	48
BERYLLIUM	0.13	NA	NA	NA	0.3	0.3
CADMIUM	0.39	0.68	4.21	NA	17.7	17.7
CHROMIUM	13.1	52.3	160	NA	592	592
COBALT	0.91	NA	10	NA	2.7	10
COPPER	8.44	18.7	108	NA	102	108
IRON	2684	NA	220000	NA	12100	220000
LEAD	21	30.2	112	NA	330	330
MANGANESE	9.8	NA	260	NA	44.9	260
MERCURY	0.11	---[1]	---[1]	---[1]	---[1]	0.11
SELENIUM	0.66	NA	1	NA	1.3	1.3
SILVER	0.52	0.73	1.77	NA	1.9	1.9
VANADIUM	8.59	NA	57	NA	15.9	57
ZINC	14.36	124	271	NA	306	306

Shaded cells indicate an difference between this PRG and the PRG in the primary Table 11 of the Technical Memorandum.
1 - Not applicable because mercury was not selected as a COC for risks to sediment invertebrates.
It was selected as a COC because of risks to the red drum via the food chain pathway.
NA - Not Available
PRG - Preliminary Remediation Goal

ATTACHMENT C - TABLE 14

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 3 - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Arsenic	HHRA	9/10	35.5	041M030301	14	NA	14	NA
Cadmium	Eco	7/10	72.7	041M030701	9.3	NA	5.0	NA
Endosulfan Sulfate	Eco	2/10	0.0017	041M030701	0.0072	NA	0.0072	NA
Methylene Chloride	HHRA	0/10	ND	ND	NA	NA	NA	NA
Average TOC = 56,736								

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Arsenic	HHRA	2/2	14.6	041M030201	14	NA	14	NA
Cadmium	Eco	1/2	9.3	041M030701	9.3	NA	5.0	NA
Endosulfan Sulfate	Eco	1/2	0.0072	041M030701	0.0072	NA	0.0072	NA
Methylene Chloride	HHRA	0/2	ND	ND	NA	NA	NA	NA
Average TOC = 56,000								

Phases II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Arsenic	HHRA	11/12	35.5	041M030301	14	Yes	14	No change
Cadmium	Eco	8/12	72.7	041M030701	9.3	Yes	5.0	No change
Endosulfan Sulfate	Eco	3/12	0.0072	041M030701	0.0072	No	0.0072	No change
Methylene Chloride	HHRA	0/12	ND	ND	NA	NA	NA	No change
Average TOC = 56,572								

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC.

NA - Not applicable

ND - Not detected

TOC - Total organic carbon

COC - Chemical of concern

ATTACHMENT C - TABLE 15

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 5A - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Copper	Eco	7/7	317	041M5A0501	150	NA	150	NA
Lead	Eco	7/7	427	041M5A0101	258	NA	258	NA
Zinc	Eco	7/7	2,290	041M5A0101	460	NA	460	NA
Endosulfan I	Eco	0/7	ND	ND	0.0052	NA	0.0052	NA
Average TOC = 137,389								

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Copper	Eco	3/3	108	041M5A0501	150	NA	150	NA
Lead	Eco	3/3	258	041M5A0501	258	NA	258	NA
Zinc	Eco	3/3	394	041M5A0501	460	NA	460	NA
Endosulfan I	Eco	1/3	0.0052	041M5A0401	0.0052	NA	0.0052	NA
Average TOC = 8,133								

Phase II and III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Copper	Eco	10/10	317	041M5A0501	150	Yes	150	No change
Lead	Eco	10/10	427	041M5A0101	258	Yes	258	No change
Zinc	Eco	10/10	2,290	041M5A0101	460	Yes	460	No change
Endosulfan I	Eco	1/10	0.0052	041M5A0401	0.0052	No	0.0052	No change
Average TOC = 98,612								

1 - PRG - Preliminary remediation goal is the ecological PRG; no chemicals were retained as human health COCs.
NA - Not applicable
ND - Not detected
TOC - Total organic carbon
COC - Chemical of concern

ATTACHMENT C - TABLE 18

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 18A - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG(1)	Retained as Final COC?	Uncertainty Analysis	
							PRG(1)	Change in Selection of Chemical Considered in the FS
Arsenic	HHRA	4/4	31.4	041M18A201	14	Yes	14	No change
Barium	Eco	4/4	35.9	001M001801	87	No	87	No change
Iron	Eco	4/4	48,200	041M18A201	246000	No	246000	No change
Manganese	Eco	4/4	105	001M001801	1100	No	1100	No change
Selenium	Eco	2/4	3.8	041M18A101	5.4	No	5.4	No change
Benzene	HHRA	2/3	0.05	041M18A301	500	No	500	No change
Aldrin	Eco	1/4	0.0037	041M18A201	0.04	No	0.04	No change
1,4-Dichlorobenzene	Eco	1/4	1.1	041M18A201	0.35	No	0.35	No change
4-Methylpenol (p-Cresol)	Eco	2/4	0.33	041M18A201	0.1	No	0.1	No change
Average TOC = 223,333								

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC.
NA - Not applicable
TOC - Total organic carbon
COC - Chemical of concern

ATTACHMENT C - TABLE 21

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 64 - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Phase II Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Bis(2-ethylhexyl)phthalate	Eco and HHRA	3/24	0.53	041M641901	3.3	NA	2.6	NA
Carbazole	Eco	2/24	0.4	041M640501	0.8	NA	0.32	NA
Dibenzofuran	Eco	2/24	0.085	041M640501	0.35	NA	0.13	NA
Endosulfan I	Eco	1/24	0.0008	041M641401	0.0029	NA	0.0029	NA
Aluminum	Eco	24/24	26,800	041M641601	18000	NA	18000	NA
Barium	Eco	22/24	1,280	041M640301	48	NA	48	NA
Beryllium	Eco	10/24	1.3	041M641601 041M641901	0.34	NA	0.3	NA
Cadmium	Eco	22/24	38.6	041M640301	20.2	NA	18	NA
Chromium	Eco	24/24	1,800	041M640301	774	NA	592	NA
Cobalt	Eco	15/24	6.1	041M640301	10	NA	10	NA
Copper	Eco	22/24	255	041M640301	146	NA	108	NA
Lead	Eco	23/24	634	041M640301	339	NA	330	NA
Manganese	Eco	24/24	203	041M641601	260	NA	260	NA
Mercury	Eco	14/24	0.88	041M640301	0.11	NA	0.11	NA
Selenium	Eco	11/34	3.1	041M640301	1.6	NA	1.3	NA
Silver	Eco	4/24	5.1	041M640301	3	NA	1.9	NA
Vanadium	Eco	22/24	43.4	041M641601	57	NA	57	NA
Zinc	Eco	23/24	481	041M640301	330	NA	306	NA
4,4'-DDD	HHRA	14/24	0.14	041M640201	1.4	NA	1.4	NA
4,4'-DDE	HHRA	14/24	0.078	041M640301	0.37	NA	0.37	NA
4,4'-DDT	HHRA	6/24	0.014	041M640101 041M640301	0.37	NA	0.37	NA
Aldrin	HHRA	6/24	0.004	041M640301	0.031	NA	0.031	NA
Alpha-BHC	HHRA	9/24	0.00094	041M641401	0.08	NA	0.08	NA
Alpha-Chlordane	HHRA	4/24	0.01	041M640301	0.58	NA	0.58	NA
Aroclor-1254	HHRA	8/24	0.37	041M640201	0.16	NA	0.16	NA
Aroclor-1260	HHRA	12/24	0.05	041M641901	0.82	NA	0.82	NA
Delta-BHC	HHRA	0/24	ND	ND	0.8	NA	0.8	NA
Gamma-Chlordane	HHRA	5/24	0.0085	041M640301	0.12	NA	0.12	NA

Phase III Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Bis(2-ethylhexyl)phthalate	Eco and HHRA	3/3	3.9	041M640601	3.3	NA	2.6	NA
Carbazole	Eco	3/3	0.8	041M640601	0.8	NA	0.32	NA
Dibenzofuran	Eco	2/3	0.35	041M640601	0.35	NA	0.13	NA
Endosulfan I	Eco	2/3	0.0024	041M640401	0.0029	NA	0.0029	NA
Aluminum	Eco	3/3	8,900	041M640601	18000	NA	18000	NA
Barium	Eco	3/3	17.1	041M640401	48	NA	48	NA
Beryllium	Eco	3/3	0.34	041M640501 041M640601	0.34	NA	0.3	NA
Cadmium	Eco	3/3	21	041M640601	20.2	NA	18	NA
Chromium	Eco	3/3	868	041M640601	774	NA	592	NA
Cobalt	Eco	3/3	3.4	041M640501	10	NA	10	NA
Copper	Eco	3/3	146	041M640501	146	NA	108	NA
Lead	Eco	3/3	346	041M640401	339	NA	330	NA
Manganese	Eco	3/3	65.8	041M640501	260	NA	260	NA
Mercury	Eco	3/3	0.26	041M640401 041M640501	0.11	NA	0.11	NA
Selenium	Eco	3/3	1.6	041M640401	1.6	NA	1.3	NA
Silver	Eco	3/3	3	041M640501	3	NA	1.9	NA
Vanadium	Eco	3/3	18.4	041M640401	57	NA	57	NA
Zinc	Eco	3/3	468	041M640401	330	NA	306	NA
4,4'-DDD	HHRA	3/3	0.089	041M640401	1.4	NA	1.4	NA
4,4'-DDE	HHRA	3/3	0.089	041M640401	0.37	NA	0.37	NA
4,4'-DDT	HHRA	2/3	0.019	041M640601	0.37	NA	0.37	NA
Aldrin	HHRA	0/3	ND	ND	0.03	NA	0.03	NA
Alpha-BHC	HHRA	0/3	ND	ND	0.08	NA	0.08	NA
Alpha-Chlordane	HHRA	2/3	0.0037	041M640401	0.58	NA	0.58	NA
Aroclor-1254	HHRA	0/3	ND	ND	0.16	NA	0.16	NA
Aroclor-1260	HHRA	3/3	0.3	041M640401	0.82	NA	0.82	NA
Delta-BHC	HHRA	2/3	0.00094	041M640601	0.8	NA	0.8	NA
Gamma-Chlordane	HHRA	0/3	ND	ND	0.12	NA	0.12	NA

ATTACHMENT C - TABLE 21

SEDIMENT RESULTS AND REFINEMENT OF CHEMICALS OF CONCERN - WETLAND 64 - UNCERTAINTY ANALYSIS
SITE 41 - NAS PENSACOLA

Phase IV Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Bis(2-ethylhexyl)phthalate	Eco and HHRA	4/7	1.5	041M640502	3.3	NA	2.6	NA
Carbazole	Eco	----	----	----	0.8	NA	0.32	NA
Dibenzofuran	Eco	0/7	ND	ND	0.35	NA	0.13	NA
Endosulfan I	Eco	0/7	ND	ND	0.0029	NA	0.0029	NA
Aluminum	Eco	7/7	18,000	041M641102	18000	NA	18000	NA
Barium	Eco	7/7	18	041M640502 041M641102	48	NA	48	NA
Beryllium	Eco	5/7	1.1	041M641102	0.34	NA	0.3	NA
Cadmium	Eco	6/7	23	041M640502	20.2	NA	18	NA
Chromium	Eco	7/7	700	041M640502	774	NA	592	NA
Cobalt	Eco	5/7	4.8	041M640502	10	NA	10	NA
Copper	Eco	6/7	200	041M640502	146	NA	108	NA
Lead	Eco	7/7	430	041M640502	339	NA	330	NA
Manganese	Eco	7/7	230	041M641102	260	NA	260	NA
Mercury	Eco	6/7	0.46	041M641102	0.11	NA	0.11	NA
Selenium	Eco	0/7	ND	ND	1.6	NA	1.3	NA
Silver	Eco	5/7	4	041M640502	3	NA	1.9	NA
Vanadium	Eco	7/7	37	041M641102	57	NA	57	NA
Zinc	Eco	6/7	380	041M640502	330	NA	306	NA
4,4'-DDD	HHRA	1/7	0.1	041M640602	1.4	NA	1.4	NA
4,4'-DDE	HHRA	4/7	0.043	041M640202	0.37	NA	0.37	NA
4,4'-DDT	HHRA	0/7	ND	ND	0.37	NA	0.37	NA
Aldrin	HHRA	0/7	ND	ND	0.03	NA	0.03	NA
Alpha-BHC	HHRA	0/7	ND	ND	0.08	NA	0.08	NA
Alpha-Chlordane	HHRA	0/7	ND	ND	0.58	NA	0.58	NA
Aroclor-1254	HHRA	0/7	ND	ND	0.16	NA	0.16	NA
Aroclor-1260	HHRA	0/7	ND	ND	0.82	NA	0.82	NA
Delta-BHC	HHRA	5/7	0.0069	041M641102	0.8	NA	0.8	NA
Gamma-Chlordane	HHRA	0/7	ND	ND	0.12	NA	0.12	NA

Phase II, III, and IV Results (mg/kg)

Contaminant	HHRA and/or Eco COC?	Frequency of Detection	Maximum Result (mg/kg)	Sample ID of Maximum Result (mg/kg)	PRG[1]	Retained as Final COC?	Uncertainty Analysis	
							PRG[1]	Change in Selection of Chemical Considered in the FS
Bis(2-ethylhexyl)phthalate	Eco and HHRA	10/34	3.9	041M640601	3.3	No	2.6	No change
Carbazole	Eco	5/27	0.8	041M640601	0.8	No	0.32	Max result >PRG
Dibenzofuran	Eco	4/34	0.35	041M640601	0.35	No	0.13	No change
Endosulfan I	Eco	3/34	0.0024	041M640401	0.0029	No	0.0029	No change
Aluminum	Eco	34/34	26,800	041M641601	18000	No	18000	No change
Barium	Eco	34/34	1,280	041M640301	48	No	48	No change
Beryllium	Eco	18/34	1.3	041M641601 041M641901	0.34	No	0.3	No change
Cadmium	Eco	31/34	38.6	041M640301	20.2	Yes	18	No change
Chromium	Eco	34/34	1,800	041M640301	774	Yes	592	No change
Cobalt	Eco	23/34	6.1	041M640301	10	No	10	No change
Copper	Eco	31/34	255	041M640301	146	Yes	108	No change
Lead	Eco	33/34	634	041M640301	339	Yes	330	No change
Manganese	Eco	34/34	230	041M641102	260	No	260	No change
Mercury	Eco	23/34	0.88	041M640301	0.11	No	0.11	No change
Selenium	Eco	14/34	3.1	041M640301	1.6	No	1.3	No change
Silver	Eco	12/34	5.1	041M640301	3	Yes	1.9	No change
Vanadium	Eco	32/34	43.4	041M641601	57	No	57	No change
Zinc	Eco	32/34	481	041M640301	330	Yes	306	No change
4,4'-DDD	HHRA	18/34	0.14	041M640201	1.4	No	1.4	No change
4,4'-DDE	HHRA	21/34	0.089	041M640401	0.37	No	0.37	No change
4,4'-DDT	HHRA	8/34	0.019	041M640601	0.37	No	0.37	No change
Aldrin	HHRA	6/34	0.004	041M640301	0.03	No	0.03	No change
Alpha-BHC	HHRA	9/34	0.00094	041M641401	0.08	No	0.08	No change
Alpha-Chlordane	HHRA	6/34	0.01	041M640301	0.58	No	0.58	No change
Aroclor-1254	HHRA	8/34	0.37	041M640201	0.16	No	0.16	No change
Aroclor-1260	HHRA	15/34	0.3	041M640401	0.82	No	0.82	No change
Delta-BHC	HHRA	7/34	0.0069	041M641102	0.8	No	0.8	No change
Gamma-Chlordane	HHRA	5/34	0.0085	041M640301	0.12	No	0.12	No change

1 - PRG - Preliminary remediation goal is either the human health or ecological PRG depending on whether the chemical was a human health or ecological COC. If the chemical was both a human health and ecological COC, both of the two PRGs are presented.

NA - Not applicable
ND - Not detected
TOC - Total organic carbon
COC - Chemical of concern

ATTACHMENT D

RESPONSE TO REGULATORS COMMENTS

FDEP Ecological Risk Review Comments: Technical Memorandum—Refined List of Chemicals of Concern for the Feasibility Study and Development of Preliminary Remediation Goals for Sediment, Site 41 – Combined Wetlands, Naval Air Station Pensacola
March 8, 2010

Comments:

1. Derivation of the wetland-specific PRGs was based on sediment toxicity testing. Table 2 states that samples 041M5A0501 and 041M640501 are not considered toxic despite significant reductions in growth for *C. tentans* and *N. arenaceodentata*, respectively, due to the high benthic diversity at those sample locations. Based on the sediment quality triad, if sediment samples exceed default chemistry criteria and show statistically significant toxicity to benthic organisms, the presence of a diverse benthic community does not preclude impacts to aquatic life. In fact, it suggests that the chemicals are likely stressing the ecosystem (MacDonald and Ingersoll, 2002, Table 23). Therefore, samples 041M5A0501 and 041M640501 should be considered toxic. This changes the no observed effects concentration (NOEC) and lowest observed effects concentration (LOEC) for antimony, cadmium, copper, lead, and zinc in Wetlands 3 and 5A (Table 3) and for all chemicals excluding endosulfan I in Wetland 64 (Table 6).

   Response:

   The conclusion of Section 11.1.4.4 of the RI report states that "Based on the evaluation of Wetland 5A to date, previous levels of constituents caused statistically significant reduction of growth at one sampling station, 041M5A05. However, the community index indicated that this location indicated the highest levels of diversity in Wetland 5A." The conclusion of Section 11.3.4.3 of the RI report states that "Based on the results of the chemistry and toxicity data, sample locations 041M640401 and 041M640601 exhibited conditions in which toxic chemicals were probably stressing the system." The report did not conclude that 041M640501 was a toxic location. Therefore, the Navy does not believe that neither location should be considered toxic for purposes of setting PRGs.

2. Table 2 presents a summary of the sediment toxicity tests. It is unclear from this table how the toxicity tests were performed. Notably, the length of the toxicity test is absent. The FDEP recommended method for determining chronic toxicity to fresh water whole sediment is the 42-day *Hyalella azteca* survival, growth, and reproduction test and the *Chironomus tentens* life-cycle test. For salt-water whole sediment, the FDEP recommends the 42-day *H. azteca* survival, growth and reproduction test and the *Leptochirus plumulosus* growth and reproduction test. The organisms *N. arenicola* and *N. arenaceodentata* utilized for salt-water toxicity testing at NAS Pensacola Site 41 are not included in the organisms recommended for sediment toxicity testing by the FDEP (FDEP, 2004).

Response:

Section 8.7.3 and Table 8-4 of the RI report describes the toxicity testing that was conducted, including the length of the tests. No regulator comments were received on the RI report regarding the length of the test or the test species selected.

3. The sediment toxicity tests do not appear to have been interpreted correctly. Page 2 defines a NOEC as the greatest concentration that does not cause a toxic response. However, this definition allows the NOEC to be greater than concentrations that displayed sediment toxicity. For example, in Table 3 the greatest concentration of lead that did not cause a toxic response is 75.5 mg/kg in sample 041M5A0601. However, toxicity was seen in sample 041M030701 at a lead concentration of 35.6 mg/kg. Based on the above definition, 75.5 mg/kg is considered a NOEC despite the toxic response at 35.6 mg/kg lead. NOECs should not exceed the lowest toxic concentration in a sediment sample.

Response:

By definition, the NOEC can be greater than concentrations of the same chemical in samples that are considered to be toxic because a NOEC is defined as the greatest concentration of a chemical in a non-toxic sample. The LOEC is defined as the lowest concentration in a toxic sample provided that the concentration is greater than the NOEC. Therefore, the NOECs can exceed the lowest toxic concentration in a sediment sample.

4. In Table 7, marine water sediment PELs are utilized as freshwater sediment probable effects concentrations (PECs). This is problematic for arsenic and 4,4'-DDE because their marine water PELs are not protective of benthic organisms in freshwater sediment. The marine water sediment PEL value for arsenic of 41.6 mg/kg exceeds the Florida sediment quality assessment guideline (SQAG) freshwater PEC of 33 mg/kg. The 4,4'-DDE marine water PEL of 0.374 mg/kg exceeds the Florida SQAG freshwater PEC of 0.031 mg/kg. PECs are utilized as not-to-exceed values. When the default PEC value is selected as the PRG, chemical concentrations at freshwater wetlands of concern (Wetlands 3, 5A, 18A, and 48) should not exceed the PEC values listed in MacDonald et al. (2003).

Response:

The saltwater refinement values from the RI were used, when available, because they were agreed to by the ecological technical sub-group as documented in the November 16, 2007 responses to EPA comments dated April 5, 2006 "The Tier I Partnering Team agreed to use only the EPA Region 4 Screening values and the FDEP PELs and TELs" in the RI. Also, as documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division." However, if refinement values were not available then freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

5. In Table 9, the proposed overall ecological PRG for aldrin (0.08 mg/kg) and manganese (1,100 mg/kg) for Wetlands 3, 5A, and 18A are severe effects levels (SELs). SELs should not be utilized as remedial goals since they are not protective of the benthic community. We recommend utilizing the US EPA Region III freshwater sediment screening benchmarks of 0.002 mg/kg for aldrin and 460 mg/kg for manganese. These values are lowest effect levels (LELs) and are likely to provide more adequate protection of the aquatic community.

Response:

The Navy does not agree that screening levels should be used as PRGs. The SELs are similar in definition to the PELs that were used to refine the list of COPCs in the RI report, and were also used as one of the criteria for setting PRGs in the Technical Memorandum.

6. In Tables 9-12, the overall wetlands PRGs are a mixture of average (screening level, NOEC, LOEC) and not-to-exceed (PEL and PEC) values. This does not present a problem as long as they are utilized correctly when interpreting site data. It may be more straightforward to separate them into two sets of PRGs: one set for comparison to the average concentration and the other as not-to-exceed values.

Response:

The comment needs clarified. It is not clear why the reviewer believes that screening levels, NOECs, and LOECs are average values while the PEL and PEC are not to exceed values. The Navy believes that all of the PRGs for the chemicals remaining as COCs after the refinement presented in Tables 14 through 20 are not-to-exceed values.

7. The human health PRGs listed in Table 13 for the maintenance worker and recreational fisherman are not apportioned. Per Chapter 62-780, F.A.C., alternative soil clean-up target levels (CTLs) should be apportioned.

Response:

The Navy would like to discuss this comment further with the State. If the PRGs are apportioned according to the number of carcinogenic/noncarcinogenic chemicals at each area, several of the sediment PRGs will result in fish tissue concentrations that are much lower than what is used to set fish advisories in the State of Florida. This is because the State of Florida sets fish advisories using a 10E-4 risk level, whereas apportioning the PRGs results in fish tissue levels based on a less than 10E-7 risk level. The resulting fish tissue concentrations would likely be less than background concentrations. This would also occur if the PRGs were not apportioned, but the impacts would not be as severe. Note that there was an error in the fraction of organic carbon values that were used to calculate the PRGs at Wetlands 15 and 64 so those corrections will be made when the PRGs are re-calculated.

8. Utilizing the equations and values in Attachment B, we calculate a non-apportioned benzene PRG of 453 mg/kg for the maintenance worker. In accordance with the procedure utilized in Chapter 62-777, F.A.C. (Table II), this value should be rounded to 450 mg/kg as opposed to the 500 mg/kg given in the document. We recommend utilizing the value of 450 mg/kg as the non-apportioned PRG because it is the more conservative value and is based on default criteria development for the State of Florida. This value should subsequently be apportioned per Chapter 62-780, F.A.C.

Response:

In accordance with Chapter 62-777 F.A.C. using default dermal absorption (DA) value of 0.01 (Table 3) and a GI absorption of 0.9 (Table 5) for benzene along with the equations and other input assumptions presented in Attachment B the non-apportioned PRG for the maintenance worker would be 448 mg/kg. This value would round to 450 mg/kg. This value will be proportioned per Chapter 62-780, F.A.C. See above table for revised PRG.

9. In the calculation of PRGs for sediment protective of ingestion of fish, the fraction of intake from the site (FI) is 0.1. This assumes that on the day a child trespasser consumes fish from the site (52 d/y), the fish caught on-site will only account for 10% of the fish ingestion that day. Instead, it appears likely that all fish ingested on that day would originate from the site. Therefore, we recommend utilizing an FI of 1. This would decrease the recreational fisherman PRGs listed in Table 13 by a factor of 10.

Response:

The PRG for the recreational fisherman will be modified as follows. It is assumed the recreational fisherman eats one fish meal a week over a course of the year or 52 meals a year. Not all of the fish that the recreational fisherman eats will come from the wetlands. It is assumed that only 10 percent or 5 meals consists of fish caught at any one wetlands, therefore the exposure frequency would be 5 meals per year. Since the entire meal would come from the site a value of 1 will be used for the fraction ingested.

10. Page 10 states that the exposure frequency for maintenance workers was decreased from 52 d/y in the Remedial Investigation report to 26 d/y. No explanation is given for this change and it is unclear if this assumption remains protective of maintenance workers at the site.

Response: As presented in a response to an EPA comment on the RI report, "52 days per was assumed to be the total time a maintenance worker would spend performing maintenance in wetlands during a year, whether that is applicable to only one wetland of more than one. If a worker is assumed to spend time in more than one wetland, the exposure frequency should be divided by the number of wetlands to account for their exposure during that year, unless site-specific information is available." Maintenance in any one wetland throughout the year, and subsequent exposure to sediment is expected to be minimal, and much less than 52 times per year in any one wetland. Therefore, even the assumption of 26 times per year (once every two weeks) is conservative, because there is little maintenance that would require a worker to actually enter the wetland. Therefore, the Navy believes that wetting PRGs based on an exposure frequency of 26 times per year for any one wetland is still conservative, and remains protective of maintenance workers at the site.

11. Table 22 lists the refined COCs for NAS Pensacola Site 41. We have the following comments on the refinement:

a. Wetland 3: The refinement is satisfactory.

Response:

Comment noted.

b. Wetland 5A: The refinement is satisfactory.

Response:

Comment noted.

c. Wetland 15:

i. Lead, 4,4'-DDD, 4,4'-DDT, and total DDT were listed as ecological COCs in the remedial investigation report (RI) Table 16-1 but were omitted as ecological COCs in the technical memorandum. Because these chemicals exceed refinement criteria in the RI, they should remain ecological COCs for Wetland 15.

ii. Delta-BHC was listed as an ecological COC in the RI report Table 16-1 (delta-BHC HQ = 5.6). Although it was eliminated in this technical memorandum as a COC for human health, it remains an ecological COC for this wetland.

Response:

Lead, 4,4'-DDD, 4,4'-DDT, total DDT, and delta-BHC were not listed as ecological COCs at Wetland 15 in the revised Table 16-1 (see Attachment A of the Technical Memorandum). Therefore, they were not evaluated as ecological COCs in the Technical Memorandum.

d. Wetland 16: The refinement is satisfactory.

Response:

Comment noted.

e. Wetland 18A: Table 16-1 of the RI lists beta-BHC, total BHC, 4,4'-DDD, 4,4'-DDT, and total DDT as ecological COCs. They are considered COCs due to exceedance of the refinement COCs and through food chain modeling (DDT

HQ=9.7). However, they are absent from Tables 18 and 22 of this report. These chemicals should be retained as ecological COCs based on criteria exceedances. We recommend conducting toxicity bioassays to determine if these ecological COCs are having adverse effects on wildlife in Wetland 18A.

Response:

Beta-BHC, total BHC, 4,4'-DDD, 4,4'-DDT, and total DDT, were not listed as ecological COCs at Wetland 18A in the revised Table 16-1 (see Attachment A of the Technical Memorandum). Therefore, they were not evaluated as ecological COCs in the Technical Memorandum.

f. Wetland 18B: Arsenic should be retained as a COC for human health. Arsenic was omitted as a COC based on resampling at one sample site. One sample is not adequate to characterize the wetland. It is premature to eliminate arsenic as a COC for human health based on one sample. We suggest additional sampling to confirm arsenic is not of concern for this wetland.

Response:

The Navy will agrees to retain arsenic as a COC for human health for the FS. However, the only alternative that will be evaluated for this Wetland 18B in the FS will be long-term monitoring to determine whether arsenic is really a concern at the wetland.

g. Wetland 48: The refinement is satisfactory.

Response:

Comment noted.

h. Wetland 64:

i. Aroclor 1254 and 1260 were eliminated as human health COCs based on the FI of 0.1. Amending the FI to 1 (which appears reasonable based on the limited exposure frequency) changes the recreational fisherman PRGs to 0.066 mg/kg for both chemicals. The maximum detected concentration of Aroclor 1254 (0.37 mg/kg) and Aroclor 1260 (0.3 mg/kg) exceed this PRG. Additionally, apportionment needs to be considered for these chemicals per Chapter 62-780, F.A.C. Therefore, Aroclor 1254 and 1260 should remain human health COCs for this wetland.

Response:
Please see the Navy's response to Comment 7. Aroclor-1254 will not be added as final COCs for Wetland 64 because it was not detected in any of the Phase III of Phase IV samples.

ii. Copper should be retained as an ecological COC. In Table 6, sample 41M6405 should be considered toxic and 102 mg/kg should be utilized as the LOEC for copper. The maximum Phase II (255 mg/kg), Phase III (146 mg/kg), and Phase IV (200 mg/kg) copper concentrations exceed the LOEC. Therefore, copper should be retained as an ecological COC for this wetland.

Response:

Please see the Navy's response to Comment 1. The Navy does not agree that the LOEC for copper needs revised.

iii. Silver should be retained as an ecological COC. In Table 6, sample 41M6405 should be considered toxic and 1.9 mg/kg should be utilized as the LOEC for silver. The maximum Phase II (5.1 mg/kg), Phase III (3 mg/kg), and Phase IV (4 mg/kg) silver concentrations exceed the LOEC. Therefore, silver should be retained as an ecological COC for this wetland.

Response:

Please see the Navy's response to Comment 1. The Navy does not agree that the LOEC for silver needs revised.

iv. Table 16-1 of the RI states that mercury should be retained as a bioaccumulative COC for this wetland. The refinement PRGs presented in this document did not address bioaccumulation. Therefore, mercury should be retained as an ecological COC for this wetland.

Response:

Mercury was eliminated from further evaluation for reasons provided on Page 7, 1st paragraph of the Technical Memorandum. This was primarily because risks to the red drum were marginal and most of the mercury concentrations were lower that reference concentrations. The red drum model is discussed in Section 8.7.1.3 of the RI report. Actual tissue concentrations were used, when available. Mercury is a common metal that is in most fish across the State of Florida, much of which is present from atmospheric deposition. In fact, the State of Florida has a fish advisory for the state that prohibits or limits the amount of fish that pregnant or nursing women and women who may become pregnant should consume. Therefore, mercury contamination in fish appears to be a statewide problem.

Ecological Risk Review Comments: Technical Memorandum—Refined List of Chemicals of Concern for the Feasibility Study and Development of Preliminary Remediation Goals for Sediment, Site 41 – Combined Wetlands, Naval Air Station Pensacola
January 28, 2010

General Comments:

A. Further Refinement: It is stated in the Technical Memorandum that Ensafe re-evaluated the Remedial Investigation (RI) data and refined the chemicals of concern (COC) in 2007 (Ensafe 2007a). Please note that at this early stage in the risk assessment process, Region 4 would like to refer to the COCs in the Technical Memorandum as chemicals of potential concern (COPC). If the COPCs had already been refined by Ensafe, then what is the purpose of the additional refinement in the current Technical Memorandum? The screening-level risk assessment uses conservative assumptions and the COPC refinement used benchmarks which are less conservative than those used in the refinement. Did the further refining of the COPCs in the Technical Memorandum use much less conservative benchmarks than those previously used? Also, it is usual practice in a refinement to provide the sources of the alternative (refinement) screening values (ATV), calculate refinement hazard quotients (HQ), and show how many locations exceed the ATVs. In selecting ATVs for refinement, chemical concentrations described as severe effect levels (SEL) should not be used.

Response: Note that this Technical Memorandum is not in the early stage of the risk assessment. The risk assessment was conducted as part of the approved Remedial Investigation (RI) report. As stated in the second paragraph of the Technical Memorandum, the purpose of the memorandum was to refine the list of COPCs to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. The benchmarks used in the Technical Memorandum were not less conservative than those used in the screening-level risk assessment for Site 41. Refinement values were used in the screening-level risk assessment for Site 41 to refine the list of COPCs. The source of the refinement values are noted on Tables 7 and 8. The definitions of the sources are provided in the Technical Memorandum text. Footnotes will be added to Tables 7 and 8 with the definition of the acronyms. As documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division."

B. Alternate Screening Values: The wetlands have been designated as either saltwater or freshwater. However, only the saltwater ATVs from Florida were used the refinement. Please provide the rationale (e.g. salinity) for designating the wetlands as either saltwater or freshwater. Were the salinities of the samples used in the designation? The state of Florida has sediment quality assessment guidelines (threshold effect concentrations and probable effect concentrations) for inland waters. The PECs should be used for refining the freshwater sediments.

Response: The reviewer is not correct that only saltwater ATVs were used refinement values. The saltwater refinement values from the RI were used, when available, because they were agreed to by the ecological technical sub-group as documented in the November 16, 2007 responses to EPA comments dated April 5, 2006 "The Tier I Partnering Team agreed to use only the EPA Region 4 Screening values and the FDEP PELs and TELs" in the RI. Also, as documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division." However, if refinement values were not available then freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

The salinity measurements in the wetlands are presented in Table 4-3 of the RI report.

C. Preliminary remedial goals: The procedures used for selecting the preliminary remedial goals (PRG) in the Technical Memorandum are inappropriate. In some cases literature-derived benchmark values were used as PRGs and in other cases obviously contaminated reference or background values were used as PRGs. The Triad approach consisting of different lines of evidence (chemical analysis, benthic surveys, and toxicity tests) was used in the document but not used in selecting the PRGs in the Technical Memorandum. However, results from only the toxicity tests and/or so-called background concentrations were used to select the PRGs. The toxicity results were mostly inconclusive. No dose-response relationships were established for any of the chemicals. Therefore picking and choosing PRGs from the data is not acceptable. Information from all of the available data (chemical analysis, benthic surveys, and toxicity tests) should be synthesized and analyzed prior to selecting the PRGs. Chemical concentrations from obviously contaminated reference locations should not be selected and used as PRGs.

Response: The Navy agrees that dose-response curves were not established for the chemicals, so the more conservative approach of calculating no observed effects concentrations (NOECs) and lowest observed effects concentrations (LOECs) was used. The results of the benthic community data were presented on Table 2. However, because samples were not collected at reference locations the results within a wetland were compared to other results within the same wetland. Therefore, it is difficult to interpret the results. For that reason, the Navy put more emphasis on the toxicity test data to develop PRGs.

The Navy does not agree that the reference locations are obviously contaminated. As documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006: "The reference wetland selection and subsequent use was approved by all members of the Pensacola Partnering Team, in consultation from NOAA, University of Florida, and EPA Region 4 Ecological Services Division."

D. Wetlands Characterization: It appears that some of the wetlands were not fully characterized. In some cases only two, four, or five sample results were used to make risk based decisions. Using a limited number of samples in the decision-making process leads to uncertainties in the risk assessment process.

Response: The Navy recognizes that additional sampling would reduce uncertainty associated with the nature and extent of potential contamination. Although, the project team at the time of the RI agreed to the sampling strategy, further sampling may be conducted as part of a long term monitoring program associated with the alternatives for the FS.

E. Toxicity Evaluation: The toxicity test results used in the Technical Memorandum should be evaluated properly and used with caution. The fact that there is no toxicity to benthic invertebrates from a sample does not imply that the chemical concentrations in that sample represent no-observed-effect-concentrations (NOEC) and can be used as PRGs. This is because in most cases the sediments with the highest chemical concentrations were not tested for toxicity and the NOECs and lowest-observed-effect-concentrations (LOEC) are not clear-cut. As such, the toxicity test results used in selecting the PRGs are unacceptable. Different test organisms with different sensitivities were used in the toxicity tests. The proper assumptions should be used in selecting toxicity endpoints and the associated uncertainties should be discussed. Also, the mode of action of some of the chemicals in the sediment samples is different and their effects cannot be shown merely by direct toxicity. For example the pesticides and some of the inorganics (e.g. mercury, selenium, etc.) bioaccumulate in the food web therefore their bioaccumulation potential is more important than direct toxicity. Using direct toxicity endpoints to assess these chemicals and select PRGs for them may lead to additional uncertainties. Simplistic food-web models can be used for the bioaccumulative chemicals.

Response: The fact that there is no toxicity to benthic invertebrates from a sample implies that the chemical concentrations in that sample represent an unbounded no-observed-effect-concentration (NOEC), provided that the concentration was the greatest concentration tested. That fact that in some cases the sediments with the highest chemical concentrations were not tested for toxicity only indicates that the true NOEC may be even higher. This is an acceptable method for selecting PRGs, which the Navy has done on many sites across the country.

The Navy agrees that different test organisms with different sensitivities were used in the toxicity tests, but this does not affect the development of NOECs or LOECs.

The Navy agrees that the mode of action of some of the chemicals in the sediment samples is different and their effects cannot be shown merely by direct toxicity. However, the NOECs and LOECs that were developed were from impacts to sediment invertebrates from direct toxicity.

Simplistic food chain models were used in the RI to evaluate risks to upper trophic-level birds and mammals for each terrestrial operable unit in accordance with agreements reached with FDEP and their risk assessors from the University of Florida, EPA and their ecological risk assessors and the Navy. The Navy does not believe that risks were great enough (i.e., NOAEL HQs greater than 1.0 using site-specific bioaccumulation data and average concentrations) to warrant developing PRGs for those receptor. Risk to red drum from mercury is discussed at the end of the first complete paragraph on page 15 of the technical memorandum.

F. Reference Stations/Concentrations: Reference stations are usually selected from areas not influenced by the site and should be reviewed for appropriateness prior to use in a risk assessment. In some cases reference stations may have contaminant concentrations that exceed screening values. This does not imply that chemical concentrations from those stations should be used to eliminate chemicals from consideration in the risk assessment. Rather, the reference station data should be used for appropriateness before they are used. Freshwater sediment reference station results should not be used for saltwater sediment reference stations. The concentrations of DDT/DDD/DDE from the reference stations were much higher than their respective ecological screening values (ESV) and should not be used in the risk assessment. In fact some of the DDT concentrations were up to 300 times higher than the site concentrations. These concentrations should also not be used as PRGs.

Response: Please see the Navy's response to EPA General Comment C. The basewide levels for DDT, DDE and DDD were developed as a Team Decision. As indicated in NOAA's March 22, 2001 Comment No. 2 on the Final RI report for Site 41 stated: "The Pensacola NAS team examined these histograms, identified inflection points and agreed to concentrations which we believe represent base-wide DDTx levels....Independently gathered DDTx information indicate similar concentrations found in the Pensacola Bay area. The histograms, independent data and approach used by the team is a technical success story and should be highlighted in the RI Report." The values cited in there comment were: 20 ppb for DDT, 40 ppb for DDE, and 50 ppb for DDD. Therefore, the Navy believes that the DDT/DDD/DDE concentrations from the reference stations can be used to set PRGs, when they are greater than site-specific risk-based values.

G. Site-Related Chemicals: Some of the chemicals were eliminated during the refinement because they were determined not to be site-related or not to be risk drivers. Some of these terminologies are subjective. No site-related chemicals or risk drivers were identified in the Technical Memorandum. The process for eliminating chemicals in the refinement should be reviewed with special attention paid to the bioaccumulative chemicals.

Response: Although the terminologies may be somewhat subjective, terms like "site-related" and "risk drivers" are commonly used to refine the list of ecological COPCs. The text in the Technical Memorandum explains why the Navy believes that certain chemicals are not "site-related" and/or "risk drivers." Again, the purpose of the technical memorandum was to refine the list of COPCs to the primary risk drivers that could reasonable be evaluated in the FS. For example, it is not beneficial to evaluate endosulfan sulfate in the FS at Wetland 3 when it was detected in 3 of 12 samples at a maximum detected concentration of 0.0072 mg/kg. This low concentration is not indicative of a disposal activity and other chemicals at the site (i.e., arsenic and cadmium) are of greater concern. Therefore, if risks from other chemicals that are detected more frequently and at greater concentrations are addressed in the FS, risk from the less frequently detected chemicals also should be addressed.

Please see the Navy's response to EPA General Comment E regarding bioaccumulative chemicals.

H. Uncertainties and Data Gaps: The Technical Memorandum could benefit from an "uncertainties" and a "data gaps" section. Was the available data enough to make risk decisions and are there any additional data needs? What are some of the assumptions used in the refinement? Were there any uncertainties associated with the assumptions used in the COPC refinement process?

Response: An uncertainties analysis section will be added to the Technical Memorandum to discuss EPA's concerns.

I. Surface Water: Several chemicals were retained in surface water after refinement but there is no mention of the results in the Technical Memorandum. Were there any COPCs in surface water? What was the final decision on the surface water samples? Were they supposed to be further refined as the sediment samples and presented in the Technical Memorandum?

Response: Surface water is not a media that is typically evaluated in an FS because surface water by itself cannot really be cleaned up. The rationale for not including surface water will be provided in the FS, but a mention of this will be added to the Technical Memorandum as well.

J. Fish Tissue Data: According to the RI report, fish tissue data was available. This could have been used in the COPC refinement using simplistic food-web models to estimate risk.

Response: Fish tissue data were used in the RI to calculate risks using food web models. Please see the Navy's response to EPA General Comment E regarding why PRGs were not developed for upper trophic-level birds and mammals using simplistic food-web models.

K. Chemical Toxicity: The toxicities of aluminum and iron are pH dependent. Relatively PRGs were used to eliminate these 2 inorganics during the refinement without regard to sediment pH. The surface waters appear to be acidic and it is expected that sediments will also be acidic. The toxicities of iron and aluminum should therefore be reevaluated based on the sediment pH. An iron concentration of 246,000 mg/kg was selected as a NOEC but there was an effect in the sample with a concentration of 67,100 mg/kg. This supports the general comment C above.

Response: The Navy agrees that the bioavailability and therefore toxicity of aluminum and iron are pH dependent. Toxicity test data from Wetlands 3 and 5A were combined for developing PRGs. The pH in the surface water sample from location 041M030201 was 5.78 S.U. (see Table 4-3 in the RI report). This sample had the lowest pH of any of the samples in Wetlands 3 or 5A, but the sediment from this location was not toxic. This is also the location with the greatest iron concentration (246,000 mg/kg). Although pH was not measured in a surface water sample near 041M030701, this location was near 041M0303, which had a pH of 5.99. In fact, the pH in all four samples from Wetland 3 where it was measured ranged from 5.78 to 6.41. Finally, the pH in the overlying water measured during the toxicity testing (Appendix G of the RI report) indicated relatively neutral pH. Therefore, pH does not appear to be a factor in the toxicity test results. The reviewer notes that "An iron concentration of 246,000 mg/kg was selected as a NOEC but there was an effect in the sample with a concentration of 67,100 mg/kg." The Navy agrees with that statement. However, the pH discussion above supports that fact that iron was not the source of toxicity in the sample with 67,100 mg/kg. If it were, the sample with the greater iron concentration should have been toxic. Finally, Appendix K of the RI report indicated that although aluminum and iron concentrations were enriched at a few locations, these metals are widespread as NAS Pensacola and were not considered contaminants.

L. Total DDT, Total PCB etc: In soils and sediment it is easier to sum DDT and its metabolites (DDTr), sum PCB, dioxin TEQ, etc. for use in the risk assessment instead of the individual chemicals. If the screening had been done according to Region 4 requirements, total PCBs would have been retained in Table 16-1 because the detection limits are usually higher than the ecological screening values.

Response: The Navy agrees that sum DDT, sum PCB, dioxin TEQ, etc. for use in the risk assessment instead of the individual chemicals is appropriate. For that reason, Section 8.2.1 of the RI report indicates that the results for the individual chemicals were totaled. Section 8.33 of the RI report also indicates that non-detected chemicals were evaluated in the risk assessment. Total PCBs were evaluated in the RI report, and were subsequently eliminated during the refinement process in the RI. For example, see Table 10-2-19 in the RI report.

M. Ecological Risk Assessment: This comment does not pertain so much to the Technical Memorandum but to the general ecological risk assessment process. The original screening-level ecological risk assessment (SLERA) should have evaluated all of the chemicals including the detected and non-detected ones and compared them with Region 4 screening values. Reviewing the detection limits and including the non-detected analytes in the SLERA is necessary for the following reason. If the SLERA indicates adverse ecological effects are possible at environmental concentrations below standard quantitation limits, a "non-detect" based on those limits cannot be used to support a "no risk" decision (USEPA 1997). Therefore, it is essential that all contaminants (detected and non-detected) for which analysis was completed should be evaluated in the SLERA before proceeding to the refinement.

Response: Section 8.33 of the RI report indicates that detected and non-detected chemicals were evaluated in the risk assessment. Non-detected chemicals were subsequently eliminated as COPCs.

Specific Comments

Below are some specific page-by-page comments on the Technical Memorandum.

1. Page 1, last paragraph: One of the tasks listed in this section was to calculate NOECs and LOECs, no such calculations were presented in the document. As stated earlier, the results of the toxicity tests should not be the only line of evidence in selecting the NOECs and LOECs.

   Response: The Navy believes that the methodology for developing the NOECs and LOECs are adequately described in the Technical Memorandum, but the text will be reviewed to determine whether any clarification is needed. Please see the Navy's response to EPA General Comments C and E.

2. Page 2, Calculation of NOECs and LOECs: This whole section needs to be revised in light of the general comments. Bioaccumulative chemicals should not be regarded as direct toxicants.

2nd paragraph, 2nd sentence: This statement should be re-worded. Concentrations should not be described as "great." Also, it should be noted that NOECs and LOECs are determined under "specified conditions of exposure."

Last paragraph: The procedure of extrapolating risks from one wetland to another is unacceptable. This is because some of the wetlands are freshwater and others are saltwater. They have different physical and chemicals characteristics (pH, total organic carbon, particle size distribution, redox potential, etc.) which may influence risk and lead to additional uncertainty.

Response: Bioaccumulative chemicals can have direct toxic effects as well as effects to upper trophic level receptors that consume lower trophic level receptors that have bioaccumulated the chemicals. Please see the Navy's response to EPA General Comment E.

The Navy does not agree that the sentence needs reworded. The NOEC is the greatest concentration in a sample that does not cause a toxic response. The sentence will be revised, however, to address the comment: "NOECs are defined as the greatest concentrations in a sample that did not have a toxic response and LOECs are defined as the lowest concentrations greater than the NOEC in a sample that had a toxic response. NOECS and LOECs are developed using samples from the same sample set and represent the same exposure conditions."

In the RI report, the wetlands were placed into one of five groups (Groups A through E) based on contaminants, physical characteristics, and whether they were impacted by IR sites (see Section 4.2 of the RI report). These were the same groups that were used in the Technical Memorandum so the Navy believes that the use of data from one wetland to evaluate another wetland within the same group is acceptable. The Navy did not use toxicity data from a freshwater wetland to evaluate effects to a saltwater wetland.

3. Page 4, 2nd full paragraph: If none of the Wetland 5B samples were toxic and the wetland is not being used in the FS, then what is the rationale for using the toxicity results for the other wetlands? This one size fits all approach is unacceptable.

   Response: The information from Wetland 5B was presented for informational purposed in case a similar wetland is evaluated in the future. Please see the Navy's response to Specific Comment 2.

4. Page 5, Compilation of Reference Values, 1st paragraph: If the background concentrations were multiplied by two, then the rest of the text and Tables 7 and 8 should reflect this fact.

   Second paragraph: Were the values used for DDT and metabolites (DDTr) also multiplied by two? The values appear to be too high. The legal application of pesticides is not the issue here. If all pesticides were applied legally, then why are the background concentrations of only DDTr being considered and why are they orders of magnitude higher than the wetlands values? How about the background concentrations of the other pesticides?

Update of Refinement Values: Saltwater sediment screening values should not be used for freshwater sediment. The state of Florida has screening values for both and they should be used. The rationale for re-refining the COPCs was questioned in the general comments section. If they are being re-done, then they should be done using the most appropriate refinement values. This will make the document defensible.

Last paragraph: Please verify and correct the third sentence in this paragraph which states: "Freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available."

Response: The reference concentrations were the same reference concentrations used in the RI report. The fourth sentence in the first paragraph of Section "Compilation of Reference Values" will be changed to: "As presented in Section 6.1 of the RI (EnSafe, 2007a), the mean detection was calculated, multiplied by two, and the resulting multiplier was used as the reference concentration."

Please see the Navy's responses to EPA General Comments C and E regarding the DDT and metabolites (DDTx) reference concentrations. Section 6.2 of the RI explains how the basewide concentrations were developed for DDT and metabolites (DDTx). Background concentrations for the other pesticides were not developed as part of the RI.

Please see the Navy's response to EPA General Comment B regarding the refinement values.

The third sentence in the referenced paragraph is correct as it referring to the refinement values on Tables 7 and 8 in the Technical Memorandum for COCs that did not have refinement values in the RI Report. For those chemicals, freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

5. Page 6, Probable Effects Concentrations: The freshwater probable effects concentrations described here (MacDonald et al., 2000) are not the same ones listed in the tables. Those listed in the tables are saltwater values.

Development of Ecological PRGs: Mention is made of ensuring that wetlands are not excavated where there is marginal risk. This statement may be true. However, any excavation should be a risk management decision and not the conclusion of the risk assessment. The risk assessment should be performed to show where the risks are and the management decisions should be left to the risk managers.

Response: As discussed in the Navy's response to EPA Specific Comment 4, the freshwater refinement values were only used for chemicals that did not have a refinement value in the RI report.

Although the Navy agrees that the referenced sentence is a risk management statement, the statement is not coming at the end of the risk assessment. In essence, the Technical Memorandum is a risk management document because it will be an appendix to the Feasibility Study (FS). Therefore, it is an appropriate place for that statement because the PRGs are needed for the FS.

6. Page 7, 1st paragraph: The red drum model shows that mercury is an ecological risk at Wetland 64. Mercury should therefore not be eliminated from Wetland 64 because it is not a "risk driver." It was detected in 50 percent of the fish samples and 68 percent of the sediment samples at Wetland 64. Mercury should therefore be retained for further evaluation at Wetland 64. Perhaps site-specific biota-sediment accumulation factors (BSAF) should be calculated for mercury and the models should be redone to determine if it is still a problem. It is also stated in the text that mercury is not site-related. If not site-related, then where did it come from? No information is provided in the entire document about the operations of the site and which contaminants are related to the site and which ones are not.

   Response: Mercury was eliminated from further evaluation for reasons provided on Page 7, 1st paragraph. This was primarily because risks to the red drum were marginal and most of the mercury concentrations were lower that reference concentrations. The red drum model is discussed in Section 8.7.1.3 of the RI report. Actual tissue concentrations were used, when available. Mercury is a common metal that is in most fish across the State of Florida, much of which is present from atmospheric deposition. In fact, the State of Florida has a fish advisory for the state that prohibits or limits the amount of fish that pregnant or nursing women and women who may become pregnant should consume. Therefore, mercury contamination in fish appears to be a statewide problem.

7. Refinement of Chemicals of Concern, Pages 11 thru 15: Additional justification should be sought for eliminating come of the chemicals. In some cases it is stated that a chemical was detected in only one of four samples or was legally applied and therefore is eliminated. One of four is 25 percent and legal application does not preclude its presence. Site-wide averages, simplistic food-web models, alternative toxicity values, location specific information, etc. can be used to refine the COPCs.

   Response: The Navy believes that it provided sufficient justification for eliminating chemicals from evaluation in the FS. As stated in the second paragraph of the Technical Memorandum, the purpose of the memo was to refine the list of COCs to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. Therefore, the refinement that was conducted is adequate to meet that objective.

8. Wetland 15, page 12. Iron should not be eliminated from this wetland. The pH of all wetlands should be checked to determine if high levels of iron and aluminum are a problem.

Response: Please see the Navy's response to EPA General Comment K.

9. Summary and Conclusions: Please revise this section for correctness. Arsenic should be retained as an ecological COPC in Wetlands 3 and 18B.

Response: The Navy does not believe this section needs revised based on the responses to the comments. Arsenic was not a final ecological COPC from the RI report for Wetlands 3 and 18B so it was not retained as an ecological COPC in the Technical Memorandum.

10. Table 1: Arsenic should be retained as an ecological COPC.
Please check and correct the spelling of manganese and carbazole.

Response: Arsenic was only a final ecological COPC from the RI report for Wetland 15, so it was only retained as an ecological COPC for Wetland 15 in the Technical Memorandum. The spelling of manganese and carbazole will be corrected.

11. Table 2: This table is incomplete and needs a lot of clarification. The following are some questions arising from the table:

a) Laboratory control or reference numbers are not available for comparison. Did the control exposures meet the acceptance criteria?
b) There may be problems using the toxicity endpoints to derive PRGs.
c) The "C." in *C. tentans*, "H." in *H. azteca*, "N." in *N. arenaceodentata*, and "L." in *L. plumulosus* have not been spelled out anywhere in the document.
e) Growth is reported in milligrams (mg). Are the results in mg for all of the organisms or mg/organism; and is growth reported in wet weight or dry weight?
f) How was growth in the *H. azteca* tests measured and was the growth data analyzed statistically?
g) How was growth in the *C. tentans* tests measured? What was growth measured after the 28-day exposure or after 10 days of exposure? What was the duration of the emergence tests and is 50% emergence acceptable?
h) *C. tentans* was used for freshwater sediments 3 and 5A in 28-day tests and *H. azteca* was used for freshwater sediment 5B in 10-day tests. Is they any rationale for using different organisms and are the freshwater sediment toxicity results comparable between the stations?
i) The *L. plumulosus* tests were supposedly 7-day tests, while the test guidance calls for 10 or 28-day tests. Also, growth is an endpoint in this test. Therefore, the L. *plumulosus* exposures may not be adequate for ecological risk purposes. Should this fact be explained in the "uncertainties" section?
j) Were the benthic community analysis results analyzed statistically; if so were there any significant differences; if not, why not?
k) Was pH, salinity, grain size, acid-volatile sulfur, etc. of the sediments measured?
l) Was benthic community analysis performed at Wetland 5B?

Response:

a) The toxicity test lab reports are presented in Appendix G of the RI report for your review. The control sediment had acceptable survival results.

b) Please clarify the problems using the toxicity endpoints to derive PRGs.

c) The "C." in *C. tentans*, "H." in *H. azteca*, "N." in *N. arenaceodentata*, and "L." in *L. plumulosus* will be spelled out in the document.

e) Based on the lab reports presented in Appendix G of the RI report, it appears that growth is reported in milligrams/organism, dry weight. This will be added to Table 2.

f) After final counts, the surviving organisms were placed, by replicates, into tared weigh boats, placed in a drying oven and dried overnight at 60°C. Each replicate was weighed after drying in a dessicator. The growth data was analyzed statistically using Toxstat. See the toxicity test report in Appendix G in the RI report for more details.

g) The same level of detail regarding the growth measurements was not presented in the toxicity test report for *C. tentans* report in Appendix G in the RI report. Growth was measured after 10 days of exposure (see Table 1 in the toxicity test report in Appendix G in the RI report). The duration of the emergence tests was 28 days. The toxicity test report indicated that "there were no chronic effects for emergence when compared to the control sediment larvae which only yielded 50% and 60% emerged adults. Guidance suggests that the average emergence usually observed is 60%, and the control population should yield 70%. All stations performed as well as or better than the control sediment." Therefore, the 50% emergence rate for the site sample is acceptable.

h) As indicated in the first paragraph in Section 4.7 of the RI report: "Initially, the 10-day *Hyalella azteca* test for survival, growth, and reproduction was planned to be performed on sediment samples collected from Wetlands 5A and 3 during Phase III. However, based on the recommendation of the contract laboratory, the 28-day *Chironomus tentans* test (ASTM Method E1706-95B) for survival and emergence was performed instead. USEPA and FDEP concurred with this analysis change. The 10-day Hyalella test was discontinued because 10 days was considered insufficient to obtain adequate growth and reproduction response, both key measurement endpoints for this test. The longer test enabled the chronic endpoints to be measured more effectively."

i) Table 8-4 in the RI reports indicates that the *L. plumulosus* were 10-day tests. Also, Table 1 in the Toxicity test Report in Appendix G of the RI report indicates the test was 10 days. It is not know why the Project Team agreed to only include the survival endpoint for *L. plumulosus*. However, growth was measured form *N. arenaceodentata* at the same locations so the Navy believes the data are adequate for ecological risk purposes and determining PRGs

j) The benthic community analysis results were not analyzed statistically. It is not known why the Project Team agreed to this approach. However, for reasons discussed in the Navy's response to EPA General Comment C, the benthic data were given much less weight for setting PRGs compared to the toxicity test data.

k) As presented in Table 4-1 of the RI report, most of the sediment samples were analyzed for grain size, but the only sediment samples analyzed for AVS/SEM were from Wetland 64 in 2001. These samples were not used for toxicity testing. It does not appear that the sediment samples were analyzed for pH or salinity.

l) Benthic community analysis was not performed at Wetland 5B.

12. Tables 3-6: The toxicity tests results are not reliable for use in selecting PRGs.

Response: The Navy disagrees that toxicity tests results are not reliable for use in selecting PRGs. Please see the Navy's response to EPA General Comment C.

13. Table 7: Please add "wetland sediment" to the title of this table and use freshwater refinement values instead of saltwater sediment refinement values. Also indicate that the reference concentrations are two times the average (of two sediments).

Response: The title of Table 7 will be changed to "REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR FRESHWATER WETLAND SEDIMENT." A footnote will be added to Table 7 to indicate which refinement values are saltwater and which are freshwater. A note that the reference concentrations are two times the average of the two reference sediment samples will be added as a footnote to Table 7.

14. Table 8: Please add "wetland sediment" to the title of this table. Also indicate that the reference concentrations are two times the average (of two sediments).

Response: The title of Table 8 will be changed to "REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR SALTWATER WETLAND SEDIMENT." A footnote will be added to Table 7 to indicate which refinement values are saltwater and which are freshwater. A note that the reference concentrations are two times the average of the two reference sediment samples will be added as a footnote to Table 8.

15. Tables 9-12: Refinement values and reference concentrations should not be used as PRGs. PRGs should be selected for DDTr, total PCBs, etc. and not the individual chemicals.

Response: The Navy believes that refinement values and reference concentrations can be used to set PRGs because PRGs should not be lower than reference concentrations or the refinement values that were used in the RI to refine the list of COPCs. PRGs should not be selected for DDTr, total PCBs, etc. as there were not COCs from the RI report.

16. Tables 14-20: Low detection frequency has been used as a criterion for eliminating chemicals in the COPC refinement. What is the frequency of detection cut-off, 5% or 10%? A frequency of detection of 5% is considered provided enough samples were collected.

Response: Please see the Navy's response to EPA Specific Comment 7.

17. Table 21: The recent results alone should not be used to make risk decisions. All of the results should be used because there is no guarantee that the recent sampling actually sampled the original sampling locations. Also, risk driver (subjective) and site-related should not be used to eliminate chemicals from the wetlands.

Response: Please see the Navy's response to EPA Specific Comment 7.

18. Table 22: Arsenic should be included as a final COPC in Wetlands 3 and 18B and mercury should be included in Wetland 64 for further evaluation.

Response: Please see the Navy's response to EPA Specific Comment 9 for arsenic. Please see the Navy's response to EPA Specific Comment 7 for mercury.

NAS Pensacola Partnering Conference Call Summary

For the Response to Comments on the

Technical Memorandum Site 41 - Combined Wetlands, Naval Air Station, Pensacola.

Date: August 23, 2010

Participants:

Gerry Walker (TtNUS)
David Grabka (FDEP)
Allison Harris (Ensafe)
Brian Caldwell (TtNUS)
Greg Fraley (USEPA)
Aaron Bernhardt (TtNUS)
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Linda George (EPA)
Leo
Steve Stuchel (EPA)
Ligia Mora-Applegate (FDEP)
Juanita Sapp (TtNUS, scribe)

Purpose: This teleconference was initiated by the Navy to discusses the Regulatory comments by the U.S. Environmental Protection Agency (USEPA) and Florida Department of Environmental Protection (FDEP); the Response to Regulatory Comments provided by the Navy; and the Response to Response to Comments submitted by FDEP on the: Technical Memorandum -Refined List of Chemicals of Concern for the Feasibility Study and Development of Preliminary Remediation Goals for Sediment, Site 41 -Combined Wetlands, Naval Air Station, Pensacola. The document is undated. If the University of Florida indicated that the responses were acceptable in their follow-up comments, they were not discussed during the call and are not summarized in these minutes.

University of Florida Comment #1: Derivation of the wetland-specific PRGs was based on sediment toxicity testing. Table 2 states that samples 041M5A0501 and 041M640501 are not considered toxic despite significant reductions in growth for C. *tentans* and N. *arenaceodentata*, respectively, due to the high benthic diversity at those sample locations. Based on the sediment quality triad, if sediment samples exceed default chemistry criteria and show statistically significant toxicity to benthic organisms, the presence of a diverse benthic community does not preclude impacts to aquatic life. In fact, it suggests that the chemicals are likely stressing the ecosystem (MacDonald and Ingersoll, 2002, Table 23). Therefore, samples 041M5A0501 and 041M640501 should be considered toxic. This changes the no observed effects concentration (NOEC) and lowest observed effects concentration (LOEC) for antimony, cadmium, copper, lead, and zinc in Wetlands 3 and SA (Table 3) and for all chemicals excluding endosulfan I in Wetland 64 (Table 6).

Navy response to Comment #1: The conclusion of Section 11.1.4.4 of the RI report states that "Based on the evaluation of Wetland SA to date, previous levels of constituents caused statistically significant reduction of growth at one sampling station, 041M5A05. However, the community index indicated that this location indicated the highest levels of diversity in Wetland SA." The conclusion of Section 11.3.4.3 of the RI report states that "Based on the results of the chemistry and toxicity data, sample locations 041M640401 and 041M640601 exhibited conditions in which toxic chemicals were probably stressing the system." The report did not conclude that 041M640501 was a toxic location. Therefore, the Navy does not believe that either location should be considered toxic for purposes of setting PRGs.

Follow-up response to Comment #1: It is understood that samples 041M5A05 and 041M640501 were not considered toxic in the RI report. However, the weight-of-evidence approach suggests that chemicals at these two locations are stressing the ecosystem. Chemical concentrations that adversely affect the ecosystem should be taken into consideration when deriving PRGs even if a particular sample location was not labeled as toxic in the RI report.

Consensus: The discussion focused on whether 041M5A05 and 041M640501 should be considered toxic for setting PRGs. FDEP indicates that samples in question should be considered toxic for Wetland 64 because they had marginally lower growth, even though survival in the samples was not impacted. TtNUS indicated that the benthic community metrics were the highest at these locations indicating that the benthic community was not being impacted. Identifying those samples as toxic would be a disconnect between the Remedial Investigation (RI) and the Feasibility Study (FS). TtNUS indicated that they would evaluate the impact that identifying those two samples toxic would have on the PRGs. [Post meeting note: It was determined that the overall PRGs would not change significantly by identifying those two samples as toxic, so to be consistent with the conclusions of the RI, the PRGs were developed identifying those samples as non-toxic. However, the uncertainty section that was added to the Technical Memorandum includes a discussion to present the impact that on the PRGs had those samples been identified as toxic.]

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University of Florida Comment #2: Table 2 presents a summary of the sediment toxicity tests. It is unclear from this table how the toxicity tests were performed. Notably, the length of the toxicity test is absent. The FDEP recommended method for determining chronic toxicity to fresh water whole sediment is the 42-day *Hyalella azteca* survival, growth, and reproduction test and the *Chironomus tentans* life-cycle fest. For salt-water whole sediment, the FDEP recommends the 42-day *H. azteca* survival, growth and reproduction test and the *Leptochirus plumulosus* growth and reproduction test. The organisms *N. arenicola* and *N. arenaceodentata* utilized for salt-water toxicity testing at NAS Pensacola Site 41 are not included in the organisms recommended for sediment toxicity testing by the FDEP (FDEP, 2004).

Navy response to Comment #2: Section 8.7.3 and Table 8-4 of the RI report describes the toxicity testing that was conducted, including the length of the tests. No regulator comments were received on the RI report regarding the length of the test or the test species selected.

Follow-up response to Comment #2: The 42-day H. azteca survival, growth, and reproduction test is recommended by the FDEP for assessment of the chronic toxicity of sediments to benthic invertebrates. Wetlands 64, 16, and 18 utilized a 20-day marine *N. arenacoedentala* chronic toxicity test and Wetlands 5A and 3 utilized a 28-day C. tentans toxicity test (Table 8-4 of the RI). Chronic toxicity may occur at lower concentrations when the organisms are exposed for longer periods of time. The 42-day chronic toxicity test recommended by the FDEP may reveal toxicity at lower concentrations than is visualized during a 20-or 28-day toxicity test. Use of these shorter tests increases the uncertainty in the toxicity results and may leave toxic sediments on-site.

Consensus: Dave Grabka indicated that toxicity tests could be used to define the area that is impacted, versus using chemical concentrations. If so, the partnering team needs to make a decision on whether the 42-day toxicity test should be conducted in the future, vs. 20- or 28-day toxicity tests, which is the test that the FDEP Risk assessors recommend. Steve Stuckel (EPA) indicated that in his experience, the 28-day test is adequate for determining toxicity. He stated that other confounding factors can impact the toxicity test when it lasts longer than 28 days and the only additional endpoint that is measured is reproduction. However he noted that he has not seen very many 42-day tests used in practice.

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University of Florida Comment #3: The sediment toxicity tests do not appear to have been interpreted correctly. Page 2 defines a NOEC as the greatest concentration that does not cause a toxic response. However, this definition allows the NOEC to be greater than concentrations that displayed sediment toxicity. For example, in Table 3 the greatest concentration of lead that did not cause a toxic response is 75.5 mg/kg in sample 041M5A0601. However, toxicity was seen in sample 041M030701 at a lead concentration of 35.6

mglkg. Based on the above definition, 75.5 mglkg is considered a NOEC despite the toxic response at 35.6 mglkg lead. NOECs should not exceed the lowest toxic concentration in a sediment sample.

Navy response to Comment #3: By definition, the NOEC can be greater than concentrations of the same chemical in samples that are considered to be toxic because a NOEG is defined as the greatest concentration of a chemical in a non-toxic sample. The LOEG is defined as the lowest concentration in a toxic sample provided that the concentration is greater than the NOEG. Therefore, the NOEGs can exceed the lowest toxic concentration in a sediment sample.

Follow-up response to Comment #3: Sediment toxicity tests evaluate the toxicity of the mixture of chemicals present within the sediment. The benefit to these tests is that they account for the possible non-additive toxic effects of mixtures and for changes in site-specific bio-availability. Because many site-specific characteristics are affecting the toxicity of the samples, it is difficult to determine what combination of sediment characteristics is responsible for the toxic effect. Therefore, the LOEC of 35.6 mg/kg lead should have greater weight than the NOEC of 75.5 mg/kg. In addition, the LOEC (Wetland 3) and NOEC (Wetland 5A) concentrations for lead come from two separate wetlands in Wetland Group B. It appears that the grouping of these two wetlands may not be appropriate.

Consensus: In most wetlands there are not a lot of data to evaluate other characteristics that may be impacting the toxicity of the samples. However, the NOEC and LOEC approach was conservative, as noted by some of the values. Therefore, the data will be reviewed to determine whether the NOECs and LOECs can be modified based on site-specific characteristics. [**Post meeting note**: The site specific physical characteristics are discussed in the uncertainty analysis section that was added to the Technical Memorandum.]

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University of Florida· Comment #4: In Table 7, marine water sediment PELs are utilized as freshwater sediment probable effects concentrations (PEGs). This is problematic for arsenic and 4,4'-DDE because their marine water PELs are not protective of benthic organisms in freshwater sediment. The marine water sediment PEL value for arsenic of 41.6 mglkg exceeds the Florida sediment quality assessment guideline (SQAG) freshwater PEG of 33 mglkg. The 4,4'-DDE marine water PEL of 0.374 mglkg exceeds the Florida SQAG freshwater PEG of 0.031 mglkg. PEGs are utilized as not-to-exceed values. When the default PEG value is selected as the PRG, chemical concentrations at freshwater wetlands of concern (Wetlands 3, 5A, 18A, and 48) should not exceed the PEG values listed in MacDonald et al. (2003).

Navy response to Comment #4: The saltwater refinement values from the RI were used, when available, because they were agreed to by the ecological technical subgroup as documented in the November 16, 2007 responses to EPA comments dated April 5, 2006 which indicated "The Tier I Partnering Team agreed to use only the EPA Region 4 Screening values and the FDEP PELs and TELs" in the RI. Also, as documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006: "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division." However, if refinement values were not available then freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

Follow-up response to Comment #4: It is unclear why marine water PELs were utilized for freshwater sediment when freshwater PECs are available. As stated above, marine water PELs for arsenic and 4,4'-DDE exceed the freshwater PECs and are not protective of freshwater benthic invertebrates. Use of the marine water PELs for freshwater is likely to result in toxic sediments remaining in freshwater wetlands.

Consensus: Although it was acknowledged that the RI report used saltwater refinement values for both the freshwater and saltwater wetlands, as agreed to be the project team at the time, it was agreed that for this Technical Memorandum, saltwater refinement values would be used for saltwater wetlands and freshwater refinement values would be used for freshwater wetlands. It was also agreed that the refinement values would not be changed in the RI report.

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University of Florida Comment #5: In Table 9, the proposed overall ecological PRG for aldrin (0.08 mglkg) and manganese (1,100 mg/kg) for Wetlands 3, 5A, and 18A are severe effects levels (SELs). SELs should not be utilized as remedial goals since they are not protective of the benthic community. We recommend utilizing the US EPA Region III freshwater sediment screening benchmarks of 0.002 mg/kg for aldrin and 460 mg/kg for manganese. These values are lowest effect levels (LELs) and are likely to provide more adequate protection of the aquatic community.

Navy response to Comment #5: The Navy does not agree that screening levels should be used as PRGs. The SELs are similar in definition to the PELs that were used to refine the list of COPCs in the RI report, and were also used as one of the criteria for setting PRGs in the Technical Memorandum.

Follow-up response to Comment #5: SELs are defined as the concentration at which a pronounced disturbance of the sediment-dwelling community can be expected. The SEL represents approximately the 90th percentile of the effects data. The PEL represents the geometric mean of the 50th percentile of the effects data and the 85th percentile of the no effect data. We therefore disagree that SELs are similar to PELs (MacDonald et al., 2003). SELs suggest significant adverse impacts to the benthic community and should not be utilized as PRGs.

Consensus: The Navy agreed to look at other refinement values or other approaches for determining the refinement values such as using the geometric range of the LEL and SEL. [Post meeting note: The Upper Effects Thresholds from Buchman (2008) was used as the refinement values for aldrin and manganese in the Technical Memorandum.]

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University of Florida Comment #7: The human health PRGs listed in Table 13 for the maintenance worker and recreational fisherman are not apportioned. Per Chapter 62780, FAC., alternative soil clean-up target levels (CTLs) should be apportioned.

Navy response to Comment #7: The Navy would like to discuss this comment further with the State. If the PRGs are apportioned according to the number of carcinogenic/noncarcinogenic chemicals at each area, several of the sediment PRGs will result in fish tissue concentrations that are much lower than what is used to set fish advisories in the State of Florida. This is because the State of Florida sets fish advisories using a 10E-4 risk level, whereas apportioning the PRGs results in fish tissue levels based on a less than 10E-7 risk level. The resulting fish tissue concentrations would likely be less than background concentrations. This would also occur if the PRGs were not apportioned, but the impacts would not be as severe. Note that there was an error in the fraction of organic carbon values that were used to calculate the PRGs at Wetlands 15 and 64 so those corrections will be made when the PRGs are re-calculated.

Follow-up response to Comment #7: In the State of Florida, human health risk-based CTLs are derived using a target risk level of 10^{-6}. This includes CTLs based on the consumption of fish (Chapter 62-302, FAC.), which have a health protection goal very different from a fish advisory level. Additionally, whenever alternative CTLs are utilized, apportionment is required per Chapter 62-780, FAC. This ensures the total risk from chemicals present at the site does not exceed the FDEP target risk of 10^{-6}.

Consensus: This item was not resolved during the call, but it was agreed that the Technical Memorandum should include better support for the approach used to develop the human health PRGs. [Post meeting note: This additional support was included in the revised Technical Memorandum.]
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University of Florida Comment #9: In the calculation of PRGs for sediment protective of ingestion of fish, the fraction of intake from the site (FI) is 0.1. This assumes that on the day a child trespasser consumes fish from the site (52 d/y), the fish caught on-site will only account for 10% of the fish ingestion that day Instead, it appears likely that all fish ingested on that day would originate from the site. Therefore, we recommend utilizing an FI of 1. This would decrease the recreational fisherman PRGs listed in Table 13 by a factor of 10.

Navy response to Comment #9: The PRG for the recreational fisherman will be modified as follows. It is assumed the recreational fisherman eats one fish meal a week over a course of the year or 52 meals a year. Not all of the fish that the recreational fisherman eats will come from the wetlands. It is assumed that only 10 percent or 5 meals consists of fish caught at anyone wetlands, therefore the exposure frequency would be 5 meals per year. Since the entire meal would come from the site a value of 1 will be used for the fraction ingested.

Follow-up response to Comment #9: The above response modifies the exposure frequency of the recreational fisherman to 5 d/y . This exposure frequency appears low for a recreational fisherman scenario. We recommend using a value of 52 d/y as proposed in the technical memorandum. This exposure frequency represents a value of approximately once a week and appears more reasonable.

Consensus: Addressed in comment 7
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c. <u>Wetland 15:</u>

i. Lead, 4,4'-DDD, 4,4'-DDT, and total DDT were listed as ecological COCs in the remedial investigation report (RI) Table 16-1 but were omitted as ecological COCs in the technical memorandum. Because these chemicals exceed refinement criteria in the RI, they should remain ecological COCs for Wetland 15.

ii. Delta-BHC was listed as an ecological COC in the RI report Table 16-1 (delta-BHC HQ = 5.6). Although it was eliminated in this technical memorandum as a COC for human health, it remains an ecological COC for this wetland.

Navy response to Comment #11c: Lead, 4,4'-DDD, 4,4'-DDT, total DDT, and delta-BHC were not listed as ecological COCs at Wetland 15 in the revised Table 16-1 (see Attachment A of the Technical Memorandum). Therefore, they were not evaluated as ecological COCs in the Technical Memorandum.

Follow-up response to Comment #11c: Revised Table 16-1 excludes total DDT and total BHC as ecological COCs based on food chain modeling results that conclude the hazard quotient is less than one for concentrations present in Wetland 15. However, it is not clear why lead was excluded as an ecological COC. Revised Table 16-1 lists an HQ of 1.9 for lead in Wetland 15 and it appears to remain of concern.

Consensus: Text will be added to the Technical Memorandum to better explain why and how Table 16-1 was refined from the RI report to the Technical Memorandum.

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iii. Silver should be retained as an ecological COC In Table 6, sample 41M6405 should be considered toxic and 1.9 mglkg should be utilized as the LOEC for silver. The maximum Phase /I (5.1 mglkg), Phase /II (3 mg/kg), and Phase IV (4 mg/kg) silver concentrations exceed the LOEC. Therefore, silver should be retained as an ecological COC for this wetland.

Navy response to Comment #11h(iii): Please see the Navy's response to Comment 1. The Navy does not agree that the LOEC for silver needs revised.

Follow-up response to Comment #11h(iii): Please see the follow-up response to Comment #1. Silver should be retained as an ecological COC for Wetland 64.

Consensus: See response to Comment #1.

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iv. Table 16-1 of the RI states that mercury should be retained as a bioaccumulative COC for this wetland. The refinement PRGs presented in this document did not address bioaccumulation. Therefore, mercury should be retained as an ecological COC for this wetland.

Navy response to Comment #11h(iv): Mercury was eliminated from further evaluation for reasons provided on Page 7, 1st paragraph of the Technical Memorandum. This was primarily because risks to the red drum were marginal and most of the mercury concentrations were lower that reference concentrations. The red drum model is discussed in Section 8.7.1.3 of the RI report. Actual tissue concentrations were used, when available. Mercury is a common metal that is in most fish across the State of Florida, much of which is present from atmospheric deposition. In fact, the State of Florida has a fish advisory for the state that prohibits or limits the amount of fish that pregnant or nursing women and women who may become pregnant should consume. Therefore, mercury contamination in fish appears to be a statewide problem.

Follow-up response to Comment #11 h(iv): The response suggests that mercury concentrations in fish tissue at Wetland 64 are representative of background. To our knowledge, a site-specific background mercury concentration in fish tissue was not obtained. Although mercury concentrations in fish tissue may be elevated in some areas of the state, it is not possible to determine if the fish tissue concentrations at Wetland 64 are representative of background without a site-specific background study.

Consensus: Additional discussion regarding mercury concentrations in background fish will be included in the Technical Memorandum.

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There is a difference in the ecological COCs listed in Table 16-1 of the Final RI dated August 17, 2005 and the revised Table 16-1 listed as Attachment A of the technical memorandum. It is unclear why these tables differ or how the revised Table 16-1 was derived. Information regarding the elimination of COCs from the revised Table 16-1 should be provided.

Consensus: Text will be added to the Technical Memorandum to better explain why and how Table 16-1 was refined from the RI report to the Technical Memorandum.

General Comments:

A. Further Refinement: It is stated in the Technical Memorandum that Ensafe re-evaluated the Remedial Investigation (RI) data and refined the chemicals of concern (COC) in 2007 (Ensafe 2007a). Please note that at this early stage in the risk assessment process, Region 4 would like to refer to the COCs in the Technical Memorandum as chemicals of potential concern (COPC). If the COPCs had already been refined by Ensafe, then what is the purpose of the additional refinement in the current Technical Memorandum? The screening-level risk assessment uses conservative assumptions and the COPC refinement used benchmarks which are less conservative than those used in the refinement. Did the further refining of the COPCs in the Technical Memorandum use much less conservative benchmarks than those previously used? Also, it is usual practice in a refinement to provide the sources of the alternative (refinement) screening values (ATV), calculate refinement hazard quotients (HQ), and show how many locations exceed the ATVs. In selecting ATVs for refinement, chemical concentrations described as severe effect levels (SEL) should not be used.

Response: Note that this Technical Memorandum is not in the early stage of the risk assessment. The risk assessment was conducted as part of the approved Remedial Investigation (RI) report. As stated in the second paragraph of the Technical Memorandum, the purpose of the memorandum was to refine the list of COPCs to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. The benchmarks used in the Technical Memorandum were not less conservative than those used in the screening-level risk assessment for Site 41. Refinement values were used in the screening-level risk assessment for Site 41 to refine the list of COPCs. The source of the refinement values are noted on Tables 7 and 8. The definitions of the sources are provided in the Technical Memorandum text. Footnotes will be added to Tables 7 and 8 with the definition of the acronyms. As documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division."

Consensus: Response was acceptable

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B. Alternate Screening Values: The wetlands have been designated as either saltwater or freshwater. However, only the saltwater ATVs from Florida were used the refinement. Please provide the rationale (e.g. salinity) for designating the wetlands as either saltwater or freshwater. Were the salinities of the samples used in the designation? The state of Florida has sediment quality assessment guidelines (threshold effect concentrations and probable effect concentrations) for inland waters. The PECs should be used for refining the freshwater sediments.

Response: The reviewer is not correct that only saltwater ATVs were used refinement values. The saltwater refinement values from the RI were used, when available, because they were agreed to by the ecological technical sub-group as documented in the November 16, 2007 responses to EPA comments dated April 5, 2006 "The Tier I Partnering Team agreed to use only the EPA Region 4 Screening values and the FDEP PELs and TELs" in the RI. Also, as documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division." However, if refinement values were not available then freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

The salinity measurements in the wetlands are presented in Table 4-3 of the RI report.

Consensus: The Navy agrees to use saltwater refinement values for saltwater wetlands and freshwater refinement values for freshwater wetlands

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C. Preliminary remedial goals: The procedures used for selecting the preliminary remedial goals (PRG) in the Technical Memorandum are inappropriate. In some cases literature-derived benchmark values were used as PRGs and in other cases obviously contaminated reference or background values were used as PRGs. The Triad approach consisting of different lines of evidence (chemical analysis, benthic surveys, and toxicity tests) was used in the document but not used in selecting the PRGs in the Technical Memorandum. However, results from only the toxicity tests and/or so-called background concentrations were used to select the PRGs. The toxicity results were mostly inconclusive. No dose-response relationships were established for any of the chemicals. Therefore picking and choosing PRGs from the data is not acceptable. Information from all of the available data (chemical analysis, benthic surveys, and toxicity tests) should be synthesized and analyzed prior to selecting the PRGs. Chemical concentrations from obviously contaminated reference locations should not be selected and used as PRGs.

Response: The Navy agrees that dose-response curves were not established for the chemicals, so the more conservative approach of calculating no observed effects concentrations (NOECs) and lowest observed effects concentrations (LOECs) was used. The results of the benthic community data were presented on Table 2. However, because samples were not collected at reference locations the results within a wetland were compared to other results within the same wetland. Therefore, it is difficult to interpret the results. For that reason, the Navy put more emphasis on the toxicity test data to develop PRGs.

The Navy does not agree that the reference locations are obviously contaminated. As documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006: "The reference wetland selection and subsequent use was approved by all members of the Pensacola Partnering Team, in consultation from NOAA, University of Florida, and EPA Region 4 Ecological Services Division."

Consensus: EPA would like other data evaluated including TOC and grain size. Please see Consensus for FDEP Comment #3.

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D. Wetlands Characterization: It appears that some of the wetlands were not fully characterized. In some cases only two, four, or five sample results were used to make risk based decisions. Using a limited number of samples in the decision-making process leads to uncertainties in the risk assessment process.

Response: The Navy recognizes that additional sampling would reduce uncertainty associated with the nature and extent of potential contamination. Although, the project team at the time of the RI agreed to the sampling strategy, further sampling may be conducted as part of a long term monitoring program associated with the alternatives for the FS.

Consensus: The team agreed that additional data could be collected as part of a monitoring program.

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E. Toxicity Evaluation: The toxicity test results used in the Technical Memorandum should be evaluated properly and used with caution. The fact that there is no toxicity to benthic invertebrates from a sample does not imply that the chemical concentrations in that sample represent no-observed-effect-concentrations (NOEC) and can be used as PRGs. This is because in most cases the sediments with the highest chemical concentrations were not tested for toxicity and the NOECs and lowest-observed-effect-concentrations (LOEC) are not clear-cut. As such, the toxicity test results used in selecting the PRGs are unacceptable. Different test organisms with different sensitivities were used in the toxicity tests. The proper assumptions should be used in selecting toxicity endpoints and the associated uncertainties should be discussed. Also, the mode of action of some of the chemicals in the sediment samples is different and their effects cannot be shown merely by direct toxicity. For example the pesticides and some of the inorganics (e.g. mercury, selenium, etc.) bioaccumulate in the food web therefore their bioaccumulation potential is more important than direct toxicity. Using direct toxicity endpoints to assess these chemicals and select PRGs for them may lead to additional uncertainties. Simplistic food-web models can be used for the bioaccumulative chemicals.

Response: The fact that there is no toxicity to benthic invertebrates from a sample implies that the chemical concentrations in that sample represent an unbounded no-observed-effect-concentration (NOEC), provided that the concentration was the greatest concentration tested. That fact that in some cases the sediments with the highest chemical concentrations were not tested for toxicity only indicates that the true NOEC may be even higher. This is an acceptable method for selecting PRGs, which the Navy has done on many sites across the country.

The Navy agrees that different test organisms with different sensitivities were used in the toxicity tests, but this does not affect the development of NOECs or LOECs.

The Navy agrees that the mode of action of some of the chemicals in the sediment samples is different and their effects cannot be shown merely by direct toxicity. However, the NOECs and LOECs that were developed were from impacts to sediment invertebrates from direct toxicity.

Simplistic food chain models were used in the RI to evaluate risks to upper trophic-level birds and mammals for each terrestrial operable unit in accordance with agreements reached with FDEP and their risk assessors from the University of Florida, EPA and their ecological risk assessors and the Navy. The Navy does not believe that risks were great enough (i.e., NOAEL HQs greater than 1.0 using site-specific bioaccumulation data and average concentrations) to warrant developing PRGs for those receptor. Risk to red drum from mercury is discussed at the end of the first complete paragraph on page 15 of the technical memorandum.

Consensus: Parts of this comment were already discussed with the FDEP comments. No changes need to be made to the Technical Memorandum based on this comment.

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F. Reference Stations/Concentrations: Reference stations are usually selected from areas not influenced by the site and should be reviewed for appropriateness prior to use in a risk assessment. In some cases reference stations may have contaminant concentrations that exceed screening values. This does not imply that chemical concentrations from those stations should be used to eliminate chemicals from consideration in the risk assessment. Rather, the reference station data should be used for appropriateness before they are used. Freshwater sediment reference station results should not be used for saltwater sediment reference stations. The concentrations of DDT/DDD/DDE from the reference stations were much higher than their respective ecological screening values (ESV) and should not be used in the risk assessment. In fact some of the DDT concentrations were up to 300 times higher than the site concentrations. These concentrations should also not be used as PRGs.

Response: Please see the Navy's response to EPA General Comment C. The basewide levels for DDT, DDE and DDD were developed as a Team Decision. As indicated in NOAA's March 22, 2001 Comment No. 2 on the Final RI report for Site 41 stated: "The Pensacola NAS team examined these histograms, identified inflection points and agreed to concentrations which we believe represent base-wide DDTx levels....Independently gathered DDTx information indicate similar concentrations found in the Pensacola Bay area. The histograms, independent data and approach used by the team is a technical success story and should be highlighted in the RI Report." The values cited in there comment were: 20 ppb for DDT, 40 ppb for DDE, and 50 ppb for DDD. Therefore, the Navy believes that the DDT/DDD/DDE concentrations from the reference stations can be used to set PRGs, when they are greater than site-specific risk-based values.

Consensus: EPA indicated that they accept the team's decision about background. No changes need to be made to the Technical Memorandum based on this comment.

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G. Site-Related Chemicals: Some of the chemicals were eliminated during the refinement because they were determined not to be site-related or not to be risk drivers. Some of these terminologies are subjective. No site-related chemicals or risk drivers were identified in the Technical Memorandum. The process for eliminating chemicals in the refinement should be reviewed with special attention paid to the bioaccumulative chemicals.

Response: Although the terminologies may be somewhat subjective, terms like "site-related" and "risk drivers" are commonly used to refine the list of ecological COPCs. The text in the Technical Memorandum explains why the Navy believes that certain chemicals are not "site-related" and/or "risk drivers." Again, the purpose of the technical memorandum was to refine the list of COPCs to the primary risk drivers that could reasonable be evaluated in the FS. For example, it is not beneficial to evaluate endosulfan sulfate in the FS at Wetland 3 when it was detected in 3 of 12 samples at a maximum detected concentration of 0.0072 mg/kg. This low concentration is not indicative of a disposal activity and other chemicals at the site (i.e., arsenic and cadmium) are of greater concern. Therefore, if risks from other chemicals that are detected more frequently and at greater concentrations are addressed in the FS, risk from the less frequently detected chemicals also should be addressed.

Please see the Navy's response to EPA General Comment E regarding bioaccumulative chemicals.

Consensus: Additional information would be added to the Technical Memorandum, where necessary, to help support the decisions for eliminating chemicals as risk drivers.

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H. Uncertainties and Data Gaps: The Technical Memorandum could benefit from an "uncertainties" and a "data gaps" section. Was the available data enough to make risk decisions and are there any additional data needs? What are some of the assumptions used in the refinement? Were there any uncertainties associated with the assumptions used in the COPC refinement process?

Response: An uncertainties analysis section will be added to the Technical Memorandum to discuss EPA's concerns.

Consensus: It was agreed that an uncertainty analysis section would be added to the Technical Memorandum.

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I. Surface Water: Several chemicals were retained in surface water after refinement but there is no mention of the results in the Technical Memorandum. Were there any COPCs in surface water? What was the final decision on the surface water samples? Were they supposed to be further refined as the sediment samples and presented in the Technical Memorandum?

Response: Surface water is not a media that is typically evaluated in an FS because surface water by itself cannot really be cleaned up. The rationale for not including surface water will be provided in the FS, but a mention of this will be added to the Technical Memorandum as well.

Consensus: The Technical Memorandum will mention that surface water is not evaluated in the memorandum because the primary sink for contaminants is sediment and it is difficult to remediate surface water.

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J. Fish Tissue Data: According to the RI report, fish tissue data was available. This could have been used in the COPC refinement using simplistic food-web models to estimate risk.

Response: Fish tissue data were used in the RI to calculate risks using food web models. Please see the Navy's response to EPA General Comment E regarding why PRGs were not developed for upper trophic-level birds and mammals using simplistic food-web models.

Consensus: Response was acceptable.

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K. Chemical Toxicity: The toxicities of aluminum and iron are pH dependent. Relatively PRGs were used to eliminate these 2 inorganics during the refinement without regard to sediment pH. The surface waters appear to be acidic and it is expected that sediments will also be acidic. The toxicities of iron and aluminum should therefore be reevaluated based on the sediment pH. An iron concentration of 246,000 mg/kg was selected as a NOEC but there was an effect in the sample with a concentration of 67,100 mg/kg. This supports the general comment C above.

Response: The Navy agrees that the bioavailability and therefore toxicity of aluminum and iron are pH dependent. Toxicity test data from Wetlands 3 and 5A were combined for developing PRGs. The pH in the surface water sample from location 041M030201 was 5.78 S.U. (see Table 4-3 in the RI report). This sample had the lowest pH of any of the samples in Wetlands 3 or 5A, but the sediment from this location was not toxic. This is also the location with the greatest iron concentration (246,000 mg/kg). Although pH was not measured in a surface water sample near 041M030701, this location was near 041M0303, which had a pH of 5.99. In fact, the pH in all four samples from Wetland 3 where it was measured ranged from 5.78 to 6.41. Finally, the pH in the overlying water measured during the toxicity testing (Appendix G of the RI report) indicated relatively neutral pH. Therefore, pH does not appear to be a factor in the toxicity test results. The reviewer notes that "An iron concentration of 246,000 mg/kg was selected as a NOEC but there was an effect in the sample with a concentration of 67,100 mg/kg." The Navy agrees with that statement. However, the pH discussion above supports that fact that iron was not the source of toxicity in the sample with 67,100 mg/kg. If it were, the sample with the greater iron concentration should have been toxic. Finally, Appendix K of the RI report indicated that although aluminum and iron concentrations were enriched at a few locations, these metals are widespread as NAS Pensacola and were not considered contaminants.

Consensus: The Navy agreed to evaluate pH data to determine whether aluminum and iron need to be retained as risk drivers.

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L. Total DDT, Total PCB etc: In soils and sediment it is easier to sum DDT and its metabolites (DDTr), sum PCB, dioxin TEQ, etc. for use in the risk assessment instead of the individual chemicals. If the screening had been done according to Region 4 requirements, total PCBs would have been retained in Table 16-1 because the detection limits are usually higher than the ecological screening values.

Response: The Navy agrees that sum DDT, sum PCB, dioxin TEQ, etc. for use in the risk assessment instead of the individual chemicals is appropriate. For that reason, Section 8.2.1 of the RI report indicates that the results for the individual chemicals were totaled. Section 8.33 of the RI report also indicates that non-detected chemicals were evaluated in the risk assessment. Total PCBs were evaluated in the RI report, and were subsequently eliminated during the refinement process in the RI. For example, see Table 10-2-19 in the RI report.

Consensus: Response was acceptable.

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M. Ecological Risk Assessment: This comment does not pertain so much to the Technical Memorandum but to the general ecological risk assessment process. The original screening-level ecological risk assessment (SLERA) should have evaluated all of the chemicals including the detected and non-detected ones and compared them with Region 4 screening values. Reviewing the detection limits and including the non-detected analytes in the SLERA is necessary for the following reason. If the SLERA indicates adverse ecological effects are possible at environmental concentrations below standard quantitation limits, a "non-detect" based on those limits cannot be used to support a "no risk" decision (USEPA 1997). Therefore, it is essential that all contaminants (detected and non-detected) for which analysis was completed should be evaluated in the SLERA before proceeding to the refinement.

Response: Section 8.33 of the RI report indicates that detected and non-detected chemicals were evaluated in the risk assessment. Non-detected chemicals were subsequently eliminated as COPCs.

Consensus: Response was acceptable.

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Specific Comments

Below are some specific page-by-page comments on the Technical Memorandum.

1. Page 1, last paragraph: One of the tasks listed in this section was to calculate NOECs and LOECs, no such calculations were presented in the document. As stated earlier, the results of the toxicity tests should not be the only line of evidence in selecting the NOECs and LOECs.

   Response: The Navy believes that the methodology for developing the NOECs and LOECs are adequately described in the Technical Memorandum, but the text will be reviewed to determine whether any clarification is needed. Please see the Navy's response to EPA General Comments C and E.

Consensus: EPA would like other data evaluated including TOC and grain size. Please see Consensus for FDEP Comment #3.

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2. Page 2, Calculation of NOECs and LOECs: This whole section needs to be revised in light of the general comments. Bioaccumulative chemicals should not be regarded as direct toxicants.

2nd paragraph, 2nd sentence: This statement should be re-worded. Concentrations should not be described as "great." Also, it should be noted that NOECs and LOECs are determined under "specified conditions of exposure."

Last paragraph: The procedure of extrapolating risks from one wetland to another is unacceptable. This is because some of the wetlands are freshwater and others are saltwater. They have different physical and chemicals characteristics (pH, total organic carbon, particle size distribution, redox potential, etc.) which may influence risk and lead to additional uncertainty.

Response: Bioaccumulative chemicals can have direct toxic effects as well as effects to upper trophic level receptors that consume lower trophic level receptors that have bioaccumulated the chemicals. Please see the Navy's response to EPA General Comment E.

The Navy does not agree that the sentence needs reworded. The NOEC is the greatest concentration in a sample that does not cause a toxic response. The sentence will be revised, however, to address the comment: "NOECs are defined as the greatest concentrations in a sample that did not have a toxic response and LOECs are defined as the lowest concentrations greater than the NOEC in a sample that had a toxic response. NOECS and LOECs are developed using samples from the same sample set and represent the same exposure conditions."

In the RI report, the wetlands were placed into one of five groups (Groups A through E) based on contaminants, physical characteristics, and whether they were impacted by IR sites (see Section 4.2 of the RI report). These were the same groups that were used in the Technical Memorandum so the Navy believes that the use of data from one wetland to evaluate another wetland within the same group is acceptable. The Navy did not use toxicity data from a freshwater wetland to evaluate effects to a saltwater wetland.

Consensus: The Navy agreed to provide a better explanation of the NOEC and LOEC in the Technical Memorandum. Please see Consensus for FDEP Comment #3.

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3. Page 4, 2nd full paragraph: If none of the Wetland 5B samples were toxic and the wetland is not being used in the FS, then what is the rationale for using the toxicity results for the other wetlands? This one size fits all approach is unacceptable.

Response: The information from Wetland 5B was presented for informational purposed in case a similar wetland is evaluated in the future. Please see the Navy's response to Specific Comment 2.

Consensus: Response was acceptable.

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4. Page 5, Compilation of Reference Values, 1st paragraph: If the background concentrations were multiplied by two, then the rest of the text and Tables 7 and 8 should reflect this fact.

Second paragraph: Were the values used for DDT and metabolites (DDTr) also multiplied by two? The values appear to be too high. The legal application of pesticides is not the issue here. If all pesticides were applied legally, then why are the background concentrations of only DDTr being considered and why are they orders of magnitude higher than the wetlands values? How about the background concentrations of the other pesticides?

Update of Refinement Values: Saltwater sediment screening values should not be used for freshwater sediment. The state of Florida has screening values for both and they should be used. The rationale for re-refining the COPCs was questioned in the general comments section. If they are being re-done, then they should be done using the most appropriate refinement values. This will make the document defensible.

Last paragraph: Please verify and correct the third sentence in this paragraph which states: "Freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available."

Response: The reference concentrations were the same reference concentrations used in the RI report. The fourth sentence in the first paragraph of Section "Compilation of Reference Values" will be changed to: "As presented in Section 6.1 of the RI (EnSafe, 2007a), the mean detection was calculated, multiplied by two, and the resulting multiplier was used as the reference concentration."

Please see the Navy's responses to EPA General Comments C and E regarding the DDT and metabolites (DDTx) reference concentrations. Section 6.2 of the RI explains how the basewide concentrations were developed for DDT and metabolites (DDTx). Background concentrations for the other pesticides were not developed as part of the RI.

Please see the Navy's response to EPA General Comment B regarding the refinement values.

The third sentence in the referenced paragraph is correct as it referring to the refinement values on Tables 7 and 8 in the Technical Memorandum for COCs that did not have refinement values in the RI Report. For those chemicals, freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

Consensus: The Navy will make the above-listed changes and will use saltwater refinement values would be used for saltwater wetlands and freshwater refinement values.

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5. Page 6, Probable Effects Concentrations: The freshwater probable effects concentrations described here (MacDonald et al., 2000) are not the same ones listed in the tables. Those listed in the tables are saltwater values.

Development of Ecological PRGs: Mention is made of ensuring that wetlands are not excavated where there is marginal risk. This statement may be true. However, any excavation should be a risk management decision and not the conclusion of the risk assessment. The risk assessment should be performed to show where the risks are and the management decisions should be left to the risk managers.

Response: As discussed in the Navy's response to EPA Specific Comment 4, the freshwater refinement values were only used for chemicals that did not have a refinement value in the RI report.

Although the Navy agrees that the referenced sentence is a risk management statement, the statement is not coming at the end of the risk assessment. In essence, the Technical Memorandum is a risk management document because it will be an appendix to the Feasibility Study (FS). Therefore, it is an appropriate place for that statement because the PRGs are needed for the FS.

Consensus: See Consensus for EPA Comment #4.

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6. Page 7, 1st paragraph: The red drum model shows that mercury is an ecological risk at Wetland 64. Mercury should therefore not be eliminated from Wetland 64 because it is not a "risk driver." It was detected in 50 percent of the fish samples and 68 percent of the sediment samples at Wetland 64. Mercury should therefore be retained for further evaluation at Wetland 64. Perhaps site-specific biota-sediment accumulation factors (BSAF) should be calculated for mercury and the models should be redone to determine if it is still a problem. It is also stated in the text that mercury is not site-related. If not site-related, then where did it come from? No information is provided in the entire document about the operations of the site and which contaminants are related to the site and which ones are not.

Response: Mercury was eliminated from further evaluation for reasons provided on Page 7, 1st paragraph. This was primarily because risks to the red drum were marginal and most of the mercury concentrations were lower that reference concentrations. The red drum model is discussed in Section 8.7.1.3 of the RI report. Actual tissue concentrations were used, when available. Mercury is a common metal that is in most fish across the State of Florida, much of which is present from atmospheric deposition. In fact, the State of Florida has a fish advisory for the state that prohibits or limits the amount of fish that pregnant or nursing women and women who may become pregnant should consume. Therefore, mercury contamination in fish appears to be a statewide problem.

Consensus: Additional discussion regarding mercury concentrations in background fish will be included in the Technical Memorandum.

==

7. Refinement of Chemicals of Concern, Pages 11 thru 15: Additional justification should be sought for eliminating come of the chemicals. In some cases it is stated that a chemical was

detected in only one of four samples or was legally applied and therefore is eliminated. One of four is 25 percent and legal application does not preclude its presence. Site-wide averages, simplistic food-web models, alternative toxicity values, location specific information, etc. can be used to refine the COPCs.

Response: The Navy believes that it provided sufficient justification for eliminating chemicals from evaluation in the FS. As stated in the second paragraph of the Technical Memorandum, the purpose of the memo was to refine the list of COCs to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. Therefore, the refinement that was conducted is adequate to meet that objective.

Consensus: Additional information would be added to the Technical Memorandum, where necessary, to help support the decisions for eliminating chemicals as risk drivers.

==

8. Wetland 15, page 12. Iron should not be eliminated from this wetland. The pH of all wetlands should be checked to determine if high levels of iron and aluminum are a problem.

Response: Please see the Navy's response to EPA General Comment K.

Consensus: The Navy agreed to evaluate pH data to determine whether aluminum and iron need to be retained as risk drivers.

==

9. Summary and Conclusions: Please revise this section for correctness. Arsenic should be retained as an ecological COPC in Wetlands 3 and 18B.

Response: The Navy does not believe this section needs revised based on the responses to the comments. Arsenic was not a final ecological COPC from the RI report for Wetlands 3 and 18B so it was not retained as an ecological COPC in the Technical Memorandum.

Consensus: The Navy will re-evaluate whether arsenic should be retained as an ecological COPC in Wetlands 3 and 18B. [**Post meeting note:** arsenic was retained as a risk driver for Wetland 18B.]

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10. Table 1: Arsenic should be retained as an ecological COPC.
Please check and correct the spelling of manganese and carbazole.

Response: Arsenic was only a final ecological COPC from the RI report for Wetland 15, so it was only retained as an ecological COPC for Wetland 15 in the Technical Memorandum. The spelling of manganese and carbazole will be corrected.

Consensus: The Navy will correct the spelling errors. See Consensus for EPA Comment #9 regarding arsenic.

==

11. Table 2: This table is incomplete and needs a lot of clarification. The following are some questions arising from the table:

a) Laboratory control or reference numbers are not available for comparison. Did the control exposures meet the acceptance criteria?
b) There may be problems using the toxicity endpoints to derive PRGs.
c) The "C." in *C. tentans*, "H." in *H. azteca*, "N." in *N. arenaceodentata*, and "L." in *L. plumulosus* have not been spelled out anywhere in the document.
e) Growth is reported in milligrams (mg). Are the results in mg for all of the organisms or mg/organism; and is growth reported in wet weight or dry weight?
f) How was growth in the *H. azteca* tests measured and was the growth data analyzed statistically?
g) How was growth in the *C. tentans* tests measured? What was growth measured after the 28-day exposure or after 10 days of exposure? What was the duration of the emergence tests and is 50% emergence acceptable?
h) *C. tentans* was used for freshwater sediments 3 and 5A in 28-day tests and *H. azteca* was used for freshwater sediment 5B in 10-day tests. Is they any rationale for using different organisms and are the freshwater sediment toxicity results comparable between the stations?
i) The *L. plumulosus* tests were supposedly 7-day tests, while the test guidance calls for 10 or 28-day tests. Also, growth is an endpoint in this test. Therefore, the L. *plumulosus* exposures may not be adequate for ecological risk purposes. Should this fact be explained in the "uncertainties" section?
j) Were the benthic community analysis results analyzed statistically; if so were there any significant differences; if not, why not?
k) Was pH, salinity, grain size, acid-volatile sulfur, etc. of the sediments measured?
l) Was benthic community analysis performed at Wetland 5B?

Response:

a) The toxicity test lab reports are presented in Appendix G of the RI report for your review. The control sediment had acceptable survival results.

Consensus: Response was acceptable.

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b) Please clarify the problems using the toxicity endpoints to derive PRGs.

Consensus: See Consensus for EPA Comment #1.

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c) The "C." in *C. tentans*, "H." in *H. azteca*, "N." in *N. arenaceodentata*, and "L." in *L. plumulosus* will be spelled out in the document.

Consensus: Response was acceptable.

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e) Based on the lab reports presented in Appendix G of the RI report, it appears that growth is reported in milligrams/organism, dry weight. This will be added to Table 2.

Consensus: Response was acceptable.

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f) After final counts, the surviving organisms were placed, by replicates, into tared weigh boats, placed in a drying oven and dried overnight at 60°C. Each replicate was weighed after drying in a dessicator. The growth data was analyzed statistically using Toxstat. See the toxicity test report in Appendix G in the RI report for more details.

Consensus: Response was acceptable.

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g) The same level of detail regarding the growth measurements was not presented in the toxicity test report for *C. tentans* report in Appendix G in the RI report. Growth was measured after 10 days of exposure (see Table 1 in the toxicity test report in Appendix G in the RI report). The duration of the emergence tests was 28 days. The toxicity test report indicated that "there were no chronic effects for emergence when compared to the control sediment larvae which only yielded 50% and 60% emerged adults. Guidance suggests that the average emergence usually observed is 60%, and the control population should yield 70%. All stations performed as well as or better than the control sediment." Therefore, the 50% emergence rate for the site sample is acceptable.

Consensus: Response was acceptable.

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h) As indicated in the first paragraph in Section 4.7 of the RI report: "Initially, the 10-day *Hyalella azteca* test for survival, growth, and reproduction was planned to be performed on sediment samples collected from Wetlands 5A and 3 during Phase III. However, based on the recommendation of the contract laboratory, the 28-day *Chironomus tentans* test (ASTM Method E1706-95B) for survival and emergence was performed instead. USEPA and FDEP concurred with this analysis change. The 10-day *Hyalella* test was discontinued because 10 days was considered insufficient to obtain adequate growth and reproduction response, both key measurement endpoints for this test. The longer test enabled the chronic endpoints to be measured more effectively."

Consensus: Response was acceptable.

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i) Table 8-4 in the RI reports indicates that the *L. plumulosus* were 10-day tests. Also, Table 1 in the Toxicity test Report in Appendix G of the RI report indicates the test was 10 days. It is not know why the Project Team agreed to only include the survival endpoint for *L. plumulosus.* However, growth was measured form *N. arenaceodentata* at the same locations so the Navy believes the data are adequate for ecological risk purposes and determining PRGs

Consensus: Response was acceptable.

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j) The benthic community analysis results were not analyzed statistically. It is not known why the Project Team agreed to this approach. However, for reasons discussed in the Navy's response to EPA General Comment C, the benthic data were given much less weight for setting PRGs compared to the toxicity test data.

Consensus: Response was acceptable.

==

k) As presented in Table 4-1 of the RI report, most of the sediment samples were analyzed for grain size, but the only sediment samples analyzed for AVS/SEM were from Wetland 64 in 2001. These samples were not used for toxicity testing. It does not appear that the sediment samples were analyzed for pH or salinity.

Consensus: Response was acceptable.

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l) Benthic community analysis was not performed at Wetland 5B.

Consensus: Response was acceptable.

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12. Tables 3-6: The toxicity tests results are not reliable for use in selecting PRGs.

Response: The Navy disagrees that toxicity tests results are not reliable for use in selecting PRGs. Please see the Navy's response to EPA General Comment C.

Consensus: See Consensus for EPA Comment #1.

==

13. Table 7: Please add "wetland sediment" to the title of this table and use freshwater refinement values instead of saltwater sediment refinement values. Also indicate that the reference concentrations are two times the average (of two sediments).

Response: The title of Table 7 will be changed to "REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR FRESHWATER WETLAND SEDIMENT." A footnote will be added to Table 7 to indicate which refinement values are saltwater and which are freshwater. A note that the reference concentrations are two times the average of the two reference sediment samples will be added as a footnote to Table 7.

Consensus: Response was acceptable.

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14. Table 8: Please add "wetland sediment" to the title of this table. Also indicate that the reference concentrations are two times the average (of two sediments).

Response: The title of Table 8 will be changed to "REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR SALTWATER WETLAND SEDIMENT." A footnote will be added to Table 7 to indicate which refinement values are saltwater and which are freshwater. A note that the reference concentrations are two times the average of the two reference sediment samples will be added as a footnote to Table 8.

Consensus: Response was acceptable.

==

15. Tables 9-12: Refinement values and reference concentrations should not be used as PRGs. PRGs should be selected for DDTr, total PCBs, etc. and not the individual chemicals.

Response: The Navy believes that refinement values and reference concentrations can be used to set PRGs because PRGs should not be lower than reference concentrations or the refinement values that were used in the RI to refine the list of COPCs. PRGs should not be selected for DDTr, total PCBs, etc. as there were not COCs from the RI report.

Consensus: Response was acceptable.

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16. Tables 14-20: Low detection frequency has been used as a criterion for eliminating chemicals in the COPC refinement. What is the frequency of detection cut-off, 5% or 10%? A frequency of detection of 5% is considered provided enough samples were collected.

Response: Please see the Navy's response to EPA Specific Comment 7.

Consensus: Additional information would be added to the Technical Memorandum, where necessary, to help support the decisions for eliminating chemicals as risk drivers.

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17. Table 21: The recent results alone should not be used to make risk decisions. All of the results should be used because there is no guarantee that the recent sampling actually sampled the original sampling locations. Also, risk driver (subjective) and site-related should not be used to eliminate chemicals from the wetlands.

Response: Please see the Navy's response to EPA Specific Comment 7.

Consensus: Additional information would be added to the Technical Memorandum, where necessary, to help support the decisions for eliminating chemicals as risk drivers.

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18. Table 22: Arsenic should be included as a final COPC in Wetlands 3 and 18B and mercury should be included in Wetland 64 for further evaluation.

Response: Please see the Navy's response to EPA Specific Comment 9 for arsenic. Please see the Navy's response to EPA Specific Comment 7 for mercury.

Consensus: See Consensus for EPA Comment #9 regarding arsenic.

Ecological Risk Review Comments: Technical Memorandum—Refined List of Chemicals of Concern for the Feasibility Study and Development of Preliminary Remediation Goals for Sediment, Site 41 – Combined Wetlands, Naval Air Station Pensacola
January 28, 2010

General Comments:

A. Further Refinement: It is stated in the Technical Memorandum that Ensafe re-evaluated the Remedial Investigation (RI) data and refined the chemicals of concern (COC) in 2007 (Ensafe 2007a). Please note that at this early stage in the risk assessment process, Region 4 would like to refer to the COCs in the Technical Memorandum as chemicals of potential concern (COPC). If the COPCs had already been refined by Ensafe, then what is the purpose of the additional refinement in the current Technical Memorandum? The screening-level risk assessment uses conservative assumptions and the COPC refinement used benchmarks which are less conservative than those used in the refinement. Did the further refining of the COPCs in the Technical Memorandum use much less conservative benchmarks than those previously used? Also, it is usual practice in a refinement to provide the sources of the alternative (refinement) screening values (ATV), calculate refinement hazard quotients (HQ), and show how many locations exceed the ATVs. In selecting ATVs for refinement, chemical concentrations described as severe effect levels (SEL) should not be used.

Response: Note that this Technical Memorandum is not in the early stage of the risk assessment. The risk assessment was conducted as part of the approved Remedial Investigation (RI) report. As stated in the second paragraph of the Technical Memorandum, the purpose of the memorandum was to refine the list of COPCs to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. The benchmarks used in the Technical Memorandum were not less conservative than those used in the screening-level risk assessment for Site 41. Refinement values were used in the screening-level risk assessment for Site 41 to refine the list of COPCs. The source of the refinement values are noted on Tables 7 and 8. The definitions of the sources are provided in the Technical Memorandum text. Footnotes will be added to Tables 7 and 8 with the definition of the acronyms. As documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division."

B. Alternate Screening Values: The wetlands have been designated as either saltwater or freshwater. However, only the saltwater ATVs from Florida were used the refinement. Please provide the rationale (e.g. salinity) for designating the wetlands as either saltwater or freshwater. Were the salinities of the samples used in the designation? The state of Florida has sediment quality assessment guidelines (threshold effect concentrations and probable effect concentrations) for inland waters. The PECs should be used for refining the freshwater sediments.

Response: The reviewer is not correct that only saltwater ATVs were used refinement values. The saltwater refinement values from the RI were used, when available, because they were agreed to by the ecological technical sub-group as documented in the November 16, 2007 responses to EPA comments dated April 5, 2006 "The Tier I Partnering Team agreed to use only the EPA Region 4 Screening values and the FDEP PELs and TELs" in the RI. Also, as documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006 "The Navy's approach for evaluating sediment data were based on the professional judgment of the NAS Pensacola Partnering Team. In addition the Team included ecological experts from the University of Florida, NOAA, and EPA Region 4 Ecological Services Division." However, if refinement values were not available then freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

The salinity measurements in the wetlands are presented in Table 4-3 of the RI report.

C. Preliminary remedial goals: The procedures used for selecting the preliminary remedial goals (PRG) in the Technical Memorandum are inappropriate. In some cases literature-derived benchmark values were used as PRGs and in other cases obviously contaminated reference or background values were used as PRGs. The Triad approach consisting of different lines of evidence (chemical analysis, benthic surveys, and toxicity tests) was used in the document but not used in selecting the PRGs in the Technical Memorandum. However, results from only the toxicity tests and/or so-called background concentrations were used to select the PRGs. The toxicity results were mostly inconclusive. No dose-response relationships were established for any of the chemicals. Therefore picking and choosing PRGs from the data is not acceptable. Information from all of the available data (chemical analysis, benthic surveys, and toxicity tests) should be synthesized and analyzed prior to selecting the PRGs. Chemical concentrations from obviously contaminated reference locations should not be selected and used as PRGs.

Response: The Navy agrees that dose-response curves were not established for the chemicals, so the more conservative approach of calculating no observed effects concentrations (NOECs) and lowest observed effects concentrations (LOECs) was used. The results of the benthic community data were presented on Table 2. However, because samples were not collected at reference locations the results within a wetland were compared to other results within the same wetland. Therefore, it is difficult to interpret the results. For that reason, the Navy put more emphasis on the toxicity test data to develop PRGs.

The Navy does not agree that the reference locations are obviously contaminated. As documented in the November 16, 2007 responses to FDEP comments dated January 23, 2006: "The reference wetland selection and subsequent use was approved by all members of the Pensacola Partnering Team, in consultation from NOAA, University of Florida, and EPA Region 4 Ecological Services Division."

D. Wetlands Characterization: It appears that some of the wetlands were not fully characterized. In some cases only two, four, or five sample results were used to make risk based decisions. Using a limited number of samples in the decision-making process leads to uncertainties in the risk assessment process.

Response: The Navy recognizes that additional sampling would reduce uncertainty associated with the nature and extent of potential contamination. Although, the project team at the time of the RI agreed to the sampling strategy, further sampling may be conducted as part of a long term monitoring program associated with the alternatives for the FS.

E. Toxicity Evaluation: The toxicity test results used in the Technical Memorandum should be evaluated properly and used with caution. The fact that there is no toxicity to benthic invertebrates from a sample does not imply that the chemical concentrations in that sample represent no-observed-effect-concentrations (NOEC) and can be used as PRGs. This is because in most cases the sediments with the highest chemical concentrations were not tested for toxicity and the NOECs and lowest-observed-effect-concentrations (LOEC) are not clear-cut. As such, the toxicity test results used in selecting the PRGs are unacceptable. Different test organisms with different sensitivities were used in the toxicity tests. The proper assumptions should be used in selecting toxicity endpoints and the associated uncertainties should be discussed. Also, the mode of action of some of the chemicals in the sediment samples is different and their effects cannot be shown merely by direct toxicity. For example the pesticides and some of the inorganics (e.g. mercury, selenium, etc.) bioaccumulate in the food web therefore their bioaccumulation potential is more important than direct toxicity. Using direct toxicity endpoints to assess these chemicals and select PRGs for them may lead to additional uncertainties. Simplistic food-web models can be used for the bioaccumulative chemicals.

Response: The fact that there is no toxicity to benthic invertebrates from a sample implies that the chemical concentrations in that sample represent an unbounded no-observed-effect-concentration (NOEC), provided that the concentration was the greatest concentration tested. That fact that in some cases the sediments with the highest chemical concentrations were not tested for toxicity only indicates that the true NOEC may be even higher. This is an acceptable method for selecting PRGs, which the Navy has done on many sites across the country.

The Navy agrees that different test organisms with different sensitivities were used in the toxicity tests, but this does not affect the development of NOECs or LOECs.

The Navy agrees that the mode of action of some of the chemicals in the sediment samples is different and their effects cannot be shown merely by direct toxicity. However, the NOECs and LOECs that were developed were from impacts to sediment invertebrates from direct toxicity.

Simplistic food chain models were used in the RI to evaluate risks to upper trophic-level birds and mammals for each terrestrial operable unit in accordance with agreements reached with FDEP and their risk assessors from the University of Florida, EPA and their ecological risk assessors and the Navy. The Navy does not believe that risks were great enough (i.e., NOAEL HQs greater than 1.0 using site-specific bioaccumulation data and average concentrations) to warrant developing PRGs for those receptor. Risk to red drum from mercury is discussed at the end of the first complete paragraph on page 15 of the technical memorandum.

F. Reference Stations/Concentrations: Reference stations are usually selected from areas not influenced by the site and should be reviewed for appropriateness prior to use in a risk assessment. In some cases reference stations may have contaminant concentrations that exceed screening values. This does not imply that chemical concentrations from those stations should be used to eliminate chemicals from consideration in the risk assessment. Rather, the reference station data should be used for appropriateness before they are used. Freshwater sediment reference station results should not be used for saltwater sediment reference stations. The concentrations of DDT/DDD/DDE from the reference stations were much higher than their respective ecological screening values (ESV) and should not be used in the risk assessment. In fact some of the DDT concentrations were up to 300 times higher than the site concentrations. These concentrations should also not be used as PRGs.

Response: Please see the Navy's response to EPA General Comment C. The basewide levels for DDT, DDE and DDD were developed as a Team Decision. As indicated in NOAA's March 22, 2001 Comment No. 2 on the Final RI report for Site 41 stated: "The Pensacola NAS team examined these histograms, identified inflection points and agreed to concentrations which we believe represent base-wide DDTx levels....Independently gathered DDTx information indicate similar concentrations found in the Pensacola Bay area. The histograms, independent data and approach used by the team is a technical success story and should be highlighted in the RI Report." The values cited in there comment were: 20 ppb for DDT, 40 ppb for DDE, and 50 ppb for DDD. Therefore, the Navy believes that the DDT/DDD/DDE concentrations from the reference stations can be used to set PRGs, when they are greater than site-specific risk-based values.

G. Site-Related Chemicals: Some of the chemicals were eliminated during the refinement because they were determined not to be site-related or not to be risk drivers. Some of these terminologies are subjective. No site-related chemicals or risk drivers were identified in the Technical Memorandum. The process for eliminating chemicals in the refinement should be reviewed with special attention paid to the bioaccumulative chemicals.

Response: Although the terminologies may be somewhat subjective, terms like "site-related" and "risk drivers" are commonly used to refine the list of ecological COPCs. The text in the Technical Memorandum explains why the Navy believes that certain chemicals are not "site-related" and/or "risk drivers." Again, the purpose of the technical memorandum was to refine the list of COPCs to the primary risk drivers that could reasonable be evaluated in the FS. For example, it is not beneficial to evaluate endosulfan sulfate in the FS at Wetland 3 when it was detected in 3 of 12 samples at a maximum detected concentration of 0.0072 mg/kg. This low concentration is not indicative of a disposal activity and other chemicals at the site (i.e., arsenic and cadmium) are of greater concern. Therefore, if risks from other chemicals that are detected more frequently and at greater concentrations are addressed in the FS, risk from the less frequently detected chemicals also should be addressed.

Please see the Navy's response to EPA General Comment E regarding bioaccumulative chemicals.

H. Uncertainties and Data Gaps: The Technical Memorandum could benefit from an "uncertainties" and a "data gaps" section. Was the available data enough to make risk decisions and are there any additional data needs? What are some of the assumptions used in the refinement? Were there any uncertainties associated with the assumptions used in the COPC refinement process?

Response: An uncertainties analysis section will be added to the Technical Memorandum to discuss EPA's concerns.

I. Surface Water: Several chemicals were retained in surface water after refinement but there is no mention of the results in the Technical Memorandum. Were there any COPCs in surface water? What was the final decision on the surface water samples? Were they supposed to be further refined as the sediment samples and presented in the Technical Memorandum?

Response: Surface water is not a media that is typically evaluated in an FS because surface water by itself cannot really be cleaned up. The rationale for not including surface water will be provided in the FS, but a mention of this will be added to the Technical Memorandum as well.

J. Fish Tissue Data: According to the RI report, fish tissue data was available. This could have been used in the COPC refinement using simplistic food-web models to estimate risk.

Response: Fish tissue data were used in the RI to calculate risks using food web models. Please see the Navy's response to EPA General Comment E regarding why PRGs were not developed for upper trophic-level birds and mammals using simplistic food-web models.

K. Chemical Toxicity: The toxicities of aluminum and iron are pH dependent. Relatively PRGs were used to eliminate these 2 inorganics during the refinement without regard to sediment pH. The surface waters appear to be acidic and it is expected that sediments will also be acidic. The toxicities of iron and aluminum should therefore be reevaluated based on the sediment pH. An iron concentration of 246,000 mg/kg was selected as a NOEC but there was an effect in the sample with a concentration of 67,100 mg/kg. This supports the general comment C above.

Response: The Navy agrees that the bioavailability and therefore toxicity of aluminum and iron are pH dependent. Toxicity test data from Wetlands 3 and 5A were combined for developing PRGs. The pH in the surface water sample from location 041M030201 was 5.78 S.U. (see Table 4-3 in the RI report). This sample had the lowest pH of any of the samples in Wetlands 3 or 5A, but the sediment from this location was not toxic. This is also the location with the greatest iron concentration (246,000 mg/kg). Although pH was not measured in a surface water sample near 041M030701, this location was near 041M0303, which had a pH of 5.99. In fact, the pH in all four samples from Wetland 3 where it was measured ranged from 5.78 to 6.41. Finally, the pH in the overlying water measured during the toxicity testing (Appendix G of the RI report) indicated relatively neutral pH. Therefore, pH does not appear to be a factor in the toxicity test results. The reviewer notes that "An iron concentration of 246,000 mg/kg was selected as a NOEC but there was an effect in the sample with a concentration of 67,100 mg/kg." The Navy agrees with that statement. However, the pH discussion above supports that fact that iron was not the source of toxicity in the sample with 67,100 mg/kg. If it were, the sample with the greater iron concentration should have been toxic. Finally, Appendix K of the RI report indicated that although aluminum and iron concentrations were enriched at a few locations, these metals are widespread as NAS Pensacola and were not considered contaminants.

L. Total DDT, Total PCB etc: In soils and sediment it is easier to sum DDT and its metabolites (DDTr), sum PCB, dioxin TEQ, etc. for use in the risk assessment instead of the individual chemicals. If the screening had been done according to Region 4 requirements, total PCBs would have been retained in Table 16-1 because the detection limits are usually higher than the ecological screening values.

Response: The Navy agrees that sum DDT, sum PCB, dioxin TEQ, etc. for use in the risk assessment instead of the individual chemicals is appropriate. For that reason, Section 8.2.1 of the RI report indicates that the results for the individual chemicals were totaled. Section 8.33 of the RI report also indicates that non-detected chemicals were evaluated in the risk assessment. Total PCBs were evaluated in the RI report, and were subsequently eliminated during the refinement process in the RI. For example, see Table 10-2-19 in the RI report.

M. Ecological Risk Assessment: This comment does not pertain so much to the Technical Memorandum but to the general ecological risk assessment process. The original screening-level ecological risk assessment (SLERA) should have evaluated all of the chemicals including the detected and non-detected ones and compared them with Region 4 screening values. Reviewing the detection limits and including the non-detected analytes in the SLERA is necessary for the following reason. If the SLERA indicates adverse ecological effects are possible at environmental concentrations below standard quantitation limits, a "non-detect" based on those limits cannot be used to support a "no risk" decision (USEPA 1997). Therefore, it is essential that all contaminants (detected and non-detected) for which analysis was completed should be evaluated in the SLERA before proceeding to the refinement.

Response: Section 8.33 of the RI report indicates that detected and non-detected chemicals were evaluated in the risk assessment. Non-detected chemicals were subsequently eliminated as COPCs.

Specific Comments

Below are some specific page-by-page comments on the Technical Memorandum.

1. Page 1, last paragraph: One of the tasks listed in this section was to calculate NOECs and LOECs, no such calculations were presented in the document. As stated earlier, the results of the toxicity tests should not be the only line of evidence in selecting the NOECs and LOECs.

   Response: The Navy believes that the methodology for developing the NOECs and LOECs are adequately described in the Technical Memorandum, but the text will be reviewed to determine whether any clarification is needed. Please see the Navy's response to EPA General Comments C and E.

2. Page 2, Calculation of NOECs and LOECs: This whole section needs to be revised in light of the general comments. Bioaccumulative chemicals should not be regarded as direct toxicants.

2nd paragraph, 2nd sentence: This statement should be re-worded. Concentrations should not be described as "great." Also, it should be noted that NOECs and LOECs are determined under "specified conditions of exposure."

Last paragraph: The procedure of extrapolating risks from one wetland to another is unacceptable. This is because some of the wetlands are freshwater and others are saltwater. They have different physical and chemicals characteristics (pH, total organic carbon, particle size distribution, redox potential, etc.) which may influence risk and lead to additional uncertainty.

Response: Bioaccumulative chemicals can have direct toxic effects as well as effects to upper trophic level receptors that consume lower trophic level receptors that have bioaccumulated the chemicals. Please see the Navy's response to EPA General Comment E.

The Navy does not agree that the sentence needs reworded. The NOEC is the greatest concentration in a sample that does not cause a toxic response. The sentence will be revised, however, to address the comment: "NOECs are defined as the greatest concentrations in a sample that did not have a toxic response and LOECs are defined as the lowest concentrations greater than the NOEC in a sample that had a toxic response. NOECS and LOECs are developed using samples from the same sample set and represent the same exposure conditions."

In the RI report, the wetlands were placed into one of five groups (Groups A through E) based on contaminants, physical characteristics, and whether they were impacted by IR sites (see Section 4.2 of the RI report). These were the same groups that were used in the Technical Memorandum so the Navy believes that the use of data from one wetland to evaluate another wetland within the same group is acceptable. The Navy did not use toxicity data from a freshwater wetland to evaluate effects to a saltwater wetland.

3. Page 4, 2nd full paragraph: If none of the Wetland 5B samples were toxic and the wetland is not being used in the FS, then what is the rationale for using the toxicity results for the other wetlands? This one size fits all approach is unacceptable.

Response: The information from Wetland 5B was presented for informational purposed in case a similar wetland is evaluated in the future. Please see the Navy's response to Specific Comment 2.

4. Page 5, Compilation of Reference Values, 1st paragraph: If the background concentrations were multiplied by two, then the rest of the text and Tables 7 and 8 should reflect this fact.

Second paragraph: Were the values used for DDT and metabolites (DDTr) also multiplied by two? The values appear to be too high. The legal application of pesticides is not the issue here. If all pesticides were applied legally, then why are the background concentrations of only DDTr being considered and why are they orders of magnitude higher than the wetlands values? How about the background concentrations of the other pesticides?

Update of Refinement Values: Saltwater sediment screening values should not be used for freshwater sediment. The state of Florida has screening values for both and they should be used. The rationale for re-refining the COPCs was questioned in the general comments section. If they are being re-done, then they should be done using the most appropriate refinement values. This will make the document defensible.

Last paragraph: Please verify and correct the third sentence in this paragraph which states: "Freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available."

Response: The reference concentrations were the same reference concentrations used in the RI report. The fourth sentence in the first paragraph of Section "Compilation of Reference Values" will be changed to: "As presented in Section 6.1 of the RI (EnSafe, 2007a), the mean detection was calculated, multiplied by two, and the resulting multiplier was used as the reference concentration."

Please see the Navy's responses to EPA General Comments C and E regarding the DDT and metabolites (DDTx) reference concentrations. Section 6.2 of the RI explains how the basewide concentrations were developed for DDT and metabolites (DDTx). Background concentrations for the other pesticides were not developed as part of the RI.

Please see the Navy's response to EPA General Comment B regarding the refinement values.

The third sentence in the referenced paragraph is correct as it referring to the refinement values on Tables 7 and 8 in the Technical Memorandum for COCs that did not have refinement values in the RI Report. For those chemicals, freshwater refinement values were preferentially used for the freshwater wetlands and saltwater refinement values were preferentially used for the freshwater wetlands, when available.

5. Page 6, Probable Effects Concentrations: The freshwater probable effects concentrations described here (MacDonald et al., 2000) are not the same ones listed in the tables. Those listed in the tables are saltwater values.

Development of Ecological PRGs: Mention is made of ensuring that wetlands are not excavated where there is marginal risk. This statement may be true. However, any excavation should be a risk management decision and not the conclusion of the risk assessment. The risk assessment should be performed to show where the risks are and the management decisions should be left to the risk managers.

Response: As discussed in the Navy's response to EPA Specific Comment 4, the freshwater refinement values were only used for chemicals that did not have a refinement value in the RI report.

Although the Navy agrees that the referenced sentence is a risk management statement, the statement is not coming at the end of the risk assessment. In essence, the Technical Memorandum is a risk management document because it will be an appendix to the Feasibility Study (FS). Therefore, it is an appropriate place for that statement because the PRGs are needed for the FS.

6. Page 7, 1st paragraph: The red drum model shows that mercury is an ecological risk at Wetland 64. Mercury should therefore not be eliminated from Wetland 64 because it is not a "risk driver." It was detected in 50 percent of the fish samples and 68 percent of the sediment samples at Wetland 64. Mercury should therefore be retained for further evaluation at Wetland 64. Perhaps site-specific biota-sediment accumulation factors (BSAF) should be calculated for mercury and the models should be redone to determine if it is still a problem. It is also stated in the text that mercury is not site-related. If not site-related, then where did it come from? No information is provided in the entire document about the operations of the site and which contaminants are related to the site and which ones are not.

   Response: Mercury was eliminated from further evaluation for reasons provided on Page 7, 1st paragraph. This was primarily because risks to the red drum were marginal and most of the mercury concentrations were lower that reference concentrations. The red drum model is discussed in Section 8.7.1.3 of the RI report. Actual tissue concentrations were used, when available. Mercury is a common metal that is in most fish across the State of Florida, much of which is present from atmospheric deposition. In fact, the State of Florida has a fish advisory for the state that prohibits or limits the amount of fish that pregnant or nursing women and women who may become pregnant should consume. Therefore, mercury contamination in fish appears to be a statewide problem.

7. Refinement of Chemicals of Concern, Pages 11 thru 15: Additional justification should be sought for eliminating come of the chemicals. In some cases it is stated that a chemical was detected in only one of four samples or was legally applied and therefore is eliminated. One of four is 25 percent and legal application does not preclude its presence. Site-wide averages, simplistic food-web models, alternative toxicity values, location specific information, etc. can be used to refine the COPCs.

   Response: The Navy believes that it provided sufficient justification for eliminating chemicals from evaluation in the FS. As stated in the second paragraph of the Technical Memorandum, the purpose of the memo was to refine the list of COCs to allow the FS to focus on those chemicals that are the primary risk drivers in each wetland. Therefore, the refinement that was conducted is adequate to meet that objective.

8. Wetland 15, page 12. Iron should not be eliminated from this wetland. The pH of all wetlands should be checked to determine if high levels of iron and aluminum are a problem.

Response: Please see the Navy's response to EPA General Comment K.

9. Summary and Conclusions: Please revise this section for correctness. Arsenic should be retained as an ecological COPC in Wetlands 3 and 18B.

Response: The Navy does not believe this section needs revised based on the responses to the comments. Arsenic was not a final ecological COPC from the RI report for Wetlands 3 and 18B so it was not retained as an ecological COPC in the Technical Memorandum.

10. Table 1: Arsenic should be retained as an ecological COPC.
Please check and correct the spelling of manganese and carbazole.

Response: Arsenic was only a final ecological COPC from the RI report for Wetland 15, so it was only retained as an ecological COPC for Wetland 15 in the Technical Memorandum. The spelling of manganese and carbazole will be corrected.

11. Table 2: This table is incomplete and needs a lot of clarification. The following are some questions arising from the table:
a) Laboratory control or reference numbers are not available for comparison. Did the control exposures meet the acceptance criteria?
b) There may be problems using the toxicity endpoints to derive PRGs.
c) The "C." in *C. tentans*, "H." in *H. azteca*, "N." in *N. arenaceodentata*, and "L." in *L. plumulosus* have not been spelled out anywhere in the document.
e) Growth is reported in milligrams (mg). Are the results in mg for all of the organisms or mg/organism; and is growth reported in wet weight or dry weight?
f) How was growth in the *H. azteca* tests measured and was the growth data analyzed statistically?
g) How was growth in the *C. tentans* tests measured? What was growth measured after the 28-day exposure or after 10 days of exposure? What was the duration of the emergence tests and is 50% emergence acceptable?
h) *C. tentans* was used for freshwater sediments 3 and 5A in 28-day tests and *H. azteca* was used for freshwater sediment 5B in 10-day tests. Is they any rationale for using different organisms and are the freshwater sediment toxicity results comparable between the stations?
i) The *L. plumulosus* tests were supposedly 7-day tests, while the test guidance calls for 10 or 28-day tests. Also, growth is an endpoint in this test. Therefore, the L. *plumulosus* exposures may not be adequate for ecological risk purposes. Should this fact be explained in the "uncertainties" section?
j) Were the benthic community analysis results analyzed statistically; if so were there any significant differences; if not, why not?
k) Was pH, salinity, grain size, acid-volatile sulfur, etc. of the sediments measured?
l) Was benthic community analysis performed at Wetland 5B?

Response:

a) The toxicity test lab reports are presented in Appendix G of the RI report for your review. The control sediment had acceptable survival results.

b) Please clarify the problems using the toxicity endpoints to derive PRGs.

c) The "C." in *C. tentans*, "H." in *H. azteca*, "N." in *N. arenaceodentata*, and "L." in *L. plumulosus* will be spelled out in the document.

e) Based on the lab reports presented in Appendix G of the RI report, it appears that growth is reported in milligrams/organism, dry weight. This will be added to Table 2.

f) After final counts, the surviving organisms were placed, by replicates, into tared weigh boats, placed in a drying oven and dried overnight at 60°C. Each replicate was weighed after drying in a dessicator. The growth data was analyzed statistically using Toxstat. See the toxicity test report in Appendix G in the RI report for more details.

g) The same level of detail regarding the growth measurements was not presented in the toxicity test report for *C. tentans* report in Appendix G in the RI report. Growth was measured after 10 days of exposure (see Table 1 in the toxicity test report in Appendix G in the RI report). The duration of the emergence tests was 28 days. The toxicity test report indicated that "there were no chronic effects for emergence when compared to the control sediment larvae which only yielded 50% and 60% emerged adults. Guidance suggests that the average emergence usually observed is 60%, and the control population should yield 70%. All stations performed as well as or better than the control sediment." Therefore, the 50% emergence rate for the site sample is acceptable.

h) As indicated in the first paragraph in Section 4.7 of the RI report: "Initially, the 10-day *Hyalella azteca* test for survival, growth, and reproduction was planned to be performed on sediment samples collected from Wetlands 5A and 3 during Phase III. However, based on the recommendation of the contract laboratory, the 28-day *Chironomus tentans* test (ASTM Method E1706-95B) for survival and emergence was performed instead. USEPA and FDEP concurred with this analysis change. The 10-day Hyalella test was discontinued because 10 days was considered insufficient to obtain adequate growth and reproduction response, both key measurement endpoints for this test. The longer test enabled the chronic endpoints to be measured more effectively."

i) Table 8-4 in the RI reports indicates that the *L. plumulosus* were 10-day tests. Also, Table 1 in the Toxicity test Report in Appendix G of the RI report indicates the test was 10 days. It is not know why the Project Team agreed to only include the survival endpoint for *L. plumulosus.* However, growth was measured form *N. arenaceodentata* at the same locations so the Navy believes the data are adequate for ecological risk purposes and determining PRGs

j) The benthic community analysis results were not analyzed statistically. It is not known why the Project Team agreed to this approach. However, for reasons discussed in the Navy's response to EPA General Comment C, the benthic data were given much less weight for setting PRGs compared to the toxicity test data.

k) As presented in Table 4-1 of the RI report, most of the sediment samples were analyzed for grain size, but the only sediment samples analyzed for AVS/SEM were from Wetland 64 in 2001. These samples were not used for toxicity testing. It does not appear that the sediment samples were analyzed for pH or salinity.

l) Benthic community analysis was not performed at Wetland 5B.

12. Tables 3-6: The toxicity tests results are not reliable for use in selecting PRGs.

Response: The Navy disagrees that toxicity tests results are not reliable for use in selecting PRGs. Please see the Navy's response to EPA General Comment C.

13. Table 7: Please add "wetland sediment" to the title of this table and use freshwater refinement values instead of saltwater sediment refinement values. Also indicate that the reference concentrations are two times the average (of two sediments).

Response: The title of Table 7 will be changed to "REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR FRESHWATER WETLAND SEDIMENT." A footnote will be added to Table 7 to indicate which refinement values are saltwater and which are freshwater. A note that the reference concentrations are two times the average of the two reference sediment samples will be added as a footnote to Table 7.

14. Table 8: Please add "wetland sediment" to the title of this table. Also indicate that the reference concentrations are two times the average (of two sediments).

Response: The title of Table 8 will be changed to "REFERENCE CONCENTRATIONS, SCREENING VALUES, AND REFINEMENT VALUES FOR SALTWATER WETLAND SEDIMENT." A footnote will be added to Table 7 to indicate which refinement values are saltwater and which are freshwater. A note that the reference concentrations are two times the average of the two reference sediment samples will be added as a footnote to Table 8.

15. Tables 9-12: Refinement values and reference concentrations should not be used as PRGs. PRGs should be selected for DDTr, total PCBs, etc. and not the individual chemicals.

Response: The Navy believes that refinement values and reference concentrations can be used to set PRGs because PRGs should not be lower than reference concentrations or the refinement values that were used in the RI to refine the list of COPCs. PRGs should not be selected for DDTr, total PCBs, etc. as there were not COCs from the RI report.

16. Tables 14-20: Low detection frequency has been used as a criterion for eliminating chemicals in the COPC refinement. What is the frequency of detection cut-off, 5% or 10%? A frequency of detection of 5% is considered provided enough samples were collected.

Response: Please see the Navy's response to EPA Specific Comment 7.

17. Table 21: The recent results alone should not be used to make risk decisions. All of the results should be used because there is no guarantee that the recent sampling actually sampled the original sampling locations. Also, risk driver (subjective) and site-related should not be used to eliminate chemicals from the wetlands.

Response: Please see the Navy's response to EPA Specific Comment 7.

18. Table 22: Arsenic should be included as a final COPC in Wetlands 3 and 18B and mercury should be included in Wetland 64 for further evaluation.

Response: Please see the Navy's response to EPA Specific Comment 9 for arsenic. Please see the Navy's response to EPA Specific Comment 7 for mercury.

APPENDIX B

CONTAMININANT MASS CALCULATIONS

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

10/31/2010 3:12 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$168		Analyze sediment samples from 3 locations for cadmium and arsenic. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$4,293	$5,000	
Contingency @ 10%	$429	$500	
TOTAL	**$4,722**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$4,722	$4,722	0.935	$4,413
2		$4,722	$4,722	0.873	$4,125
3		$4,722	$4,722	0.816	$3,855
4		$4,722	$4,722	0.763	$3,603
5		$10,222	$10,222	0.713	$7,288
6		$4,722	$4,722	0.666	$3,147
7		$4,722	$4,722	0.623	$2,941
8		$4,722	$4,722	0.582	$2,748
9		$4,722	$4,722	0.544	$2,569
10		$10,222	$10,222	0.508	$5,196
11		$4,722	$4,722	0.475	$2,244
12		$4,722	$4,722	0.444	$2,097
13		$4,722	$4,722	0.415	$1,960
14		$4,722	$4,722	0.388	$1,831
15		$10,222	$10,222	0.362	$3,705
16		$4,722	$4,722	0.339	$1,600
17		$4,722	$4,722	0.317	$1,495
18		$4,722	$4,722	0.296	$1,397
19		$4,722	$4,722	0.277	$1,306
20		$10,222	$10,222	0.258	$2,642
21		$4,722	$4,722	0.242	$1,140
22		$4,722	$4,722	0.226	$1,066
23		$4,722	$4,722	0.211	$996
24		$4,722	$4,722	0.197	$931
25		$10,222	$10,222	0.184	$1,883
26		$4,722	$4,722	0.172	$813
27		$4,722	$4,722	0.161	$760
28		$4,722	$4,722	0.150	$710
29		$4,722	$4,722	0.141	$664
30		$10,222	$10,222	0.131	$1,343
				TOTAL PRESENT WORTH	**$79,014**

NAS PENSACOLA
Pensacola, Florida
Wetland 5A
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 5A
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$84		Analyze sediment samples from 1 location for copper, lead, and zinc. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$4,209	$5,000	
Contingency @ 10%	$421	$500	
TOTAL	**$4,630**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 5A
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$4,630	$4,630	0.935	$4,327
2		$4,630	$4,630	0.873	$4,044
3		$4,630	$4,630	0.816	$3,779
4		$4,630	$4,630	0.763	$3,532
5		$10,130	$10,130	0.713	$7,222
6		$4,630	$4,630	0.666	$3,085
7		$4,630	$4,630	0.623	$2,883
8		$4,630	$4,630	0.582	$2,695
9		$4,630	$4,630	0.544	$2,518
10		$10,130	$10,130	0.508	$5,150
11		$4,630	$4,630	0.475	$2,200
12		$4,630	$4,630	0.444	$2,056
13		$4,630	$4,630	0.415	$1,921
14		$4,630	$4,630	0.388	$1,796
15		$10,130	$10,130	0.362	$3,672
16		$4,630	$4,630	0.339	$1,568
17		$4,630	$4,630	0.317	$1,466
18		$4,630	$4,630	0.296	$1,370
19		$4,630	$4,630	0.277	$1,280
20		$10,130	$10,130	0.258	$2,618
21		$4,630	$4,630	0.242	$1,118
22		$4,630	$4,630	0.226	$1,045
23		$4,630	$4,630	0.211	$977
24		$4,630	$4,630	0.197	$913
25		$10,130	$10,130	0.184	$1,866
26		$4,630	$4,630	0.172	$797
27		$4,630	$4,630	0.161	$745
28		$4,630	$4,630	0.150	$696
29		$4,630	$4,630	0.141	$651
30		$10,130	$10,130	0.131	$1,331
				TOTAL PRESENT WORTH	**$77,868**

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

10/31/2010 3:14 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 **PROJECT PLANNING & DOCUMENTS**											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

10/31/2010 3:14 PM

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$168		Analyze sediment samples from 2 locations for arsenic, manganese, and selenium. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$4,293	$5,000	
Contingency @ 10%	$429	$500	
TOTAL	**$4,722**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

10/31/2010 3:14 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$4,722	$4,722	0.935	$4,413
2		$4,722	$4,722	0.873	$4,125
3		$4,722	$4,722	0.816	$3,855
4		$4,722	$4,722	0.763	$3,603
5		$10,222	$10,222	0.713	$7,288
6		$4,722	$4,722	0.666	$3,147
7		$4,722	$4,722	0.623	$2,941
8		$4,722	$4,722	0.582	$2,748
9		$4,722	$4,722	0.544	$2,569
10		$10,222	$10,222	0.508	$5,196
11		$4,722	$4,722	0.475	$2,244
12		$4,722	$4,722	0.444	$2,097
13		$4,722	$4,722	0.415	$1,960
14		$4,722	$4,722	0.388	$1,831
15		$10,222	$10,222	0.362	$3,705
16		$4,722	$4,722	0.339	$1,600
17		$4,722	$4,722	0.317	$1,495
18		$4,722	$4,722	0.296	$1,397
19		$4,722	$4,722	0.277	$1,306
20		$10,222	$10,222	0.258	$2,642
21		$4,722	$4,722	0.242	$1,140
22		$4,722	$4,722	0.226	$1,066
23		$4,722	$4,722	0.211	$996
24		$4,722	$4,722	0.197	$931
25		$10,222	$10,222	0.184	$1,883
26		$4,722	$4,722	0.172	$813
27		$4,722	$4,722	0.161	$760
28		$4,722	$4,722	0.150	$710
29		$4,722	$4,722	0.141	$664
30		$10,222	$10,222	0.131	$1,343
				TOTAL PRESENT WORTH	**$79,014**

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

10/31/2010 3:15 PM

Item	Quantity	Unit	Unit Cost: Subcontract	Unit Cost: Material	Unit Cost: Labor	Unit Cost: Equipment	Extended Cost: Subcontract	Extended Cost: Material	Extended Cost: Labor	Extended Cost: Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

10/31/2010 3:15 PM

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$28		Analyze sediment samples from 1 location for arsenic. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$4,153	$5,000	
Contingency @ 10%	$415	$500	
TOTAL	**$4,568**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

10/31/2010 3:15 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$4,568	$4,568	0.935	$4,269
2		$4,568	$4,568	0.873	$3,990
3		$4,568	$4,568	0.816	$3,729
4		$4,568	$4,568	0.763	$3,485
5		$10,068	$10,068	0.713	$7,179
6		$4,568	$4,568	0.666	$3,044
7		$4,568	$4,568	0.623	$2,845
8		$4,568	$4,568	0.582	$2,659
9		$4,568	$4,568	0.544	$2,485
10		$10,068	$10,068	0.508	$5,118
11		$4,568	$4,568	0.475	$2,170
12		$4,568	$4,568	0.444	$2,028
13		$4,568	$4,568	0.415	$1,896
14		$4,568	$4,568	0.388	$1,772
15		$10,068	$10,068	0.362	$3,649
16		$4,568	$4,568	0.339	$1,547
17		$4,568	$4,568	0.317	$1,446
18		$4,568	$4,568	0.296	$1,352
19		$4,568	$4,568	0.277	$1,263
20		$10,068	$10,068	0.258	$2,602
21		$4,568	$4,568	0.242	$1,103
22		$4,568	$4,568	0.226	$1,031
23		$4,568	$4,568	0.211	$964
24		$4,568	$4,568	0.197	$901
25		$10,068	$10,068	0.184	$1,855
26		$4,568	$4,568	0.172	$787
27		$4,568	$4,568	0.161	$735
28		$4,568	$4,568	0.150	$687
29		$4,568	$4,568	0.141	$642
30		$10,068	$10,068	0.131	$1,323
				TOTAL PRESENT WORTH	**$77,103**

NAS PENSACOLA
Pensacola, Florida
Wetland 18B
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

10/31/2010 3:15 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 18B
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$28		Analyze sediment samples from 1 location for arsenic. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$4,153	$5,000	
Contingency @ 10%	$415	$500	
TOTAL	**$4,568**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 18B
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$4,568	$4,568	0.935	$4,269
2		$4,568	$4,568	0.873	$3,990
3		$4,568	$4,568	0.816	$3,729
4		$4,568	$4,568	0.763	$3,485
5		$10,068	$10,068	0.713	$7,179
6		$4,568	$4,568	0.666	$3,044
7		$4,568	$4,568	0.623	$2,845
8		$4,568	$4,568	0.582	$2,659
9		$4,568	$4,568	0.544	$2,485
10		$10,068	$10,068	0.508	$5,118
11		$4,568	$4,568	0.475	$2,170
12		$4,568	$4,568	0.444	$2,028
13		$4,568	$4,568	0.415	$1,896
14		$4,568	$4,568	0.388	$1,772
15		$10,068	$10,068	0.362	$3,649
16		$4,568	$4,568	0.339	$1,547
17		$4,568	$4,568	0.317	$1,446
18		$4,568	$4,568	0.296	$1,352
19		$4,568	$4,568	0.277	$1,263
20		$10,068	$10,068	0.258	$2,602
21		$4,568	$4,568	0.242	$1,103
22		$4,568	$4,568	0.226	$1,031
23		$4,568	$4,568	0.211	$964
24		$4,568	$4,568	0.197	$901
25		$10,068	$10,068	0.184	$1,855
26		$4,568	$4,568	0.172	$787
27		$4,568	$4,568	0.161	$735
28		$4,568	$4,568	0.150	$687
29		$4,568	$4,568	0.141	$642
30		$10,068	$10,068	0.131	$1,323
				TOTAL PRESENT WORTH	**$77,103**

NAS PENSACOLA
Pensacola, Florida
Wetland 48
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

10/31/2010 3:16 PM

Item	Quantity	Unit	Unit Cost: Subcontract	Unit Cost: Material	Unit Cost: Labor	Unit Cost: Equipment	Extended Cost: Subcontract	Extended Cost: Material	Extended Cost: Labor	Extended Cost: Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 48
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

10/31/2010 3:16 PM

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$1,120		Analyze sediment samples from 8 locations for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, & total DDT. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$5,245	$5,000	
Contingency @ 10%	$525	$500	
TOTAL	**$5,770**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 48
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

10/31/2010 3:16 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$5,770	$5,770	0.935	$5,392
2		$5,770	$5,770	0.873	$5,039
3		$5,770	$5,770	0.816	$4,710
4		$5,770	$5,770	0.763	$4,402
5		$11,270	$11,270	0.713	$8,035
6		$5,770	$5,770	0.666	$3,844
7		$5,770	$5,770	0.623	$3,593
8		$5,770	$5,770	0.582	$3,358
9		$5,770	$5,770	0.544	$3,138
10		$11,270	$11,270	0.508	$5,729
11		$5,770	$5,770	0.475	$2,741
12		$5,770	$5,770	0.444	$2,562
13		$5,770	$5,770	0.415	$2,394
14		$5,770	$5,770	0.388	$2,238
15		$11,270	$11,270	0.362	$4,085
16		$5,770	$5,770	0.339	$1,954
17		$5,770	$5,770	0.317	$1,826
18		$5,770	$5,770	0.296	$1,707
19		$5,770	$5,770	0.277	$1,595
20		$11,270	$11,270	0.258	$2,912
21		$5,770	$5,770	0.242	$1,393
22		$5,770	$5,770	0.226	$1,302
23		$5,770	$5,770	0.211	$1,217
24		$5,770	$5,770	0.197	$1,137
25		$11,270	$11,270	0.184	$2,076
26		$5,770	$5,770	0.172	$993
27		$5,770	$5,770	0.161	$928
28		$5,770	$5,770	0.150	$868
29		$5,770	$5,770	0.141	$811
30		$11,270	$11,270	0.131	$1,480
				TOTAL PRESENT WORTH	**$92,009**

NAS PENSACOLA
Pensacola, Florida
Wetland 64
Alternative SED - 2: Monitoring and Natural Recovery
Capital Cost

10/31/2010 3:16 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
Subtotal							$0	$0	$5,550	$0	$5,550
Overhead on Labor Cost @ 30%									$1,665		$1,665
G & A on Labor Cost @ 10%									$555		$555
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$7,770	$0	$7,770
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$777
Subtotal											$8,547
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$8,547
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$8,547**

NAS PENSACOLA
Pensacola, Florida
Wetland 64
Alternative SED - 2: Monitoring and Natural Recovery
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Sampling	$5,600		Labor and supplies to collect samples from boat with a crew of two.
Analysis/Sediment	$420		Analyze sediment samples from 3 locations for cadmium, chromium, copper, lead, silver, zinc. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$6,020	$5,000	
Contingency @ 10%	$602	$500	
TOTAL	**$6,622**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 64
Alternative SED - 2: Monitoring and Natural Recovery
Present Worth Analysis

10/31/2010 3:16 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$8,547		$8,547	1.000	$8,547
1		$6,622	$6,622	0.935	$6,189
2		$6,622	$6,622	0.873	$5,784
3		$6,622	$6,622	0.816	$5,406
4		$6,622	$6,622	0.763	$5,052
5		$12,122	$12,122	0.713	$8,643
6		$6,622	$6,622	0.666	$4,413
7		$6,622	$6,622	0.623	$4,124
8		$6,622	$6,622	0.582	$3,854
9		$6,622	$6,622	0.544	$3,602
10		$12,122	$12,122	0.508	$6,162
11		$6,622	$6,622	0.475	$3,146
12		$6,622	$6,622	0.444	$2,940
13		$6,622	$6,622	0.415	$2,748
14		$6,622	$6,622	0.388	$2,568
15		$12,122	$12,122	0.362	$4,394
16		$6,622	$6,622	0.339	$2,243
17		$6,622	$6,622	0.317	$2,096
18		$6,622	$6,622	0.296	$1,959
19		$6,622	$6,622	0.277	$1,831
20		$12,122	$12,122	0.258	$3,133
21		$6,622	$6,622	0.242	$1,599
22		$6,622	$6,622	0.226	$1,495
23		$6,622	$6,622	0.211	$1,397
24		$6,622	$6,622	0.197	$1,306
25		$12,122	$12,122	0.184	$2,233
26		$6,622	$6,622	0.172	$1,140
27		$6,622	$6,622	0.161	$1,066
28		$6,622	$6,622	0.150	$996
29		$6,622	$6,622	0.141	$931
30		$12,122	$12,122	0.131	$1,592

TOTAL PRESENT WORTH **$102,588**

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Capital Cost

10/31/2010 3:13 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
1.2 Prepare LUC Documents	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
2 SIGN PLACEMENT											
2.1 Warning Signs	10	ea		$74.00	$120.00		$0	$740	$1,200	$0	$1,940
Subtotal							$0	$740	$14,150	$0	$14,890
Overhead on Labor Cost @ 30%									$4,245		$4,245
G & A on Labor Cost @ 10%									$1,415		$1,415
G & A on Material Cost @ 10%								$74			$74
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$44		$0	$44
Total Direct Cost							$0	$858	$19,810	$0	$20,668
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$2,067
Subtotal											$22,735
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$22,735
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$22,735**

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Annual Cost

10/31/2010 3:13 PM

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Site Inspection: Visit & Report	$3,149		One-day visit to verify LUC with Report
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$28		Analyze sediment samples from 1 location for arsenic. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,302	$5,000	
Contingency @ 10%	$730	$500	
TOTAL	**$8,032**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Present Worth Analysis

10/31/2010 3:13 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$22,735		$22,735	1.000	$22,735
1		$8,032	$8,032	0.935	$7,507
2		$8,032	$8,032	0.873	$7,016
3		$8,032	$8,032	0.816	$6,557
4		$8,032	$8,032	0.763	$6,128
5		$13,532	$13,532	0.713	$9,648
6		$8,032	$8,032	0.666	$5,352
7		$8,032	$8,032	0.623	$5,002
8		$8,032	$8,032	0.582	$4,675
9		$8,032	$8,032	0.544	$4,369
10		$13,532	$13,532	0.508	$6,879
11		$8,032	$8,032	0.475	$3,816
12		$8,032	$8,032	0.444	$3,566
13		$8,032	$8,032	0.415	$3,333
14		$8,032	$8,032	0.388	$3,115
15		$13,532	$13,532	0.362	$4,905
16		$8,032	$8,032	0.339	$2,721
17		$8,032	$8,032	0.317	$2,543
18		$8,032	$8,032	0.296	$2,376
19		$8,032	$8,032	0.277	$2,221
20		$13,532	$13,532	0.258	$3,497
21		$8,032	$8,032	0.242	$1,940
22		$8,032	$8,032	0.226	$1,813
23		$8,032	$8,032	0.211	$1,694
24		$8,032	$8,032	0.197	$1,584
25		$13,532	$13,532	0.184	$2,493
26		$8,032	$8,032	0.172	$1,383
27		$8,032	$8,032	0.161	$1,293
28		$8,032	$8,032	0.150	$1,208
29		$8,032	$8,032	0.141	$1,129
30		$13,532	$13,532	0.131	$1,778
				TOTAL PRESENT WORTH	**$134,275**

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Capital Cost

10/31/2010 3:14 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 **PROJECT PLANNING & DOCUMENTS**											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
1.2 Prepare LUC Documents	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
2 **SIGN PLACEMENT**											
2.1 Warning Signs	10	ea		$74.00	$120.00		$0	$740	$1,200	$0	$1,940
Subtotal							$0	$740	$14,150	$0	$14,890
Overhead on Labor Cost @ 30%									$4,245		$4,245
G & A on Labor Cost @ 10%									$1,415		$1,415
G & A on Material Cost @ 10%								$74			$74
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$44		$0	$44
Total Direct Cost							$0	$858	$19,810	$0	$20,668
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$2,067
Subtotal											$22,735
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$22,735
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$22,735**

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Site Inspection: Visit & Report	$3,149		One-day visit to verify LUC with Report
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$28		Analyze sediment samples from 1 location for arsenic. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,302	$5,000	
Contingency @ 10%	$730	$500	
TOTAL	**$8,032**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Present Worth Analysis

10/31/2010 3:14 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$22,735		$22,735	1.000	$22,735
1		$8,032	$8,032	0.935	$7,507
2		$8,032	$8,032	0.873	$7,016
3		$8,032	$8,032	0.816	$6,557
4		$8,032	$8,032	0.763	$6,128
5		$13,532	$13,532	0.713	$9,648
6		$8,032	$8,032	0.666	$5,352
7		$8,032	$8,032	0.623	$5,002
8		$8,032	$8,032	0.582	$4,675
9		$8,032	$8,032	0.544	$4,369
10		$13,532	$13,532	0.508	$6,879
11		$8,032	$8,032	0.475	$3,816
12		$8,032	$8,032	0.444	$3,566
13		$8,032	$8,032	0.415	$3,333
14		$8,032	$8,032	0.388	$3,115
15		$13,532	$13,532	0.362	$4,905
16		$8,032	$8,032	0.339	$2,721
17		$8,032	$8,032	0.317	$2,543
18		$8,032	$8,032	0.296	$2,376
19		$8,032	$8,032	0.277	$2,221
20		$13,532	$13,532	0.258	$3,497
21		$8,032	$8,032	0.242	$1,940
22		$8,032	$8,032	0.226	$1,813
23		$8,032	$8,032	0.211	$1,694
24		$8,032	$8,032	0.197	$1,584
25		$13,532	$13,532	0.184	$2,493
26		$8,032	$8,032	0.172	$1,383
27		$8,032	$8,032	0.161	$1,293
28		$8,032	$8,032	0.150	$1,208
29		$8,032	$8,032	0.141	$1,129
30		$13,532	$13,532	0.131	$1,778
				TOTAL PRESENT WORTH	**$134,275**

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Capital Cost

10/31/2010 3:15 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1. PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Sampling Plan	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
1.2 Prepare LUC Documents	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
2 SIGN PLACEMENT											
2.1 Warning Signs	10	ea		$74.00	$120.00		$0	$740	$1,200	$0	$1,940
Subtotal							$0	$740	$14,150	$0	$14,890
Overhead on Labor Cost @ 30%									$4,245		$4,245
G & A on Labor Cost @ 10%									$1,415		$1,415
G & A on Material Cost @ 10%								$74			$74
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$44		$0	$44
Total Direct Cost							$0	$858	$19,810	$0	$20,668
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$2,067
Subtotal											$22,735
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$22,735
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$22,735**

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Site Inspection: Visit & Report	$3,149		One-day visit to verify LUC with Report
Sampling	$4,125		Labor and supplies to collect samples with a crew of two.
Analysis/Sediment	$28		Analyze sediment samples from 1 location for arsenic. Collect samples once in years 1 through 30.
Five Year Site Review		$5,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,302	$5,000	
Contingency @ 10%	$730	$500	
TOTAL	**$8,032**	**$5,500**	

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 3: LUCs, Natural Recovery, and Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 7.0%	Present Worth
0	$22,735		$22,735	1.000	$22,735
1		$8,032	$8,032	0.935	$7,507
2		$8,032	$8,032	0.873	$7,016
3		$8,032	$8,032	0.816	$6,557
4		$8,032	$8,032	0.763	$6,128
5		$13,532	$13,532	0.713	$9,648
6		$8,032	$8,032	0.666	$5,352
7		$8,032	$8,032	0.623	$5,002
8		$8,032	$8,032	0.582	$4,675
9		$8,032	$8,032	0.544	$4,369
10		$13,532	$13,532	0.508	$6,879
11		$8,032	$8,032	0.475	$3,816
12		$8,032	$8,032	0.444	$3,566
13		$8,032	$8,032	0.415	$3,333
14		$8,032	$8,032	0.388	$3,115
15		$13,532	$13,532	0.362	$4,905
16		$8,032	$8,032	0.339	$2,721
17		$8,032	$8,032	0.317	$2,543
18		$8,032	$8,032	0.296	$2,376
19		$8,032	$8,032	0.277	$2,221
20		$13,532	$13,532	0.258	$3,497
21		$8,032	$8,032	0.242	$1,940
22		$8,032	$8,032	0.226	$1,813
23		$8,032	$8,032	0.211	$1,694
24		$8,032	$8,032	0.197	$1,584
25		$13,532	$13,532	0.184	$2,493
26		$8,032	$8,032	0.172	$1,383
27		$8,032	$8,032	0.161	$1,293
28		$8,032	$8,032	0.150	$1,208
29		$8,032	$8,032	0.141	$1,129
30		$13,532	$13,532	0.131	$1,778
				TOTAL PRESENT WORTH	**$134,275**

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 4: Removal and Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
1.2 Contractor Completion Report	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Preconstruction Meeting	30	hr			$70.00		$0	$0	$2,100	$0	$2,100
2.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.3 Equipment Mobilization/Demobilization	7	ea			$177.00	$610.00	$0	$0	$1,239	$4,270	$5,509
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	2	mo		$470.00		$453.00	$0	$940	$0	$906	$1,846
3.2 Construction Survey Support	4	day	$1,075.00				$4,300	$0	$0	$0	$4,300
3.3 Site Superintendent	6	week		$745.00	$1,802.00		$0	$4,470	$10,812	$0	$15,282
3.4 Site Health & Safety and QA/QC	6	week		$745.00	$1,322.00		$0	$4,470	$7,932	$0	$12,402
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$3,700.00	$3,200.00	$625.00	$0	$3,700	$3,200	$625	$7,525
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$771.00	$0	$0	$0	$771	$771
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$693.00	$0	$0	$0	$693	$693
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SITE PREPARATION											
5.1 Dozer, 105 hp	5	day			$343.60	$660.40	$0	$0	$1,718	$3,302	$5,020
5.2 Brush Chipper	5	day				$352.00	$0	$0	$0	$1,760	$1,760
5.3 Site Labor, (3 laborers)	15	day			$264.80		$0	$0	$3,972	$0	$3,972
5.4 Dewater Pad, 100' by 100'	10,000	sf		$1.50	$0.18	$0.22	$0	$15,000	$1,800	$2,200	$19,000
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, long arm	3	day			$355.20	$1,260.00	$0	$0	$1,066	$3,780	$4,846
6.2 Dozer, 105 hp	3	day			$343.60	$660.40	$0	$0	$1,031	$1,981	$3,012
6.3 Off-road Truck, 25 cy, 2 each	6	day			$265.20	$1,399.00	$0	$0	$1,591	$8,394	$9,985
6.4 Swamp Mats, 11,000 sf	1	week				$2,762.00	$0	$0	$0	$2,762	$2,762
6.5 Wheeled Front-end Loader	3	day			$343.60	$994.80	0	$0	$1,031	$2,984	$4,015
6.6 Dewatering Pumps, 2 each	6	day				$399.20	$0	$0	$0	$2,395	$2,395
6.7 Site Labor, (3 laborers)	9	day			$264.80		$0	$0	$2,383	$0	$2,383
6.8 Off Site Disposal, Non-Hazardous Soil	563	ton	$78.00				$43,914	$0	$0	$0	$43,914
6.9 Characterization/Offsite Disposal Soil Testing	1	ea	$1,000.00	$25.00			$1,000	$25	$0	$0	$1,025
7 SITE RESTORATION											
7.1 Excavator, long arm	14	day			$355.20	$1,260.00	$0	$0	$4,973	$17,640	$22,613
7.2 Dozer, 105 hp	14	day			$343.60	$660.40	$0	$0	$4,810	$9,246	$14,056
7.3 Site Labor, (3 laborers)	42	day			$264.80		$0	$0	$11,122	$0	$11,122
7.4 Swamp Mats, 11,000 sf	3	week				$2,762.00	$0	$0	$0	$8,286	$8,286
7.5 Select Fill	417	cy		$12.60			$0	$5,254	$0	$0	$5,254
7.6 Wetlands Restoration	0.3	ac	$32,000.00				$9,600	$0	$0	$0	$9,600
7.7 Grade & Seed Cover	1,250	sy		$0.50	$1.67	$0.34	$0	$625	$2,088	$425	$3,138
Subtotal							$59,799	$36,904	$76,212	$77,470	$250,386
Overhead on Labor Cost @ 30%									$22,864		$22,864
G & A on Labor Cost @ 10%									$7,621		$7,621
G & A on Material Cost @ 10%								$3,690			$3,690
G & A on Equipment Cost @ 10%										$7,747	$7,747
G & A on Subcontract Cost @ 10%							$5,980				$5,980
Tax on Materials and Equipment Cost @ 6%								$2,214		$4,648	$6,862

NAS PENSACOLA
Pensacola, Florida
Wetland 3
Alternative SED - 4: Removal and Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Direct Cost							$65,779	$42,809	$106,697	$89,866	$305,150
Indirects on Total Direct Cost @ 30%		(excluding transportation and disposal cost)									$78,075
Profit on Total Direct Cost @ 10%											$30,515
Subtotal											$413,740
Health & Safety Monitoring @ 2%											$8,275
Delineation Sampling											$14,296
Total Field Cost											$436,311
Contingency on Total Field Costs @ 20%											$87,262
Engineering on Total Field Cost @ 6%											$26,179
TOTAL CAPITAL COST											**$549,752**

NAS PENSACOLA
Pensacola, Florida
Wetland 5A
Alternative SED - 4: Removal and Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
1.2 Contractor Completion Report	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Preconstruction Meeting	30	hr			$70.00		$0	$0	$2,100	$0	$2,100
2.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.3 Equipment Mobilization/Demobilization	7	ea			$177.00	$610.00	$0	$0	$1,239	$4,270	$5,509
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	2	mo		$470.00		$453.00	$0	$940	$0	$906	$1,846
3.2 Construction Survey Support	4	day	$1,075.00				$4,300	$0	$0	$0	$4,300
3.3 Site Superintendent	7	week		$745.00	$1,802.00		$0	$5,215	$12,614	$0	$17,829
3.4 Site Health & Safety and QA/QC	7	week		$745.00	$1,322.00		$0	$5,215	$9,254	$0	$14,469
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$3,700.00	$3,200.00	$625.00	$0	$3,700	$3,200	$625	$7,525
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$771.00	$0	$0	$0	$771	$771
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$693.00	$0	$0	$0	$693	$693
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SITE PREPARATION											
5.1 Dozer, 105 hp	5	day			$343.60	$660.40	$0	$0	$1,718	$3,302	$5,020
5.2 Brush Chipper	5	day				$352.00	$0	$0	$0	$1,760	$1,760
5.3 Site Labor, (3 laborers)	15	day			$264.80		$0	$0	$3,972	$0	$3,972
5.4 Dewater Pad, 100' by 100'	10,000	sf		$1.50	$0.18	$0.22	$0	$15,000	$1,800	$2,200	$19,000
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, long arm	5	day			$355.20	$1,260.00	$0	$0	$1,776	$6,300	$8,076
6.2 Dozer, 105 hp	5	day			$343.60	$660.40	$0	$0	$1,718	$3,302	$5,020
6.3 Off-road Truck, 25 cy, 2 each	10	day			$265.20	$1,399.00	$0	$0	$2,652	$13,990	$16,642
6.4 Swamp Mats, 11,000 sf	1	week				$2,762.00	$0	$0	$0	$2,762	$2,762
6.5 Wheeled Front-end Loader	5	day			$343.60	$994.80	0	$0	$1,718	$4,974	$6,692
6.6 Dewatering Pumps, 2 each	10	day				$399.20	$0	$0	$0	$3,992	$3,992
6.7 Site Labor, (3 laborers)	15	day			$264.80		$0	$0	$3,972	$0	$3,972
6.8 Off Site Disposal, Non-Hazardous Soil	1,375	ton	$78.00				$107,250	$0	$0	$0	$107,250
6.9 Characterization/Offsite Disposal Soil Testing	2	ea	$1,000.00	$25.00			$2,000	$50	$0	$0	$2,050
7 SITE RESTORATION											
7.1 Excavator, long arm	17	day			$355.20	$1,260.00	$0	$0	$6,038	$21,420	$27,458
7.2 Dozer, 105 hp	17	day			$343.60	$660.40	$0	$0	$5,841	$11,227	$17,068
7.3 Site Labor, (3 laborers)	51	day			$264.80		$0	$0	$13,505	$0	$13,505
7.4 Swamp Mats, 11,000 sf	3	week				$2,762.00	$0	$0	$0	$8,286	$8,286
7.5 Select Fill	1,019	cy		$12.60			$0	$12,839	$0	$0	$12,839
7.6 Wetlands Restoration	0.6	ac	$32,000.00				$19,200	$0	$0	$0	$19,200
7.7 Grade & Seed Cover	3,056	sy		$0.50	$1.67	$0.34	$0	$1,528	$5,104	$1,039	$7,671
Subtotal							$133,735	$46,907	$91,566	$96,869	$369,077
Overhead on Labor Cost @ 30%									$27,470		$27,470
G & A on Labor Cost @ 10%									$9,157		$9,157
G & A on Material Cost @ 10%								$4,691			$4,691
G & A on Equipment Cost @ 10%										$9,687	$9,687
G & A on Subcontract Cost @ 10%							$13,374				$13,374
Tax on Materials and Equipment Cost @ 6%								$2,814		$5,812	$8,627

NAS PENSACOLA
Pensacola, Florida
Wetland 5A
Alternative SED - 4: Removal and Disposal
Capital Cost

10/31/2010 3:14 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Direct Cost							$147,109	$54,413	$128,192	$112,368	$442,081
Indirects on Total Direct Cost @ 30%	(excluding transportation and disposal cost)										$100,154
Profit on Total Direct Cost @ 10%											$44,208
Subtotal											$586,443
Health & Safety Monitoring @ 2%											$11,729
Delineation Sampling											$17,954
Total Field Cost											$616,126
Contingency on Total Field Costs @ 20%											$123,225
Engineering on Total Field Cost @ 6%											$36,968
TOTAL CAPITAL COST											**$776,319**

NAS PENSACOLA
Pensacola, Florida
Wetland 15
Alternative SED - 4: Removal and Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost				Extended Cost				
			Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
1.2 Contractor Completion Report	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Preconstruction Meeting	30	hr			$70.00		$0	$0	$2,100	$0	$2,100
2.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.3 Equipment Mobilization/Demobilization	7	ea			$177.00	$610.00	$0	$0	$1,239	$4,270	$5,509
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	2	mo		$470.00		$453.00	$0	$940	$0	$906	$1,846
3.2 Construction Survey Support	4	day	$1,075.00				$4,300	$0	$0	$0	$4,300
3.3 Site Superintendent	8	week		$745.00	$1,802.00		$0	$5,960	$14,416	$0	$20,376
3.4 Site Health & Safety and QA/QC	8	week		$745.00	$1,322.00		$0	$5,960	$10,576	$0	$16,536
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$3,700.00	$3,200.00	$625.00	$0	$3,700	$3,200	$625	$7,525
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$771.00	$0	$0	$0	$771	$771
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$693.00	$0	$0	$0	$693	$693
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SITE PREPARATION											
5.1 Dozer, 105 hp	5	day			$343.60	$660.40	$0	$0	$1,718	$3,302	$5,020
5.2 Brush Chipper	5	day				$352.00	$0	$0	$0	$1,760	$1,760
5.3 Site Labor, (3 laborers)	15	day			$264.80		$0	$0	$3,972	$0	$3,972
5.4 Dewater Pad, 100' by 100'	10,000	sf		$1.50	$0.18	$0.22	$0	$15,000	$1,800	$2,200	$19,000
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, long arm	6	day			$355.20	$1,260.00	$0	$0	$2,131	$7,560	$9,691
6.2 Dozer, 105 hp	6	day			$343.60	$660.40	$0	$0	$2,062	$3,962	$6,024
6.3 Off-road Truck, 25 cy, 2 each	12	day			$265.20	$1,399.00	$0	$0	$3,182	$16,788	$19,970
6.4 Swamp Mats, 11,000 sf	2	week				$2,762.00	$0	$0	$0	$5,524	$5,524
6.5 Wheeled Front-end Loader	6	day			$343.60	$994.80	0	$0	$2,062	$5,969	$8,030
6.6 Dewatering Pumps, 2 each	12	day				$399.20	$0	$0	$0	$4,790	$4,790
6.7 Site Labor, (3 laborers)	18	day			$264.80		$0	$0	$4,766	$0	$4,766
6.8 Off Site Disposal, Non-Hazardous Soil	1,656	ton	$78.00				$129,168	$0	$0	$0	$129,168
6.9 Characterization/Offsite Disposal Soil Testing	2	ea	$1,000.00	$25.00			$2,000	$50	$0	$0	$2,050
7 SITE RESTORATION											
7.1 Excavator, long arm	18	day			$355.20	$1,260.00	$0	$0	$6,394	$22,680	$29,074
7.2 Dozer, 105 hp	18	day			$343.60	$660.40	$0	$0	$6,185	$11,887	$18,072
7.3 Site Labor, (3 laborers)	54	day			$264.80		$0	$0	$14,299	$0	$14,299
7.4 Swamp Mats, 11,000 sf	3	week				$2,762.00	$0	$0	$0	$8,286	$8,286
7.5 Select Fill	1,227	cy		$12.60			$0	$15,460	$0	$0	$15,460
7.6 Wetlands Restoration	0.8	ac	$32,000.00				$25,600	$0	$0	$0	$25,600
7.7 Grade & Seed Cover	3,681	sy		$0.50	$1.67	$0.34	$0	$1,841	$6,147	$1,252	$9,239
Subtotal							$162,053	$51,331	$99,594	$108,275	$421,253
Overhead on Labor Cost @ 30%									$29,878		$29,878
G & A on Labor Cost @ 10%									$9,959		$9,959
G & A on Material Cost @ 10%								$5,133			$5,133
G & A on Equipment Cost @ 10%										$10,828	$10,828
G & A on Subcontract Cost @ 10%							$16,205				$16,205
Tax on Materials and Equipment Cost @ 6%								$3,080		$6,497	$9,576

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
Total Direct Cost							$178,258	$59,544	$139,432	$125,599	$502,833
Indirects on Total Direct Cost @ 30%		(excluding transportation and disposal cost)									$111,804
Profit on Total Direct Cost @ 10%											$50,283
Subtotal											$664,920
Health & Safety Monitoring @ 2%											$13,298
Delineation Sampling											$21,640
Total Field Cost											$699,859
Contingency on Total Field Costs @ 20%											$139,972
Engineering on Total Field Cost @ 6%											$41,992
TOTAL CAPITAL COST											**$881,822**

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 4: Removal and Disposal
Capital Cost

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
1.2 Contractor Completion Report	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Preconstruction Meeting	30	hr			$70.00		$0	$0	$2,100	$0	$2,100
2.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.3 Equipment Mobilization/Demobilization	7	ea			$177.00	$610.00	$0	$0	$1,239	$4,270	$5,509
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	2	mo		$470.00		$453.00	$0	$940	$0	$906	$1,846
3.2 Construction Survey Support	4	day	$1,075.00				$4,300	$0	$0	$0	$4,300
3.3 Site Superintendent	8	week		$745.00	$1,802.00		$0	$5,960	$14,416	$0	$20,376
3.4 Site Health & Safety and QA/QC	8	week		$745.00	$1,322.00		$0	$5,960	$10,576	$0	$16,536
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$3,700.00	$3,200.00	$625.00	$0	$3,700	$3,200	$625	$7,525
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$771.00	$0	$0	$0	$771	$771
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$693.00	$0	$0	$0	$693	$693
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SITE PREPARATION											
5.1 Dozer, 105 hp	5	day			$343.60	$660.40	$0	$0	$1,718	$3,302	$5,020
5.2 Brush Chipper	5	day				$352.00	$0	$0	$0	$1,760	$1,760
5.3 Site Labor, (3 laborers)	15	day			$264.80		$0	$0	$3,972	$0	$3,972
5.4 Dewater Pad, 100' by 100'	10,000	sf		$1.50	$0.18	$0.22	$0	$15,000	$1,800	$2,200	$19,000
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, long arm	5	day			$355.20	$1,260.00	$0	$0	$1,776	$6,300	$8,076
6.2 Dozer, 105 hp	5	day			$343.60	$660.40	$0	$0	$1,718	$3,302	$5,020
6.3 Off-road Truck, 25 cy, 2 each	10	day			$265.20	$1,399.00	$0	$0	$2,652	$13,990	$16,642
6.4 Swamp Mats, 11,000 sf	2	week				$2,762.00	$0	$0	$0	$5,524	$5,524
6.5 Wheeled Front-end Loader	5	day			$343.60	$994.80	0	$0	$1,718	$4,974	$6,692
6.6 Dewatering Pumps, 2 each	10	day				$399.20	$0	$0	$0	$3,992	$3,992
6.7 Site Labor, (3 laborers)	15	day			$264.80		$0	$0	$3,972	$0	$3,972
6.8 Off Site Disposal, Non-Hazardous Soil	1,344	ton	$78.00				$104,832	$0	$0	$0	$104,832
6.9 Characterization/Offsite Disposal Soil Testing	2	ea	$1,000.00	$25.00			$2,000	$50	$0	$0	$2,050
7 SITE RESTORATION											
7.1 Excavator, long arm	17	day			$355.20	$1,260.00	$0	$0	$6,038	$21,420	$27,458
7.2 Dozer, 105 hp	17	day			$343.60	$660.40	$0	$0	$5,841	$11,227	$17,068
7.3 Site Labor, (3 laborers)	51	day			$264.80		$0	$0	$13,505	$0	$13,505
7.4 Swamp Mats, 11,000 sf	3	week				$2,762.00	$0	$0	$0	$8,286	$8,286
7.5 Select Fill	995	cy		$12.60			$0	$12,537	$0	$0	$12,537
7.6 Wetlands Restoration	0.6	ac	$32,000.00				$19,200	$0	$0	$0	$19,200
7.7 Grade & Seed Cover	2,986	sy		$0.50	$1.67	$0.34	$0	$1,493	$4,987	$1,015	$7,495
Subtotal							$131,317	$48,060	$94,573	$99,607	$373,557
Overhead on Labor Cost @ 30%									$28,372		$28,372
G & A on Labor Cost @ 10%									$9,457		$9,457
G & A on Material Cost @ 10%								$4,806			$4,806
G & A on Equipment Cost @ 10%										$9,961	$9,961
G & A on Subcontract Cost @ 10%							$13,132				$13,132
Tax on Materials and Equipment Cost @ 6%								$2,884		$5,976	$8,860

NAS PENSACOLA
Pensacola, Florida
Wetland 18A
Alternative SED - 4: Removal and Disposal
Capital Cost

10/31/2010 3:15 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Direct Cost							$144,449	$55,750	$132,402	$115,544	$448,145
Indirects on Total Direct Cost @ 30%	(excluding transportation and disposal cost)										$102,698
Profit on Total Direct Cost @ 10%											$44,814
Subtotal											$595,657
Health & Safety Monitoring @ 2%											$11,913
Delineation Sampling											$16,694
Total Field Cost											$624,265
Contingency on Total Field Costs @ 20%											$124,853
Engineering on Total Field Cost @ 6%											$37,456
TOTAL CAPITAL COST											**$786,573**

NAS PENSACOLA
Pensacola, Florida
Wetland 48
Alternative SED - 4: Removal and Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
1.2 Contractor Completion Report	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Preconstruction Meeting	30	hr			$70 00		$0	$0	$2,100	$0	$2,100
2.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.3 Equipment Mobilization/Demobilization	7	ea			$177.00	$610.00	$0	$0	$1,239	$4,270	$5,509
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	6	mo		$470.00		$453.00	$0	$2,820	$0	$2,718	$5,538
3.2 Construction Survey Support	7	day	$1,075.00				$7,525	$0	$0	$0	$7,525
3.3 Site Superintendent	23	week		$745.00	$1,802.00		$0	$17,135	$41,446	$0	$58,581
3.4 Site Health & Safety and QA/QC	23	week		$745.00	$1,322.00		$0	$17,135	$30,406	$0	$47,541
4 DECONTAMINATION											
4.1 Decontamination Services	3	mo		$1,220.00	$2,245.00	$1,550.00	$0	$3,660	$6,735	$4,650	$15,045
4.2 Equipment Decon Pad	1	ls		$3,700.00	$3,200.00	$625.00	$0	$3,700	$3,200	$625	$7,525
4.3 Decon Water	3,000	gal		$0.20			$0	$600	$0	$0	$600
4.4 Decon Water Storage Tank, 6,000 gallon	3	mo				$771.00	$0	$0	$0	$2,313	$2,313
4.5 Clean Water Storage Tank, 4,000 gallon	3	mo				$693.00	$0	$0	$0	$2,079	$2,079
4.6 Disposal of Decon Waste (liquid & solid)	3	mo	$985 00				$2,955	$0	$0	$0	$2,955
5 SITE PREPARATION											
5.1 Dozer, 105 hp	10	day			$343.60	$660.40	$0	$0	$3,436	$6,604	$10,040
5.2 Brush Chipper	10	day				$352.00	$0	$0	$0	$3,520	$3,520
5.3 Site Labor, (3 laborers)	30	day			$264.80		$0	$0	$7,944	$0	$7,944
5.4 Dewater Pad, 100' by 100'	10,000	sf		$1.50	$0.18	$0.22	$0	$15,000	$1,800	$2,200	$19,000
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, long arm	30	day			$355.20	$1,260.00	$0	$0	$10,656	$37,800	$48,456
6.2 Dozer, 105 hp	30	day			$343.60	$660.40	$0	$0	$10,308	$19,812	$30,120
6.3 Off-road Truck, 25 cy, 2 each	60	day			$265.20	$1,399.00	$0	$0	$15,912	$83,940	$99,852
6.4 Swamp Mats, 11,000 sf	6	week				$2,762.00	$0	$0	$0	$16,572	$16,572
6.5 Wheeled Front-end Loader	30	day			$343.60	$994.80	0	$0	$10,308	$29,844	$40,152
6.6 Dewatering Pumps, 2 each	60	day				$399.20	$0	$0	$0	$23,952	$23,952
6.7 Site Labor, (3 laborers)	90	day			$264.80		$0	$0	$23,832	$0	$23,832
6.8 Off Site Disposal, Non-Hazardous Soil	8,040	ton	$78.00				$627,120	$0	$0	$0	$627,120
6.9 Characterization/Offsite Disposal Soil Testing	6	ea	$1,000.00	$25 00			$6,000	$150	$0	$0	$6,150
7 SITE RESTORATION											
7.1 Excavator, long arm	66	day			$355.20	$1,260.00	$0	$0	$23,443	$83,160	$106,603
7.2 Dozer, 105 hp	66	day			$343.60	$660.40	$0	$0	$22,678	$43,586	$66,264
7.3 Site Labor, (3 laborers)	196	day			$264.80		$0	$0	$51,901	$0	$51,901
7.4 Swamp Mats, 11,000 sf	13	week				$2,762.00	$0	$0	$0	$35,906	$35,906
7.5 Select Fill	6,000	cy		$12.60			$0	$75,600	$0	$0	$75,600
7.6 Wetlands Restoration	3.7	ac	$32,000.00				$118,400	$0	$0	$0	$118,400
7.7 Grade & Seed Cover	17,867	sy		$0.50	$1.67	$0.34	$0	$8,934	$29,838	$6,075	$44,846
Subtotal							$762,000	$145,734	$308,281	$413,126	$1,629,141
Overhead on Labor Cost @ 30%									$92,484		$92,484
G & A on Labor Cost @ 10%									$30,828		$30,828
G & A on Material Cost @ 10%								$14,573			$14,573
G & A on Equipment Cost @ 10%										$41,313	$41,313
G & A on Subcontract Cost @ 10%							$76,200				$76,200
Tax on Materials and Equipment Cost @ 6%								$8,744		$24,788	$33,532

NAS PENSACOLA
Pensacola, Florida
Wetland 48
Alternative SED - 4: Removal and Disposal
Capital Cost

10/31/2010 3:16 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Direct Cost							$838,200	$169,051	$431,594	$479,226	$1,918,071
Indirects on Total Direct Cost @ 30%		(excluding transportation and disposal cost)									$386,399
Profit on Total Direct Cost @ 10%											$191,807
Subtotal											$2,496,277
Health & Safety Monitoring @ 2%											$49,926
Delineation Sampling											$20,810
Total Field Cost											$2,567,013
Contingency on Total Field Costs @ 20%											$513,403
Engineering on Total Field Cost @ 6%											$154,021
TOTAL CAPITAL COST											**$3,234,436**

NAS PENSACOLA
Pensacola, Florida
Wetland 64
Alternative SED - 4: Removal and Disposal
Capital Cost

				Unit Cost				Extended Cost			
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction/Work Plans	300	hr			$37.00		$0	$0	$11,100	$0	$11,100
1.2 Contractor Completion Report	150	hr			$37.00		$0	$0	$5,550	$0	$5,550
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Preconstruction Meeting	30	hr			$70.00		$0	$0	$2,100	$0	$2,100
2.2 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.3 Equipment Mobilization/Demobilization	7	ea			$177.00	$610.00	$0	$0	$1,239	$4,270	$5,509
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	3	mo		$470.00		$453.00	$0	$1,410	$0	$1,359	$2,769
3.2 Construction Survey Support	7	day	$1,075.00				$7,525	$0	$0	$0	$7,525
3.3 Site Superintendent	12	week		$745.00	$1,802.00		$0	$8,940	$21,624	$0	$30,564
3.4 Site Health & Safety and QA/QC	12	week		$745.00	$1,322.00		$0	$8,940	$15,864	$0	$24,804
4 DECONTAMINATION											
4.1 Decontamination Services	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
4.2 Equipment Decon Pad	1	ls		$3,700.00	$3,200.00	$625.00	$0	$3,700	$3,200	$625	$7,525
4.3 Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4 Decon Water Storage Tank, 6,000 gallon	2	mo				$771.00	$0	$0	$0	$1,542	$1,542
4.5 Clean Water Storage Tank, 4,000 gallon	2	mo				$693.00	$0	$0	$0	$1,386	$1,386
4.6 Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5 SITE PREPARATION											
5.1 Dock Removal/Replacement	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000
5.2 Site Labor, (3 laborers)	30	day			$264.80		$0	$0	$7,944	$0	$7,944
5.3 Dewater Pad, 100' by 100'	10,000	sf		$1.50	$0.18	$0.22	$0	$15,000	$1,800	$2,200	$19,000
6 DREDGING AND DISPOSAL											
6.1 Hydraulic Dredging into geotubes	30,000	cy	$36.75				$1,102,500	$0	$0	$0	$1,102,500
6.2 Containment Piping, 18" dia.	300	lf		$12.65	$7.74	$0.50	$0	$3,795	$2,322	$150	$6,267
6.3 Turbidity Curtain	700	lf		$11.66	$7.23		$0	$8,162	$5,061	$0	$13,223
6.4 Excavator, 2 cy	30	day			$355.20	$1,321.00	$0	$0	$10,656	$39,630	$50,286
6.5 Wheeled Front-end Loader	30	day			$343.60	$994.80	0	$0	$10,308	$29,844	$40,152
6.6 Dewatering Pumps, 2 each	60	day				$399.20	$0	$0	$0	$23,952	$23,952
6.7 Site Labor, (3 laborers)	90	day			$264.80		$0	$0	$23,832	$0	$23,832
6.8 Off Site Disposal, Non-Hazardous Soil	9,500	ton	$78.00				$741,000	$0	$0	$0	$741,000
6.9 Characterization/Offsite Disposal Soil Testing	7	ea	$1,000.00	$25.00			$7,000	$175	$0	$0	$7,175
7 SITE RESTORATION											
7.1 Excavator, 2 cy	30	day			$355.20	$1,321.00	$0	$0	$10,656	$39,630	$50,286
7.2 Hydraulic Dredging	2.0	ac	$82,950.00				$165,900	$0	$0	$0	$165,900
7.3 Site Labor, (3 laborers)	90	day			$264.80		$0	$0	$23,832	$0	$23,832
7.4 Select Fill	3,705	cy		$12.60			$0	$46,683	$0	$0	$46,683
7.6 Wetlands Restoration	2.0	ac	$32,000.00				$64,000	$0	$0	$0	$64,000
Subtotal							$2,099,895	$100,645	$161,578	$151,188	$2,513,306
Overhead on Labor Cost @ 30%									$48,473		$48,473
G & A on Labor Cost @ 10%									$16,158		$16,158
G & A on Material Cost @ 10%								$10,065			$10,065
G & A on Equipment Cost @ 10%										$15,119	$15,119
G & A on Subcontract Cost @ 10%							$209,990				$209,990
Tax on Materials and Equipment Cost @ 6%								$6,039		$9,071	$15,110

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Direct Cost							$2,309,885	$116,748	$226,209	$175,378	$2,828,220
Indirects on Total Direct Cost @ 30%	(excluding transportation and disposal cost)										$625,575
Profit on Total Direct Cost @ 10%											$282,822
Subtotal											$3,736,617
Health & Safety Monitoring @ 1%											$37,366
Delineation Sampling											$24,848
Total Field Cost											$3,798,831
Contingency on Total Field Costs @ 20%											$759,766
Engineering on Total Field Cost @ 1%											$37,988
TOTAL CAPITAL COST											**$4,596,586**

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150	
SUBJECT: Wetlands Final FS			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY:	DATE:

Wetland 3

Alternative SED - 2: Monitoring and Natural Recovery

Annual Cost

Sediment Sampling

Labor & Materials, per round (3 sediment samples)

Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 2 days =	$2,600
car for 2 days =	$200
report @ $65.00 per hour for 15 hours =	$825
Misc supplies, copying, etc. =	$500
	$4,125

Analytical, per round for 30 years

Collect 3 sediment samples and analyze for cadmium & arsenic

type	cost each	number	total
cadmium	$20	3	$60
arsenic	$20	3	$60
			$120
40% QA/QC & Data Validation			$48
			$168

5-year review = $5,000

Alternative SED - 4: Removal and Disposal

Delineation Sampling

Sample sediments prior to excavation

Assume 15 samples to be collect a day with crew of 2

Time to Complete

		days	hours
number of samples	18	2	40
mob/demob		1	20
sample grid setup		1	20
		4	80

Labor @ $65.00 per hour	$5,200
Per diem @ $149 per day	$1,192
Car @ $100 per day	$400
Supplies @ $500	$500
Reports: 100 hours @ $65 per hour	$6,500
	$13,792

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150	
SUBJECT: Wetlands Final FS			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY:	DATE:

Analytical

Collect sediment samples and analyze for cadmium, & arsenic

type	cost each	number	total
cadmium	$20	18	$360
arsenic	$20	18	$360
			$360
40% QA/QC & Data Validation			$144
			$504

Total Delineation Sampling Cost $14,296

Capital Cost

use long arm excavator on swamp mats
load on to trucks and haul to dewatering pad (100' by 100')
pump water back to wetland, filter but no treatment
dewater sediment for 3 days then load for disposal
backfill with sand/silt to original grade
restore wetland, seed remaining area

excavation area	11,250	sf or	0.3 acres
clear twice excavated area	22,500	sf or	0.5 acres
volume/weight of excavated material	11,250	cf or	563 tons @ 100 lb/cf

wetlands restoration	0.3 acres
upland seeding	1,250 sy

Time to complete:

Mob	5 days
Site Setup & Clearing	5 days
Excavation	3 days
Dewatering & Disposal	3 additional days
Backfill	3 days
Wetland Restoration & Seed	6 days
Demob	5 days
	30 days
	6 weeks
	1.4 months

Wetland 5A

Alternative SED - 4: Removal and Disposal

Delineation Sampling

Sample sediments prior to excavation

Assume 15 samples to be collect a day with crew of 2

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Time to Complete

		days	hours
number of samples	44	3	60
mob/demob		1	20
sample grid setup		1	20
		5	100

Labor @ $65.00 per hour	$6,500
Per diem @ $149 per day	$1,490
Car @ $100 per day	$500
Supplies @ $500	$500
Reports: 100 hours @ $65 per hour	$6,500
	$15,490

Analytical

Collect sediment samples and analyze for copper, lead, & zinc

type	cost each	number	total
copper	$20	44	$880
lead	$20	44	$880
zinc	$20	44	$880
			$1,760
40% QA/QC & Data Validation			$704
			$2,464

Total Delineation Sampling Cost $17,954

Capital Cost

use long arm excavator on swamp mats
load on to trucks and haul to dewatering pad (100' by 100')
pump water back to wetland, filter but no treatment
dewater sediment for 3 days then load for disposal
backfill with sand/silt to original grade
restore wetland, seed remaining area

excavation area	27,500	sf or	0.6 acres
clear twice excavated area	55,000	sf or	1.3 acres
volume/weight of excavated material	27,500	cf or	1,375 tons @ 100 lb/cf

wetlands restoration	0.6 acres
upland seeding	3,056 sy

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150	
SUBJECT: Wetlands Final FS			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY:	DATE:

Time to complete:

Mob	5 days
Site Setup & Clearing	5 days
Excavation	5 days
Dewatering & Disposal	3 additional days
Backfill	3 days
Wetland Restoration & Seed	9 days
Demob	5 days
	35 days
	7 weeks
	1.7 months

Alternative SED - 2: Monitoring and Natural Recovery

Annual Cost

<u>Sediment Sampling</u>

Labor & Materials, per round (1 sediment sample)

Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 2 days =	$2,600
car for 2 days =	$200
report @ $65.00 per hour for 15 hours =	$825
Misc supplies, copying, etc. =	$500
	$4,125

Analytical, per round for 30 years

Collect 1 sediment sample and analyze for copper, lead, & zinc

type	cost each	number	total
copper	$20	1	$20
lead	$20	1	$20
zinc	$20	1	$20
			$60
40% QA/QC & Data Validation			$24
			$84

5-year review = $5,000

Wetland 15

Alternative SED - 4: Removal and Disposal

Delineation Sampling

Sample sediments prior to excavation

Assume 15 samples to be collect a day with crew of 2

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150	
SUBJECT: Wetlands Final FS			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY:	DATE:

Time to Complete

		days	hours
number of samples	53	4	80
mob/demob		1	20
sample grid setup		1	20
		6	120

Labor @ $65.00 per hour	$7,800
Per diem @ $149 per day	$1,788
Car @ $100 per day	$600
Supplies @ $500	$500
Reports: 100 hours @ $65 per hour	$6,500
	$17,188

Analytical
Collect sediment samples and analyze for metals (arsenic, manganese, selenium)

type	cost each	number	total
arsenic	$20	53	$1,060
manganese	$20	53	$1,060
selenium	$20	53	$1,060
			$3,180
40% QA/QC & Data Validation			$1,272
			$4,452

Total Delineation Sampling Cost $21,640

Capital Cost

use long arm excavator on swamp mats
load on to trucks and haul to dewatering pad (100' by 100')
pump water back to wetland, filter but no treatment
dewater sediment for 3 days then load for disposal
backfill with sand/silt to original grade
restore wetland, seed remaining area

excavation area	33,125	sf or	0.8 acres
clear twice excavated area	66,250	sf or	1.5 acres
volume/weight of excavated material	33,125	cf or	1,656 tons @ 100 lb/cf

wetlands restoration	0.8 acres
upland seeding	3,681 sy

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150	
SUBJECT: Wetlands Final FS			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY:	DATE:

Time to complete:

Mob	5	days
Site Setup & Clearing	5	days
Excavation	6	days
Dewatering & Disposal	4	additional days
Backfill	3	days
Wetland Restoration & Seed	10	days
Demob	5	days
	38	days
	8	weeks
	1.8	months

Annual Cost

Alternative SED - 2: Monitoring and Natural Recovery

Sediment Sampling

Labor & Materials, per round (2 sediment samples)

Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 2 days =	$2,600
car for 2 days =	$200
report @ $65.00 per hour for 15 hours =	$825
Misc supplies, copying, etc. =	$500
	$4,125

Analytical, per round for 30 years

Collect 2 sediment samples and analyze for metals (arsenic, manganese, selenium)

type	cost each	number	total
arsenic	$20	2	$40
manganese	$20	2	$40
selenium	$20	2	$40
			$120
40% QA/QC & Data Validation			$48
			$168

5-year review = $5,000

Wetland 18A

Alternative SED - 4: Removal and Disposal

Delineation Sampling

Sample sediments prior to excavation

Assume 15 samples to be collect a day with crew of 2

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Time to Complete

		days	hours
number of samples	43	3	60
mob/demob		1	20
sample grid setup		1	20
		5	100

Labor @ $65.00 per hour	$6,500
Per diem @ $149 per day	$1,490
Car @ $100 per day	$500
Supplies @ $500	$500
Reports: 100 hours @ $65 per hour	$6,500
	$15,490

Analytical
Collect sediment samples and analyze for arsenic

type	cost each	number	total
arsenic	$20	43	$860
			$860
40% QA/QC & Data Validation			$344
			$1,204
Total Delineation Sampling Cost			$16,694

Capital Cost

use long arm excavator on swamp mats
load on to trucks and haul to dewatering pad (100' by 100')
pump water back to wetland, filter but no treatment
dewater sediment for 3 days then load for disposal
backfill with sand/silt to original grade
restore wetland, seed remaining area

excavation area	26,875	sf or	0.6 acres
clear twice excavated area	53,750	sf or	1.2 acres
volume/weight of excavated material	26,875	cf or	1,344 tons @ 100 lb/cf

wetlands restoration	0.6 acres
upland seeding	2,986 sy

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Time to complete:

Mob	5 days
Site Setup & Clearing	10 days
Excavation	5 days
Dewatering & Disposal	3 additional days
Backfill	3 days
Wetland Restoration & Seed	9 days
Demob	5 days
	40 days
	8 weeks
	1.9 months

Alternative SED - 3: LUCs, Natural Recovery, and Monitoring

Annual Cost

Yearly Site Inspection/Visit for LUCs implementation (1 person)

Assume out of town travel to site.

Air	$850
Per Diem	$149
Car	$100
Hours	$900 (12 hours * $75/hr)
Report	$1,000
Misc	$150
	$3,149

Sediment Sampling

Labor & Materials, per round (1 sediment sample)

Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 2 days =	$2,600
car for 2 days =	$200
report @ $65.00 per hour for 15 hours =	$825
Misc supplies, copying, etc. =	$500
	$4,125

Analytical, per round for 30 years

Collect 1 sediment sample and analyze for arsenic

type	cost each	number	total
arsenic	$20	1	$20
			$20
40% QA/QC & Data Validation			$8
			$28

5-year review = $5,000

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150	
SUBJECT: Wetlands Final FS			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY:	DATE:

Annual Cost
Alternative SED - 2: Monitoring and Natural Recovery

Sediment Sampling

Same as SED - 3

5-year review = $5,000

Wetland 18B

Annual Cost
Alternative SED - 2: Monitoring and Natural Recovery

Sediment Sampling

Labor & Materials, per round (1 sediment sample)

Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 2 days =	$2,600
car for 2 days =	$200
report @ $65.00 per hour for 15 hours =	$825
Misc supplies, copying, etc. =	$500
	$4,125

Analytical, per round for 30 years

Collect 1 sediment sample and analyze for arsenic

type	cost each	number	total
arsenic	$20	1	$20
			$20
40% QA/QC & Data Validation			$8
			$28

5-year review = $5,000

Wetland 48

Alternative SED - 4: Removal and Disposal

Delineation Sampling

Sample sediments prior to excavation

Assume 15 samples to be collect a day with crew of 2

Time to Complete

		days	hours
number of samples	38	3	60
mob/demob		1	20
sample grid setup		1	20
		5	100

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Labor @ $65.00 per hour	$6,500
Per diem @ $149 per day	$1,490
Car @ $100 per day	$500
Supplies @ $500	$500
Reports: 100 hours @ $65 per hour	$6,500
	$15,490

Analytical

Collect sediment samples and analyze for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, & total DDT

type	cost each	number	total
DDTs	$100	38	$3,800
			$3,800
40% QA/QC & Data Validation			$1,520
			$5,320

Total Delineation Sampling Cost $20,810

Capital Cost

use long arm excavator on swamp mats
load on to trucks and haul to dewatering pad (100' by 100')
pump water back to wetland, filter but no treatment
dewater sediment for 3 days then load for disposal
backfill with sand/silt to original grade
replace road (400' by 15' wide), restore wetland, seed remaining area

excavation area	160,800	sf or	3.7 acres
clear twice excavated area	321,600	sf or	7.4 acres
volume/weight of excavated material	160,800	cf or	8,040 tons @ 100 lb/cf

wetlands restoration	3.7 acres
upland seeding	17,867 sy

Time to complete:

Mob	5 days
Site Setup & Clearing	10 days
Excavation	30 days
Dewatering & Disposal	4 additional days
Backfill	15 days
Replace Road	4 days
Wetland Restoration & Seed	42 days
Demob	5 days
	115 days
	23 weeks
	5.5 months

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Annual Cost

Alternative SED - 2: Monitoring and Natural Recovery

Sediment Sampling

Labor & Materials, per round (8 sediment samples)

Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 2 days =	$2,600
car for 2 days =	$200
report @ $65.00 per hour for 15 hours =	$825
Misc supplies, copying, etc. =	$500
	$4,125

Analytical, per round for 30 years

Collect 8 sediment samples and analyze for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, & total DDT

type	cost each	number	total
DDTs	$100	8	$800
			$800
40% QA/QC & Data Validation			$320
			$1,120

5-year review = $5,000

Wetland 64

Alternative SED - 4: Removal and Disposal

Delineation Sampling

Sample sediments prior to excavation

Assume 8 samples to be collect a day with crew of 2

Time to Complete

		days	hours
number of samples	19	3	60
mob/demob		1	20
sample grid setup		2	40
		6	120

Labor @ $65.00 per hour	$7,800
Boat @ $1,000 per day	$5,000
Per diem @ $149 per day	$1,788
Car @ $100 per day	$600
Supplies @ $500	$500
Reports: 100 hours @ $65 per hour	$6,500
	$22,188

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Analytical
Collect sediment samples and analyze for cadmium, chromium, copper, lead, silver, zinc

type	cost each	number	total
metals	$100	19	$1,900
			$1,900
40% QA/QC & Data Validation			$760
			$2,660

Total Delineation Sampling Cost $24,848

Capital Cost

use hydraulic dredge to remove sediment
pump from dredge into geotextile tubes for dewatering
pump water back to wetland, filter but no treatment
dewater sediment for 10 days then load for disposal
backfill southern area with sand/silt to using dredge (3,705 cy)
restore southern wetland area

dredge area	190,000	sf or	4.4 acres
volume/weight of excavated material	190,000	cf or	9,500 tons @ 100 lb/cf
wetlands restoration	2.0 acres		

Time to complete:

Mob	10 days
Dredging	10 days
Dewatering & Disposal	10 additional days
Backfill	10 days
Wetland Restoration	15 days
Demob	5 days
	60 days
	12 weeks
	2.9 months

Annual Cost
Alternative SED - 2: Monitoring and Natural Recovery

Sediment Sampling
Labor & Materials, per round (3 sediment samples)
Assume 2 days to sample with 2 people, local

2 people @ $65.00 per hour for 10 hours for 5 days =	$2,600
car for 2 days =	$200
boat =	$1,000
report @ $65.00 per hour for 20 hours =	$1,300
Misc supplies, copying, etc. =	$500
	$5,600

CLIENT: NAS PENSACOLA		JOB NUMBER: 112G00390.11.150
SUBJECT: Wetlands Final FS		
BASED ON:		DRAWING NUMBER:
BY: TJR Date: 10/2010	CHECKED BY: Date:	APPROVED BY: DATE:

Analytical, per round for 30 years
Collect 3 sediment samples and analyze for cadmium, chromium, copper, lead, silver, zinc

type	cost each	number	total
metals	$100	3	$300
			$300
40% QA/QC & Data Validation			$120
			$420

5-year review = $5,000

APPENDIX C

SUSTAINABILITY EVALUATION OF REMEDIAL ALTERNATIVES
FOR
OPERABLE UNIT (OU) 16, SITE 41 WETLANDS
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
OCTOBER 2010

APPENDIX C

Sustainability Evaluation of Remedial Alternatives

for

Operable Unit (OU) 16, Site 41 Wetlands

Naval Air Station Pensacola

Pensacola, Florida

October 2010

Objective

This Sustainable Remediation Evaluation (SRE) of Remedial Alternatives including references is provided as an appendix to the Feasibility Study (FS) for Operable Unit (OU) 16, Site 41 Wetlands Naval Air Station (NAS) Pensacola, FL. The purpose of the SRE is to assess the sustainability of the proposed remedial alternatives using the metrics of greenhouse gas (GHG) emissions, energy use, air emissions of criteria pollutants, water consumption, and worker safety. The results of the SRE are intended to provide additional information for consideration with the CERCLA remedy selection criteria described in the FS and to enhance the understanding of the net environmental benefit of the selected remedy.

Sustainability Evaluation Policy Background

Department of Defense (DOD) and Navy policies require continual optimization of remedies in every phase from remedy selection through site closeout. In January 2007, Executive Order 13423 set targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, etc. In October 2009, Executive Order 13514 was issued, which reinforced these sustainability requirements and established specific goals for federal agencies to meet by 2020.

In August 2009 DOD issued policy for "Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program." The DOD policy and related Navy guidance state that opportunities to increase sustainability should be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout). In response to this policy, the Navy issued an updated Navy Guidance for "Optimizing Remedy Evaluation, Selection, and Design" (Battelle, 2010), which includes sustainability evaluations as part of the traditional Navy optimization review process for remedy selection, design, and remedial action operation. In August 2010 the Naval Facilities Engineering Command (NAVFAC) issued policy requiring use of the SiteWise tool to perform sustainability reviews as part of all Feasibility Studies. As such, this sustainability evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of increasing the sustainability of remedial action at Site 41, NAS Pensacola.

SiteWise

The tool used for this evaluation is SiteWise, a stand-alone tool developed jointly by the U.S. Navy, U.S. Army Corps of Engineers (USACE), and Battelle that assesses the environmental footprint of a remedial alternative/technology in terms of a consistent set of metrics. The assessment is carried out using a building block approach where every remedial alternative is first broken down into modules that mimic the remedial phases in most remedial actions, including remedial investigation (RI), remedial action constructions (RAC), remedial action operation (RA-O), and long-term monitoring (LTM). Once broken down into various modules, the footprint of each module is individually calculated. The different footprints are then combined to estimate the overall footprint of the remedial alternative. This building block approach reduces redundancy in the sustainability evaluation and facilitates the identification of specific activities that have the greatest environmental footprint. The inputs that need to be considered include (1) production of material required by the activity; (2) transportation of the required materials to the site; (3) all site activities to be performed; and (4) management of the waste produced by the activity.

Sustainability Evaluation Framework and Limitations

The sustainability evaluation performed for Alternatives SED-2 through SED-4 considered life-cycle metrics for GHG emissions, criteria pollutant emissions, energy consumption, water usage, and worker safety. The no action alternative (Alternative SED-1) was not evaluated, as hypothetically no direct emissions or consumption occur as part of implementation of the no action alternatives.

Life-cycle metrics were analyzed for the following three sediment remedial alternatives, which are summarized in detail in the Feasibility Study:

- Alternative SED-2: Natural Recovery and Monitoring for Wetlands 3, 5A, 15, 18A, 18B, 48, and 64.
- Alternative SED-3: LUCs, Natural Recovery, and Monitoring, for Wetlands 18A and 18B
- Alternative SED-4: Ex-Situ Treatment – Removal (Excavation) and Disposal for Wetlands 3, 5A, 15, 18A, 48, and 64

However, the alternatives are not easily comparable amongst each other because the evaluation will essentially be on a case by case basis for each wetland. In addition, not every alternative applies to every wetland. Alternative SED-2 is the only reasonable option for Wetland 3. Alternative SED-2 and SED-3 have the same emissions within the limitations of the model for Alternative 18B. SED-2 will be compared to SED-4 for Wetlands 3, 5A, 15, 18A, 48, and 64. SED-2, SED-3, and SED-4 will be compared for alternative 18A.

Another limitation within Alternative SED-4 is the inclusion of mobilization/demobilization and equipment transportation to and from the site, along with trailer transportation and set up. This will likely happen once for the entire site, however, it is included in the model for each Wetland to keep a level playing field when SED-2 is considered against SED-4 Hydraulic dredging for Wetland 64 was added in using a GSR-x/SiteWise hybrid model

Life cycle impacts were calculated for energy consumption, emissions of greenhouse gases (GHGs) [carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)] and criteria pollutants [nitrogen oxides (NO_x), sulfur oxides (SO_x) and particulate matter (PM_{10})], water usage, and energy consumption. Calculation of these metrics was divided into four modules – materials production; transportation of personnel; transportation of materials, and equipment; equipment use and miscellaneous; and residual handling. Cost estimates from the Feasibility Study and design calculations from each alternative were used as a basis for quantities and related assumptions.

<u>Sustainability Evaluation Results</u>

Table C-1 summarizes the quantitative results of the sustainability evaluation performed for Site EO300 remedial alternatives. The SiteWise Impact tables for Alternatives are included in the attachments. The following sections summarize the results of the evaluation.

Alternative SED-2

Due to limitations in the model, the only input into SiteWise for SED-2 is the travel to and from the site for sampling. It is assumed there will be 2 days of sampling for each wetland, and travel back and forth from the site 200 miles each way. This long-term monitoring will happen once a year. This yields the following:

GHG Emissions metric ton	Total Energy Used MMBTU	Water Impacts gallons	NO_x Emissions metric ton	SO_x Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
0.60	6.61	NA	0.00065	1.56	9.76E-05	6.80E-06	000488

These results are the same for each Wetland (3, 5A, 15, 18A, 18B, 48, 64) and can be compared to the corresponding results for each Wetland when considering Alternative SED-4 below Once it is determined which alternative will be chosen for each wetland, these results will be scaled up (i.e. if 3 wetlands are chosen for alternative 2, the total will be tripled).

Alternative SED-3

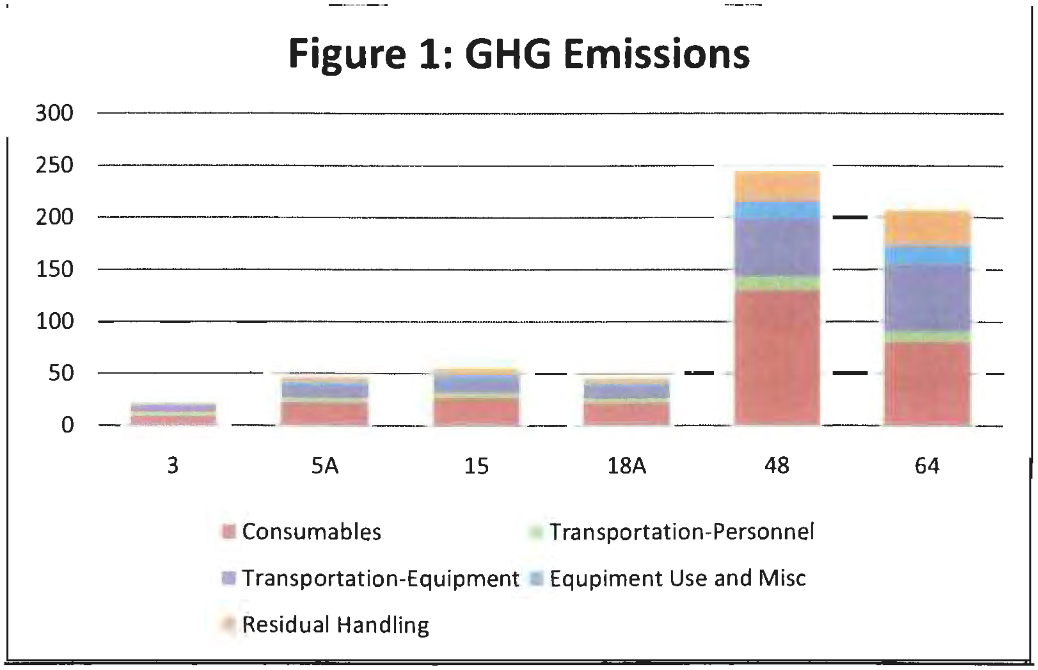
Alternative SED-3 only applies to Wetlands 18A and 18B, and thus can only be compared to SED-2 and SED-4 for Wetland 18A and SED-2 for Wetland 18B This alternative involves traveling to the site to sample, and has the same inputs and emissions as alternative SED-2. Therefore, it does not provide further decision making criteria for 18B.

Alternative SED-4

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure-1 shows how the different sectors within the Construction phase contribute to the GHG emissions total. Wetland 48 has the most GHG emissions at 244 tonnes, due to the amount of excavation, followed by Wetland 64 at 206 tonnes, and the second most amount of excavation.

The emissions from SED-2 and SED-3 only come from travel to and from the site for sampling.



Criteria Pollutant Emissions

Criteria pollutant emissions for NO_x, SO_x, and PM_{10} were estimated for each wetland. Results from the evaluation of NO_x, SO_x, and PM_{10} are summarized in Figures 2, 3, and 4, respectively. WL 48 has the highest emissions for all three criteria pollutants at 0.224 tonnes for NO_x, 0.0508 tonnes for SO_x and 0.033 tonnes for PM_{10}. These emissions can largely be attributed to the large volume of excavation that would need to be accomplished for this alternative. All of the criteria pollutant emissions are directly proportional to the amount of soil being excavated, and clean fill brought in, for each wetland. The equipment use sector has the largest amount of emissions for each wetland due to the dozers, excavators, and loaders used during remediation.

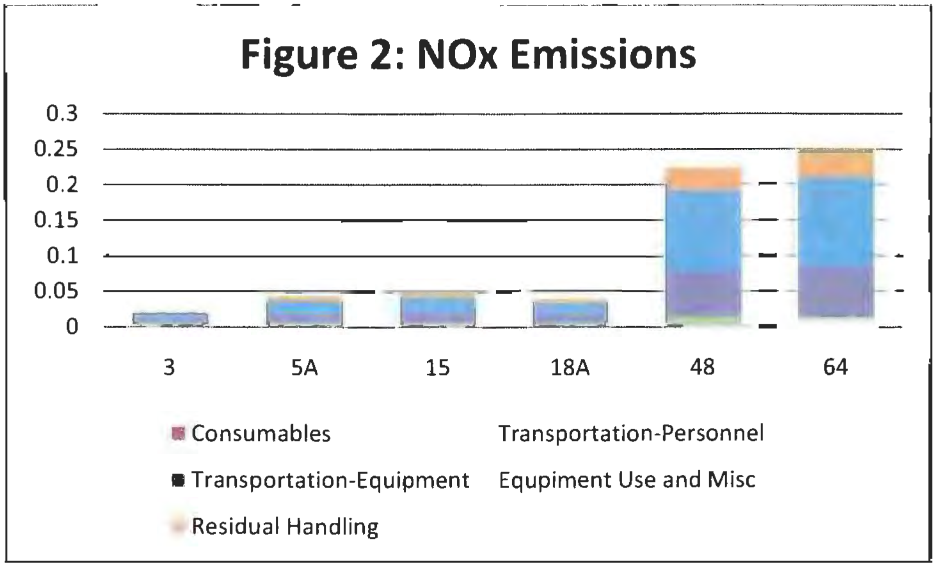


Figure 2: NOx Emissions
0.3
0.25
0.2
0.15
0.1
0.05
0
3
5A
15
18A
48
64
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

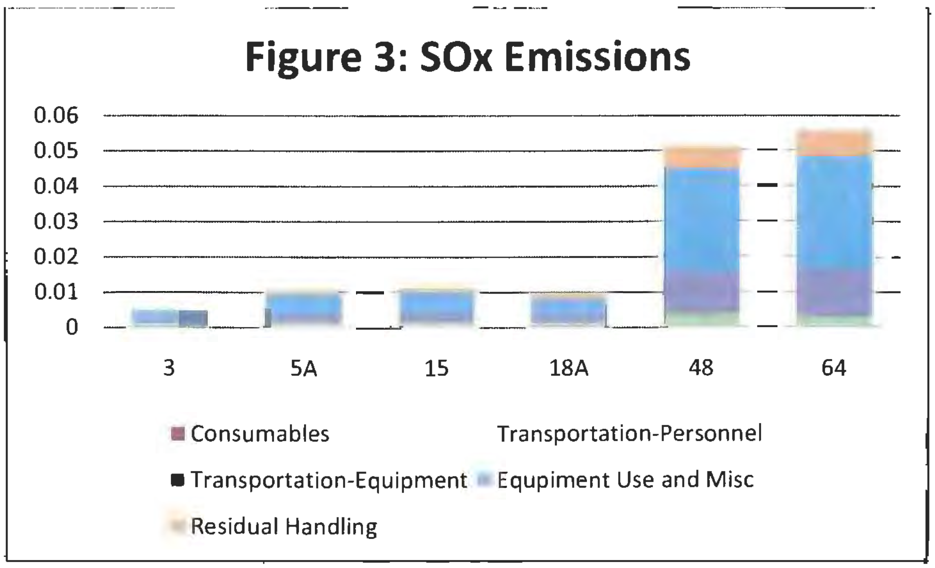
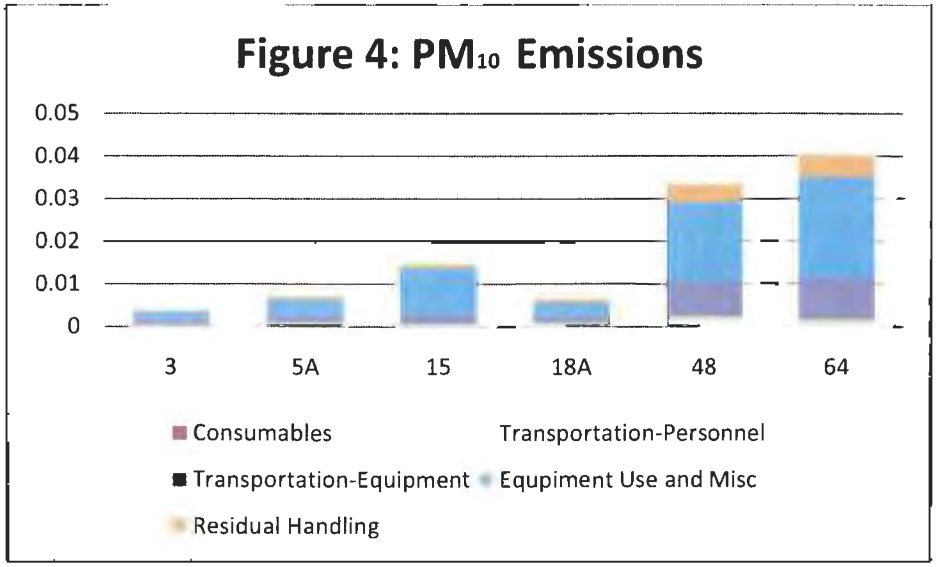
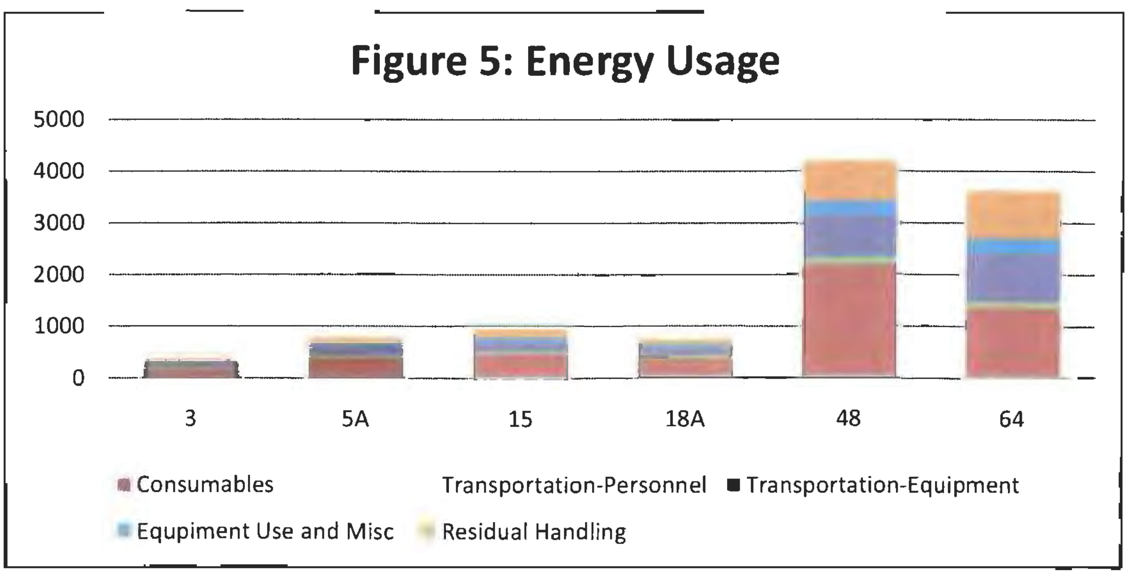


Figure 3: SOx Emissions
0.06
0.05
0.04
0.03
0.02
0.01
0
3
5A
15
18A
48
64
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling



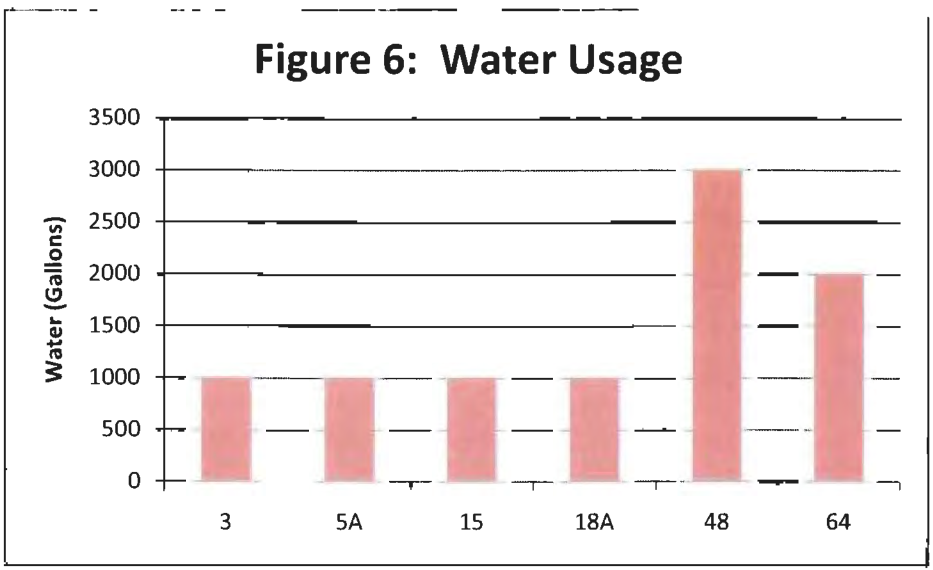
Energy Consumption

Analysis of energy consumption is summarized in Figure 5. It is clear that Consumables is the sector that yields the highest energy use. The ratio of energy use by sector is analogous to GHG emissions. A limitation in this model is that "soil" or "fill" was not a material option, so "gravel" had to be used as a soil surrogate. Soil is likely to have lower energy consumption in its production phase than gravel, thus the energy consumption for all wetlands is probably actually less than shown in Figure 5.



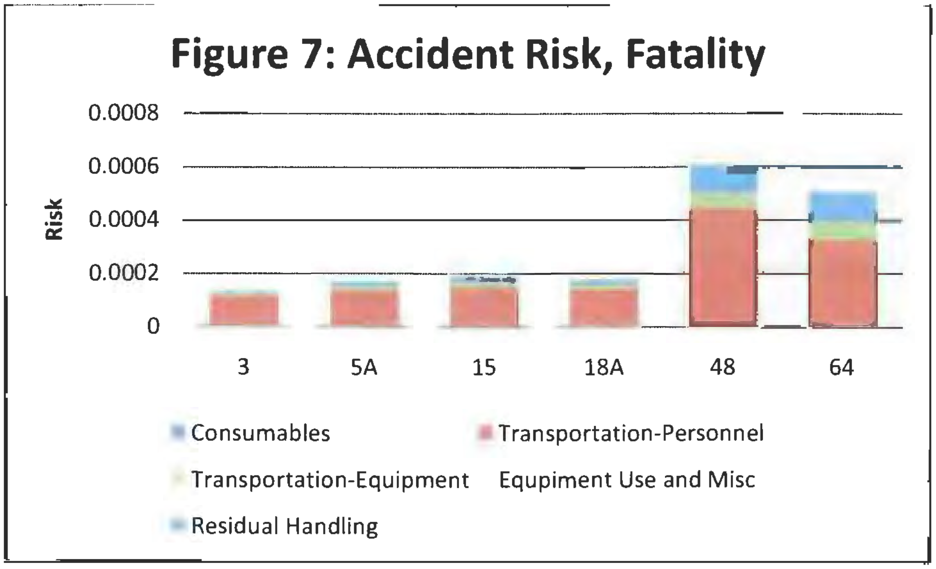
Water Usage

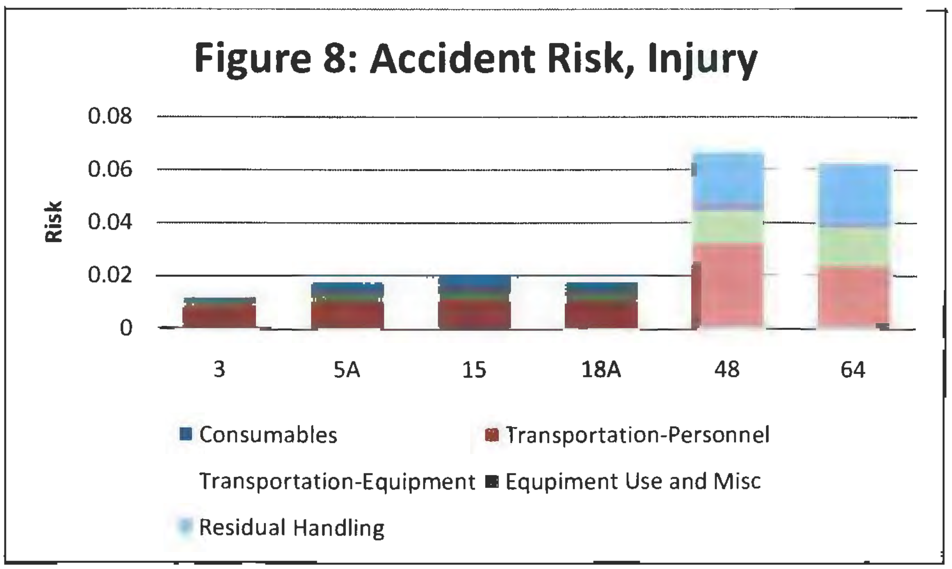
Water consumption only occurs in the Equipment Use sector, and is the same for Wetlands 3, 5A, 15, and 18A, triple that amount for Wetland 48, and double for Wetland 64. Wetland 48 uses the most water, again due to the large volume of excavation there. When compared to Alternative SED-2, there is no water consumption, so Alternative SED-4will have a greater water impact for all of the wetlands considered. Figure 6 shows the water usage for each wetland.



Worker Risk

Below in Figures 7 and 8 are a summary of the risk to remedial action workers. It is clear that transportation of personnel is the highest risk driver, due to the long distances that workers would need to travel daily.

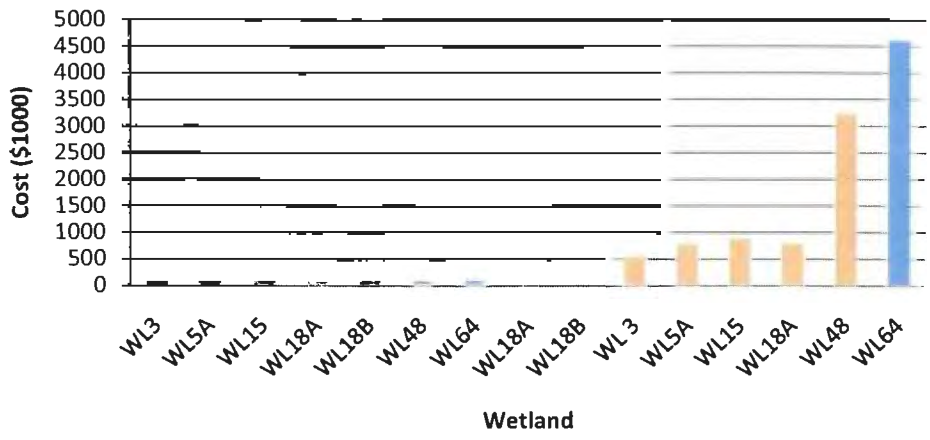




Cost of Remedy Alternatives

The estimated life-cycle costs are summarized in Figure 7, with SED-2 in blue, SED-3 in green, and SED-4 in orange. Wetland 64 has the highest cost, but not the highest environmental footprint. The estimated life-cycle costs for Wetlands under Alternative SED-2 and Wetland 18A in SED-3 are all similar and relatively low. This shows that overall, Alternative SED-4 is the most costly in addition to having the highest environmental footprint.

Figure 9: Remedy Life Cycle Cost



Conclusions

In general, optimization of the selected remedy to decrease the primary components of CO_2e emissions could potentially increase the net environmental benefit of remedy implementation. During selection and design of the remedy, a sensitivity analysis considering elements of the remedy that have the greatest impact on remedy effectiveness, life-cycle cost, and sustainability metrics may provide additional insight into appropriate optimization.

It's clear that SED-4 will have more GHG emissions, criteria pollutant emissions, energy consumption, water usage, and worker risk than any corresponding SED-2 options. Each individual wetland must be looked at separately, and if SED-2 is capable of accomplishing the clean up goals in a timely and cost effective manner, it will also be in a sustainable manner as well. Thus, SED-2 is recommended when possible, based solely on sustainability, for all alternatives.

Additional measures identified in the evaluation that may reduce the environmental footprint of the alternatives are listed below for consideration.

- Minimize travel to and from site by sampling multiple wetlands on the same days for SED-2
- Consider obtaining some, or all, of the select fill from on site, or from the closest source possible to minimize material transportation impacts.
- Consider using E-Diesel vehicles for materials and equipment transport.
- Worker risk can be minimized if travel distances are minimized.

TABLES:

SITEWISE EVALUATION SUMMARIES

TABLE C-1 PAGE 1
SUSTAINABILITY EVALUATION
SUMMARY TABLE
SITE EO300 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA

Alternative	Activities	GHG Emissions metric ton	Total Energy Used MMBTU	Water Impacts gallons	NO_x Emissions metric ton	SO_x Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
2	Consumables	0.00	0.00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.60	6.61	NA	6.50E-04	1.56E-04	9.76E-05	6.80E-06	4.88E-04
	Transportation-Equipment	0.00	0.00	NA	0	0	0	0	0
	Equipment Use and Misc	0.00	0.00	0	0	0	0	0	0
	Residual Handling	0.00	0.00	NA	0	0	0	0	0
	Sub-Total	0.60	6.61	0	6.50E-04	1.56E-04	9.76E-05	6.80E-06	4.88E-04
3	Consumables	0.00	0.00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.60	6.61	NA	6.50E-04	1.56E-04	9.76E-05	6.80E-06	4.88E-04
	Transportation-Equipment	0.00	0.00	NA	0	0	0	0	0
	Equipment Use and Misc	0.00	0.00	0	0	0	0	0	0
	Residual Handling	0.00	0.00	NA	0	0	0	0	0
	Sub-Total	0.60	6.61	0	6.50E-04	1.56E-04	9.76E-05	6.80E-06	4.88E-04
4 - WL 3	Consumables	9.01	150.78	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	3.78	41.33	NA	0.0041	0.0010	0.0006	0.000111	0.0080
	Transportation-Equipment	5.84	85.51	NA	0.0066	0.0013	0.0009	0.000007	0.0014
	Equipment Use and Misc	1.30	22.70	1000	0.0078	0.0021	0.0019	0.000002	0.0008
	Residual Handling	2.02	55.73	NA	0.0023	0.0004	0.0003	0.000006	0.0013
	Sub-Total	21.95	356.04	1000	0.0208	0.0048	0.0037	0.000127	0.0116
4 - WL 5A	Consumables	22.03	368.44	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.53	49.60	NA	0.0049	0.0012	0.0007	0.000135	0.0097
	Transportation-Equipment	11.19	163.65	NA	0.0127	0.0024	0.0017	0.000013	0.0026
	Equipment Use and Misc	3.19	54.39	1000	0.0195	0.0053	0.0039	0.000004	0.0016
	Residual Handling	4.75	131.12	NA	0.0054	0.0010	0.0007	0.000015	0.0031
	Sub-Total	45.69	767.20	1000	0.0425	0.0100	0.0071	0.000166	0.0170

TABLE C-1 PAGE 2
SUSTAINABILITY EVALUATION
SUMMARY TABLE
SITE EO300 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA

Alternative	Activities	GHG Emissions metric ton	Total Energy Used MMBTU	Water Impacts gallons	NO_x Emissions metric ton	SO_x Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
4 - WL 15	Consumables	26.52	443.65	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	5.03	54.97	NA	0.0054	0.0013	0.0008	0.000148	0.0106
	Transportation-Equipment	13.04	190.76	NA	0.0148	0.0028	0.0020	0.000015	0.0030
	Equipment Use and Misc	4.06	66.51	1000	0.0212	0.0056	0.0109	0.0000	0.0019
	Residual Handling	5.82	160.62	NA	0.0066	0.0013	0.0009	0.0000	0.0039
	Sub-Total	54.47	916.51	1000	0.0481	0.0110	0.0145	0.0002	0.0195
4 - WL 18A	Consumables	21.51	359.76	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.80	52.49	NA	0.0052	0.0012	0.0008	0.000141	0.0101
	Transportation-Equipment	10.92	159.72	NA	0.0124	0.0024	0.0017	0.000012	0.0026
	Equipment Use and Misc	2.47	41.99	1000	0.0153	0.0041	0.0032	0.000004	0.0015
	Residual Handling	5.53	114.05	NA	0.0059	0.0014	0.0009	0.000015	0.0031
	Sub-Total	45.22	728.01	1000	0.0388	0.0091	0.0065	0.000171	0.0172
4 - WL 48	Consumables	129.70	2169.43	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	13.79	150.87	NA	0.0148	0.0036	0.0022	0.000442	0.0317
	Transportation-Equipment	54.78	801.44	NA	0.0623	0.0119	0.0083	0.000059	0.0123
	Equipment Use and Misc	17.20	267.10	3000	0.1146	0.0292	0.0185	0.000008	0.0033
	Residual Handling	28.15	776.88	NA	0.0320	0.0061	0.0043	0.000089	0.0186
	Sub-Total	243.62	4165.72	3000	0.2237	0.0508	0.0333	0.000598	0.0660
4 - WL 64	Consumables	80.09	1339.62	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	10.47	114.49	NA	0.0113	0.0027	0.0017	0.000322	0.0231
	Transportation-Equipment	64.13	938.26	NA	0.0729	0.0140	0.0097	0.000069	0.0144
	Equipment Use and Misc	18.25	286.40	2000	0.1254	0.0315	0.0236	0.000005	0.0023
	Residual Handling	33.13	914.56	NA	0.0377	0.0072	0.0050	0.000105	0.0219
	Sub-Total	201.117	3518.28	2000	0.2068	0.0460	0.0322	0.000501	0.0617

APPENDIX:

SITEWISE INPUT TABLES FOR ALTERNATIVES

SITE INFORMATION	
Name	Feasibility Study - Pensacola
Date	10/13/2010
Site	NAS Pensacola
Remedial Alternative Name	Alternative SED - 2

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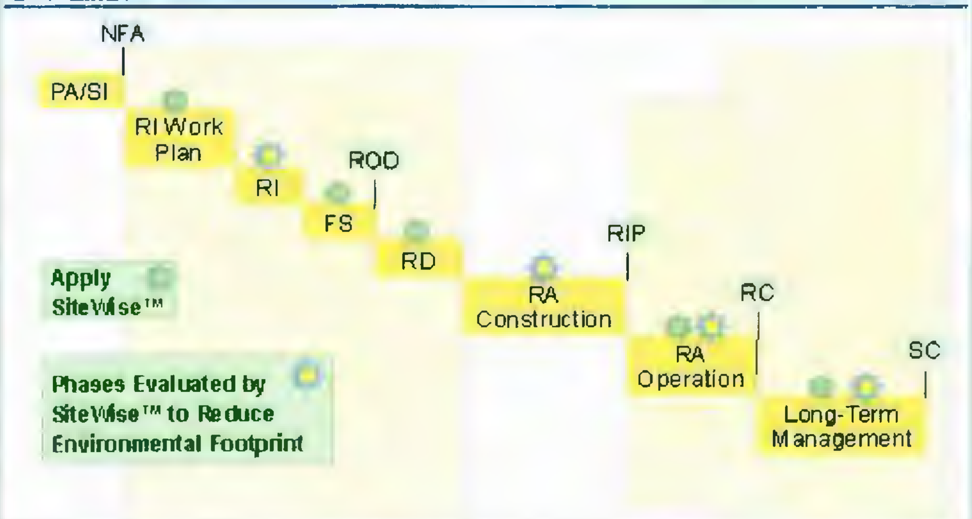

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells require the user to choose an input from a drop down menu

White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIAL	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6

[illegible]	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6

[illegible]	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	400					
Input number of trips taken	2					
Input number of travelers	1					
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible] (tons)						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

[illegible] - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6

For each pump, select only one of the three methods to calculate energy and GHG emissions

[illegible] for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method [illegible] ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	[illegible]	[illegible]

Method 2 PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	[illegible]	0
Input total head (ft)	0	0	0	[illegible]	[illegible]	0
Input number of pumps operating	[illegible]	0	0	[illegible]	[illegible]	0
Input operating time for each pump (hrs)	[illegible]	0	0	[illegible]	[illegible]	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	[illegible]	1	1	1	1	1

Method 3 - NAME PLATE [illegible] ARE KNOWN						
Input pump horsepower (hp)	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Input number of pumps operating	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Input operating time for each pump (hrs)	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIE[illegible] PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Method 2 - [illegible] USAGE IS KNOWN						
Region						

[illegible]	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6

[illegible]	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6

[illegible]	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6

MIX[illegible]	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6

RESIDUAL HANDLING

[illegible]	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

[illegible]	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
[illegible]						

[illegible]	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	Feasibility Study - Pensacola
Date	10/13/2010
Site	NAS Pensacola
Remedial Alternative Name	Alternative SED - 3, WL 18A

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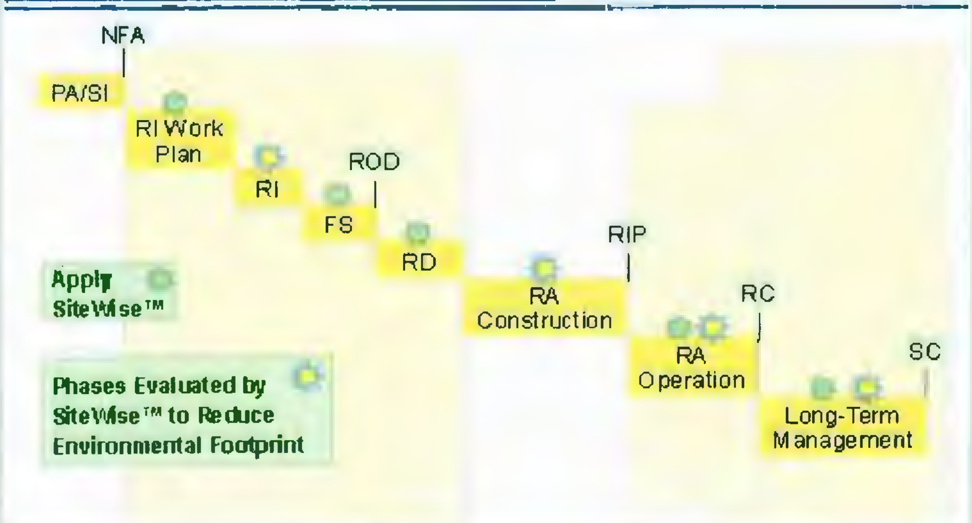


This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative
Yellow cells | require the user to choose an input from a drop down menu
White cells | require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	So

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	400					
Input number of trips taken	1					
Input number of travelers	1					
Input estimated vehicular fuel economy (mi/gal) (input only if known for the vehicle selected otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - Rail	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	[illegible]	[illegible]	0	[illegible]
Method 2 PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	[illegible]	[illegible]	0	[illegible]
Input total head (ft)	0	0	0	[illegible]	0	[illegible]
Input number of pumps operating	0	0	[illegible]	[illegible]	[illegible]	[illegible]
Input operating time for each pump (hrs)	0	0	[illegible]	[illegible]	[illegible]	[illegible]
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	[illegible]	[illegible]
Input number of pumps operating	0	0	0	0	[illegible]	[illegible]
Input operating time for each pump (hrs)	0	0	0	0	[illegible]	[illegible]
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DI[illegible] AND GASOLINE [illegible]	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Method 1 NAME PLATE SPECIFICATIONS ARE KNOWN						
Method 2 ELECTRICAL USAGE IS KNOWN						
Region						

[illegible]	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6

A[illegible]	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6

CAP[illegible] EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6

MIXING [illegible]	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6

RESIDUAL HANDLING

[illegible]	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

[illegible]	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
[illegible]						

[illegible]	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (acfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

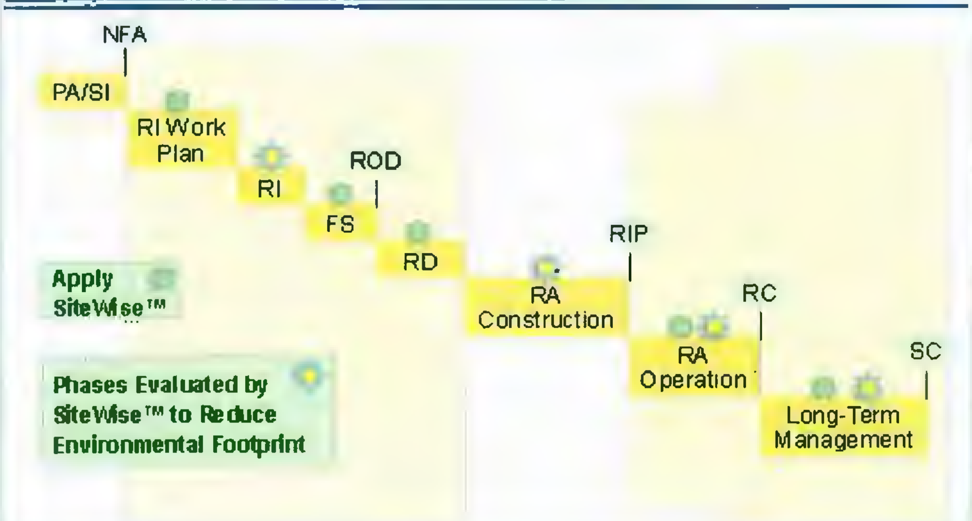
WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	FS Wetlands Remediation
Date	10/28/2010
Site	NAS Pensacola
Remedial Alternative Name	WL 3

When to Use SiteWise™ to Reduce Environmental Footprint



This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative
Yellow cells require the user to choose an input from a drop down menu
White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Soil Surrogate					
CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	Gravel	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	11,259					
Input depth of material (ft)	1					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Survey Crew	Site Labor	Site Super and HS			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	[illegible]	[illegible]	[illegible]			
Input number of trips taken	[illegible]	[illegible]	[illegible]			
Input number of travelers	1	[illegible]	[illegible]			
Input estimated vehicular fuel economy (mi/gal) (input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Clean Fill	Dozer	Excavator	Loader	Brush Chipper	Trailer Mob/Demob
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input distance traveled (miles)	1,660	200	200	200	200	400
Input weight of equipment transported (tons)	[illegible]	[illegible]	40	[illegible]	[illegible]	20

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

EQUIPMENT USE

				Brush Chipper Surrogate		
EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Excavator	Loader/Backhoe	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	1,251	834	417	417		
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1

Method [illegible] ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	[illegible]	0	0	[illegible]	[illegible]	0

Method 2 PUMP HEAD IS KNOWN						
Input flow rate (gpm)	[illegible]	[illegible]	[illegible]	[illegible]	0	0
Input total head (ft)	[illegible]	[illegible]	[illegible]	[illegible]	0	0
Input number of pumps operating	[illegible]	[illegible]	[illegible]	[illegible]	0	0
Input operating time for each pump (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1		1	1	1	1

Method 3 NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	[illegible]	[illegible]	[illegible]	[illegible]	0	0
Input number of pumps operating	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]
Input operating time for each pump (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

Assume 10 hrs/day

DIESEL AND GASOLINE PUMP	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1
Equipment operating hours (hrs)	120					
Input estimated fuel consumption rate (gal/hr) (input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method [illegible] NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Input number of equipments operating	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Input operating time for each equipment (hrs)	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Method [illegible] ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	[illegible]	[illegible]	0

Region						
Choose region from drop down menu (scroll right to see figure	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

[illegible]	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
[illegible]	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
[illegible]	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
[illegible]						

[illegible]	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (ft)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft²)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd³)						
Input production rate (yd³/hr)						
Input estimated fuel consumption rate (gal/hr) (input only if known for the mixer selected otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUAL TRANSPORTATION	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	34					
Choose vehicle type from drop down menu	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	17					
Input number of miles per trip	100					

LANDFILL OPERATION	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
[illegible] Table 7A)						

THERMAL AND CATALYTIC OXIDIZERS	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*[Electric blowers are included in the analysis]

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	1000					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	FS Wetlands Remediation
Date	10/14/2010
Site	NAS Pensacola
Remedial Alternative Name	WL 5A

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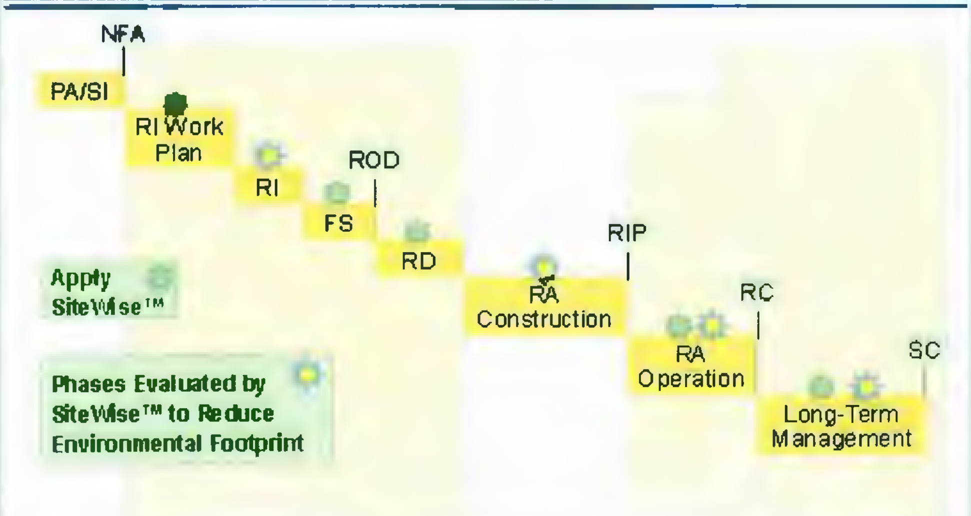
When to Use SiteWise™ to Reduce Environmental Footprint



[illegible] product [illegible]
Yellow cells [illegible] input from a drop down menu
White cells [illegible]

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS/MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Soil Surrogate					
CONSTRUCTION MATERIAL	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	Gravel	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	27 513					
Input depth of material (ft)	1					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Survey Crew	Site Labor	Site Supv and HS			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	[illegible]	[illegible]	[illegible]			
Input number of trips taken	[illegible]	[illegible]	[illegible]			
Input number of travelers	[illegible]	[illegible]	7			
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Clean Fill	Dozer	Excavator	Loader	Brush Chipper	Trailer Mob/Demob
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input distance traveled (miles)	4,044	200	200	200	200	400
Input weight of equipment transported (tons)	[illegible]	[illegible]	[illegible]	[illegible]	10	[illegible]

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

EQUIPMENT USE

				Brush Chipper Surrogate		
EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Excavator	Loader/Backhoe	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	3,057	2,038	1,019	1 019		
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	[illegible]	[illegible]	[illegible]	[illegible]	No	[illegible]
DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6

Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD
	Assume 10 hrs/day					
DIESEL AND GASOLINE PUMPS	**Pump 1**	**Pump 2**	**Pump 3**	**Pump 4**	**Pump 5**	**Pump 6**
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)	240					
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						
For each type of equipment, select only one of the methods to calculate energy and GHG emissions Enter "0" for all user input values for unused equipment columns or unused methods						
BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	**Equipment 1**	**Equipment 2**	**Equipment 3**	**Equipment 4**	**Equipment 5**	**Equipment 6**
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD
[illegible]	**Generator 1**	**Generator 2**	**Generator 3**	**Generator 4**	**Generator 5**	**Generator 6**
[illegible]	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
[illegible]	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
[illegible]						
[illegible]	**Tillage Tractor 1**	**Tillage Tractor 2**	**Tillage Tractor 3**	**Tillage Tractor 4**	**Tillage Tractor 5**	**Tillage Tractor 6**
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						
CAPPING EQUIPMENT	**Equipment 1**	**Equipment 2**	**Equipment 3**	**Equipment 4**	**Equipment 5**	**Equipment 6**
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						
MIXING EQUIPMENT	**Mixer 1**	**Mixer 2**	**Mixer 3**	**Mixer 4**	**Mixer 5**	**Mixer 6**
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

[illegible]	**Soil Residue**	**Residual Water**	**Material Residue**	**Other Residuals**	**Other Residuals**	**Other Residuals**
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	34					
Choose vehicle type from drop down menu	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	40					
Input number of miles per trip	100					
LANDFILL OPERATIONS	**Operation 1**	**Operation 2**	**Operation 3**	**Operation 4**	**Operation 5**	**Operation 6**
[illegible]						
THERMAL OXIDIZER	**Oxidizer 1**	**Oxidizer 2**	**Oxidizer 3**	**Oxidizer 4**	**Oxidizer 5**	**Oxidizer 6**
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						

Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*[Electric blowers are included in the analysis].

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	1000					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	FS Wetlands Remediation
Date	10/14/2010
Site	NAS Pensacola
Remedial Alternative Name	WL 15

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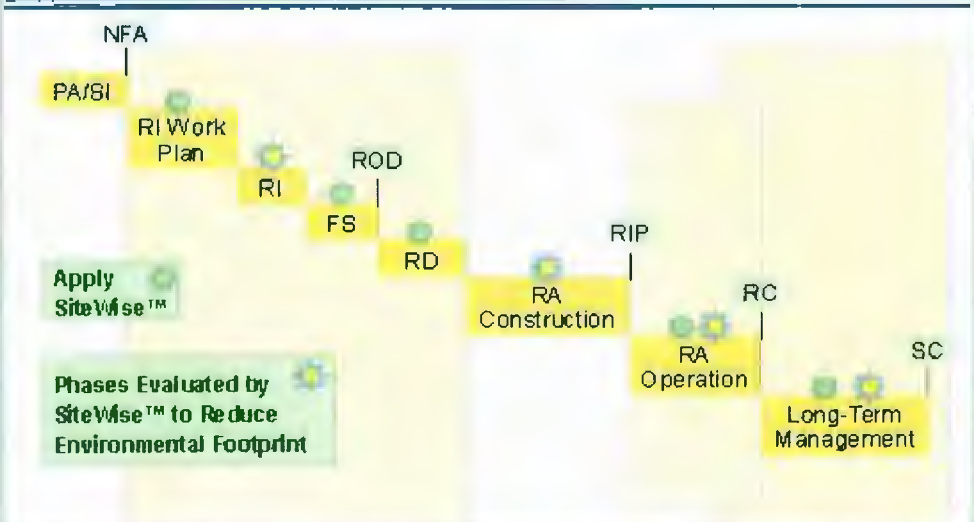

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells require the user to choose an input from a drop down menu

White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Soil Surrogate					
CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	Gravel	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	33,129					
Input depth of material (ft)	1					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Survey Crew	Site Crew	Super/HS			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	50			
Input number of trips taken	4	87	42			
Input number of travelers	1	3	2			
Input estimated vehicular fuel economy (mi/gal) (input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Soil	Brush Chipper	Dozer	Excavator	Loader	Trailer Mob/Demob
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input distance traveled (miles)	4,871	200	200	200	200	400
Input weight of equipment transported (tons)	34	11	19	[illegible]	[illegible]	20

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT USE

	Brush Chipper			Wheeled Front End Loader		
EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Loader/Backhoe	Dozer	Excavator	Loader/Backhoe	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	1,227	3,681	2,454	1,227		
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions

Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	[illegible]	0	0	[illegible]
Method 2 PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	[illegible]	[illegible]
Input total head (ft)	0	0	0	0	[illegible]	[illegible]
Input number of pumps operating	0	0	0	0	[illegible]	[illegible]
Input operating time for each pump (hrs)	0	0	0	0	[illegible]	[illegible]
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	[illegible]	[illegible]
Input number of pumps operating	0	0	0	0	[illegible]	[illegible]
Input operating time for each pump (hrs)	0	0	0	0	[illegible]	[illegible]
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD
[illegible]	**Pump 1**	**Pump 2**	**Pump 3**	**Pump 4**	**Pump 5**	**Pump 6**
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)	1200					
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions Enter "0" for all user input values for unused equipment columns or unused methods						
BLOWER, COMPRESSOR, MIXER AND OTHER EQUIPMENT	**Equipment 1**	**Equipment 2**	**Equipment 3**	**Equipment 4**	**Equipment 5**	**Equipment 6**
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	[illegible]
Input number of equipments operating	0	[illegible]	[illegible]	[illegible]	0	[illegible]
Input operating time for each equipment (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	[illegible]	[illegible]	[illegible]	[illegible]	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD
[illegible]	**Generator 1**	**Generator 2**	**Generator 3**	**Generator 4**	**Generator 5**	**Generator 6**
[illegible]	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
[illegible]	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
[illegible]						
[illegible]	**Tillage Tractor 1**	**Tillage Tractor 2**	**Tillage Tractor 3**	**Tillage Tractor 4**	**Tillage Tractor 5**	**Tillage Tractor 6**
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (ft)						
CAPPING [illegible]	**Equipment 1**	**Equipment 2**	**Equipment 3**	**Equipment 4**	**Equipment 5**	**Equipment 6**
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						
MIXING EQUIPMENT	**Mixer 1**	**Mixer 2**	**Mixer 3**	**Mixer 4**	**Mixer 5**	**Mixer 6**
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected otherwise a default will be used by the tool)						

RESIDUAL HANDLING

[illegible]	**Soil Residue**	**Residual Water**	**Material Residue**	**Other Residuals**	**Other Residuals**	**Other Residuals**
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	34					
Choose vehicle type from drop down menu	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	49					
Input number of miles per trip	100					
[illegible]	**Operation 1**	**Operation 2**	**Operation 3**	**Operation 4**	**Operation 5**	**Operation 6**
[illegible] (user must input emission factors in the Look Up Tables, Table [illegible])						
[illegible]	**Oxidizer 1**	**Oxidizer 2**	**Oxidizer 3**	**Oxidizer 4**	**Oxidizer 5**	**Oxidizer 6**
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	1000					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	FS Wetlands Remediation
Date	10/14/2010
Site	NAS Pensacola
Remedial Alternative Name	WL 18A

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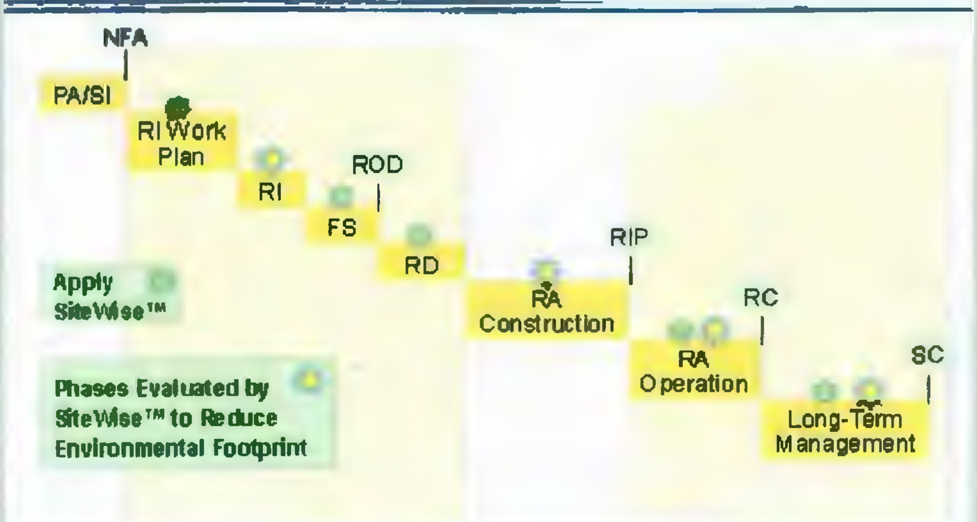
When to Use SiteWise™ to Reduce Environmental Footprint



[illegible] allows the user to define material production, transportation, equipment use, and residual handling [illegible] for the remedial alternative
Yellow cells require the user to choose an input from a drop down menu
Blue cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS/MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Soil Surrogate					
CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	Gravel	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	2[illegible] 865					
Input depth of material (ft)	1					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Survey Crew	Site Crew	Super/HS			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	[illegible]	[illegible]	[illegible]	[illegible]
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	[illegible]			
Input number of trips taken	4	81	[illegible]			
Input number of travelers	1	3	2			
Input estimated vehicular fuel economy (mi/gal) (input only if known for the vehicle selected otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Soil	Brush Chipper	Dozer	Excavator	Loader	Mob/Demob Trailer
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	[illegible]	No	No	[illegible]	[illegible]	[illegible]
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input distance traveled (miles)	3,924	200	200	200	200	400
Input weight of equipment transported (tons)	34	10	19	[illegible]	[illegible]	[illegible]

EQUIPMENT TRANSPORTATION - [illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of [illegible] (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - [illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT USE

	Brush Chipper					
EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Loader/Backhoe	Dozer	Excavator	Loader/Backhoe	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	995	2,985	1,990	995		
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	[illegible]	[illegible]	[illegible]	[illegible]
DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1

Method [illegible] ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	[illegible]	[illegible]	0	[illegible]
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input total head (ft)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input number of pumps operating	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input operating time for each pump (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.5[illegible]	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input number of pumps operating	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input operating time for each pump (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD
DIESE[illegible] PUMP	**Pump 1**	**Pump 2**	**Pump 3**	**Pump 4**	**Pump 5**	**Pump 6**
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to
Equipment operating hours (hrs)	200					
Input estimated fuel consumption rate (gal/hr) (input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	**Equipment 1**	**Equipment 2**	**Equipment 3**	**Equipment 4**	**Equipment 5**	**Equipment 6**
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	[illegible]	[illegible]	[illegible]
Input number of equipments operating	0	0	0	[illegible]	[illegible]	[illegible]
Input operating time for each equipment (hrs)	0	0	0	[illegible]	[illegible]	[illegible]
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	[illegible]	0	0	[illegible]	[illegible]	[illegible]
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD
[illegible]	**Generator 1**	**Generator 2**	**Generator 3**	**Generator 4**	**Generator 5**	**Generator 6**
[illegible]	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
[illegible]	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
[illegible]						
[illegible]	**Tillage Tractor 1**	**Tillage Tractor 2**	**Tillage Tractor 3**	**Tillage Tractor 4**	**Tillage Tractor 5**	**Tillage Tractor 6**
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay So
Input time available (work days)						
Input depth of tillage (in)						
CAPPING [illegible]	**Equipment 1**	**Equipment 2**	**Equipment 3**	**Equipment 4**	**Equipment 5**	**Equipment 6**
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						
[illegible]	**Mixer 1**	**Mixer 2**	**Mixer 3**	**Mixer 4**	**Mixer 5**	**Mixer 6**
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (input only if known for the mixer selected otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUAL [illegible]	**Soil Residue**	**Residual Water**	**Material Residue**	**Other Residuals**	**Other Residuals**	**Other Residuals**
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	24					
Choose vehicle type from drop down menu	Heavy Duty	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Diesel	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	[illegible]0					
Input number of miles per trip	100					
[illegible]	**Operation 1**	**Operation 2**	**Operation 3**	**Operation 4**	**Operation 5**	**Operation 6**
Input tons of [illegible] waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						
[illegible]	**Oxidizer 1**	**Oxidizer 2**	**Oxidizer 3**	**Oxidizer 4**	**Oxidizer 5**	**Oxidizer 6**
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (°F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	1000					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	FS Wetlands Remediation
Date	10/14/2010
Site	NAS Pensacola
Remedial Alternative Name	WL 48

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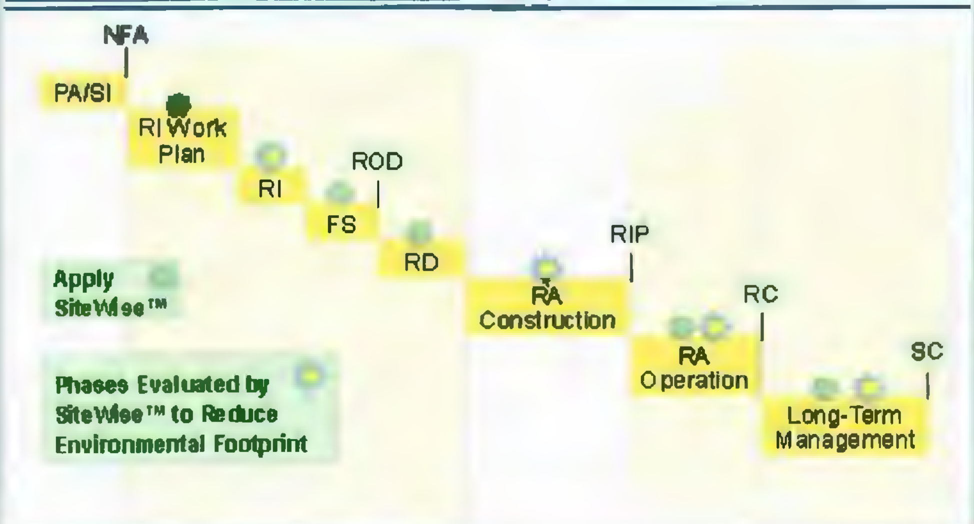


This [illegible] to define [illegible] production, transportation, equipment use, and residual handling variables for the remedial [illegible]

Yellow cells require the user to choose an input from a drop down menu

White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIAL	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Soil Surrogate					
CONSTRUCTION MATERIAL	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	Gravel	HDPE Line	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	162,000					
Input depth of material (ft)	1					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	[illegible]	[illegible]	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Survey Crew	Site Crew	Sugar/HS			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	50			
Input number of trips taken	7	316	42			
Input number of travelers	1	3	2			
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Soil	Dozer	Excavator	Loader	Brush Chipper	Trailer Mob/Demob
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input distance traveled (miles)	23,647	200	200	200	200	200
Input weight of equipment transported (tons)	34	19	40	[illegible]	[illegible]	20

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT USE

	Brush Chipper					
EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Loader/Backhoe	Dozer	Excavator	Loader/Backhoe	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	5,956	17,868	11,912	5,956		
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions

Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method	Method 1

Method 1: ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Method 2: PUMP HEAD IS KNOWN						
Input flow rate (gpm)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input total head (ft)	[illegible]	[illegible]	[illegible]	0	[illegible]	0
Input number of pumps operating	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
Input operating time for each pump (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1

Method 3: NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	[illegible]	[illegible]	[illegible]	0	[illegible]	0
Input number of pumps operating	[illegible]	[illegible]	[illegible]	0	[illegible]	0
Input operating time for each pump (hrs)	[illegible]	[illegible]	0	0	[illegible]	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

[illegible]	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)	1200					
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1: NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input number of equipments operating	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]
Input operating time for each equipment (hrs)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Method 2: ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATOR	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURE EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

[illegible] EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

[illegible]	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE [illegible]	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	[illegible]					
Choose vehicle type from drop down menu	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	237					
Input number of miles per trip	100					

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
[illegible] Table, T[illegible])						

THERMAL [illegible] OXIDIZERS	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

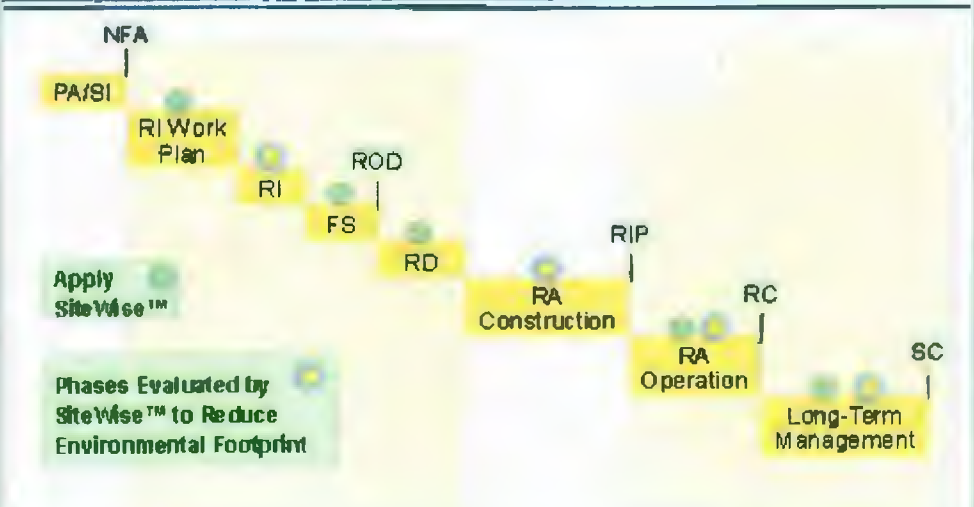
WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	3000					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	FS Wetlands Remediation
Date	12/29/2010
Site	NAS Pensacola
Remedial Alternative Name	WL 64

When to Use SiteWise™ to Reduce Environmental Footprint



Remedial Action Construction

[illegible] residual handling [illegible] fo[illegible]

[illegible] drop [illegible] menu

White cells [illegible]

MATERIAL PRODUCTION

WELL MATERIAL	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS [illegible] MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Soil Surrogate					
CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	Gravel	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	100,035					
Input depth of material (ft)	[illegible]					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Survey Crew	Site Crew	Super/HS			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	[illegible]	[illegible]
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	[illegible]	50	[illegible]			
Input number of trips taken	[illegible]	210	[illegible]			
Input number of travelers	1	1	[illegible]			
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of trips taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	intercity rail	intercity rail	intercity rail	intercity rail	intercity rail	intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Soil	Excavator	Loader	Trailer Mob/Demob		
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Gasoline	Gasoline
Input distance traveled (miles)	27,941	200	200	400		
Input weight of equipment transported (tons)	[illegible]	[illegible]	[illegible]	[illegible]		

EQUIPMENT TRANSPORTATION - [illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of [illegible]						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of [illegible]						

[illegible]	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
[illegible]						
[illegible]						

'QUIPMENT USE

[illegible]RTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Loader/Backhoe	Excavator	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	7,037	14,074				
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	[illegible]	[illegible]	[illegible]
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	[illegible]	0	[illegible]
Input total head (ft)	0	0	0	[illegible]	0	[illegible]
Input number of pumps operating	0	0	0	[illegible]	0	[illegible]
Input operating time for each pump (hrs)	0	0	0	[illegible]	[illegible]	[illegible]
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	[illegible]	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	[illegible]	0	[illegible]
Input number of pumps operating	0	0	0	[illegible]	0	[illegible]
Input operating time for each pump (hrs)	[illegible]	0	0	[illegible]	0	[illegible]
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

[illegible] AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1	2-Stroke, 0 to 1
Equipment operating hours (hrs)	1200					
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	[illegible]	[illegible]	[illegible]	[illegible]
Input number of equipments operating	0	0	[illegible]	[illegible]	[illegible]	[illegible]
Input operating time for each equipment (hrs)	0	0	[illegible]	[illegible]	[illegible]	[illegible]
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	[illegible]	0	[illegible]
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

[illegible]	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

[illegible]	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

[illegible]	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

[illegible]	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/REGENERATION	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	[illegible]	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	14					
Choose vehicle type from drop down menu	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	279					
Input number of miles per trip	100					

[illegible] OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input [illegible] (Look Up Table, Table 7[illegible])						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	2000					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN [illegible]	Entire Site
Input energy usage (MMBTU)	7.5E+01
Water consumption (gallon)	0.0E+00
Input CO_2 emission (metric ton)	5 0E+00
Input N_2O emission (metric ton CO_2 e)	0.0E+00
Input CH_4 emissions (metric ton CO_2 e)	0 0E+00
Input NOx emission (metric ton)	4.0E 02
Input SOx emission (metric ton)	9.3E-03
Input PM_{10} emission (metric ton)	7.8E-03
Input fatality risk	0 0E+00
Input injury risk	0 0E+00

GSRx - ALTERNATIVE Y-X
HYRBRID SITEWISE EVALUATION
SITE NAME
CITY STATE

Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	$CO_{2\,equiv}$	CO_2	N_2O	CH_4	NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Materials						Tonnes						MWhr	gal x 1000
				in	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation						Tonnes						MWhr	gal x 1000
Input Into Sitewise				miles									
Subtotal					**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**

GSRx - ALTERNATIVE Y-X
HYRBRID SITEWISE EVALUATION
SITE NAME
CITY STATE

Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	$CO_{2\,equiv}$	CO_2	N_2O	CH_4	NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
					Greenhouse Gas Emissions				Criteria Pollutant Emission				
Materials						Tonnes						MWhr	gal x 1000
Construction Equipment						Tonnes						MWhr	gal x 1000
Construction Phase	Dredging Equipment, ~400 HP	30 days of dredging, assume 10 hr days	300	hrs	4.96	4.95	0.00	0.00	0.04	0.01	0.01	22.00	
				hrs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
				hrs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
				hrs	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
				hrs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
				hrs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
				hrs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Subtotal					4.95	4.95	0.00	0.00	0.04	0.01	0.01	22.00	0
Operating Consumption						Tonnes						MWhr	gal x 1000
Input into Sitewise													0
					0	0	0.00	0.00	0.00	0.00	0.00	0	0
Total					5	5	0.00	0.00	0.04	0.01	0.01	22	0

Alternative 1
Values Input into SiteWise as "Other"

Modules	$CO_{2\,equiv}$	CO_2	N_2O (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
	Greenhouse Gas Emissions				Criteria Pollutant Emission				
		Tonnes						MMBTU	gal.
RT	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RAC	4.95E+00	4.95E+00	0.00E+00	0.00E+00	4.04E-02	9.34E-03	7.84E-03	7.51E+01	0.00E+00
RAO	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LTM	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note 1 MWhr = 3412141 4799 BTU 1MMTBU = 10^6 BTU

APPENDIX D

SEDIMENT EXCAVATION CALCULATIONS

APPENDIX D
SEDIMENT EXCAVATION CALCULATIONS
SITE 41 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

	Surface Area (square feet)									Volume (cubic feet)								
Wetland	Area Per Block	No. of Blocks for Area 1	Area 1	No. of Blocks for Area 2	Area 2	No. of Blocks for Area 3	Area 3	No. of Blocks for Total Area	Total Area	Volume Per Block	No. of Blocks for Volume 1	Volume 1	No. of Blocks for Volume 2	Volume 2	No. of Blocks for Volume 3	Volume 3	No. of Blocks for Total Area	Total Volume
3	625	18	11250	0	0	0	0	18	11250	625	18	11250	0	0	0	0	18	11250
5A	625	44	27500	0	0	0	0	44	27500	625	44	27500	0	0	0	0	44	27500
15	625	53	33125	0	0	0	0	53	33125	625	53	33125	0	0	0	0	53	33125
18A	625	43	26875	0	0	0	0	43	26875	625	43	26875	0	0	0	0	43	26875
48	5625	38	213750	0	0	0	0	38	213750	5625	38	213750	0	0	0	0	38	213750
64	10000	9	90000	10	100000	0	0	19	190000	10000	9	90000	10	100000	0	0	19	190000

	Surface Area (square yards)									Volume (cubic yards)								
Wetland	Area Per Block	No. of Blocks for Area 1	Area 1	No. of Blocks for Area 2	Area 2	No. of Blocks for Area 3	Area 3	No. of Blocks for Total Area	Total Area	Volume Per Block	No. of Blocks for Volume 1	Volume 1	No. of Blocks for Volume 2	Volume 2	No. of Blocks for Volume 3	Volume 3	No. of Blocks for Total Area	Total Volume
3	69	18	1250	0	0	0	0	18	1250	23	18	417	0	0	0	0	18	417
5A	69	44	3056	0	0	0	0	44	3056	23	44	1019	0	0	0	0	44	1019
15	69	53	3681	0	0	0	0	53	3681	23	53	1227	0	0	0	0	53	1227
18A	69	43	2986	0	0	0	0	43	2986	23	43	995	0	0	0	0	43	995
48	625	38	23750	0	0	0	0	38	23750	208	38	7904	0	0	0	0	38	7904
64	1111	9	10000	10	11111	0	0	19	21111	370	9	3333	10	3704	0	0	19	7037

Notes:
Area Per Block = length x width
Area = Area Per Black x No of Blocks in Area
Total Area = Area 1 + Area 2 + Area 3

Volume Per Block = length x width x depth
Volume = Volume Per Block x No. of Blocks in Area
otal Volume = Volume 1 + Volume 2 + Volume 3

APPENDIX D
SURFACE WATER MASS CALCULATIONS
SITE 41 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland	Area of Wetland (ft^2)	Depth of Surface Water (ft)	Volume of Surface Water (ft^3)	Volume of Surface Water (gallons)
3	335,571	1	335,571	2,510,070
5A	146,220	1	146,220	1,093,726
15	86,235	1	86,235	645,038
16	39,844	1	39,844	298,033
18A	113,308	1	113,308	847,544
18B	35,574	1	35,574	266,094

Notes:
Area of each wetland determined by GIS.
The depth of surface water was assumed to be 1 foot.
Volume of Surface Water (ft^3) = Area of Wetland (ft^2) x Depth of Surface Water (ft)
Volume of Surface Water (gallons) = Volume of Surface Water (ft^3) x (7.480 gallons/ft^3)

APPENDIX D
SEDIMENT MASS CALCULATIONS
SITE 41 FEASIBILITY STUDY REPORT
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Wetland	Human Health Risk Area of Concern (ft^2)	Ecological Risk Area of Concern (ft^2)	Total Area of Concern (ft^2)	Depth of Sediment (ft)	Human Health Risk Volume of Sediment (cubic yards)	Ecological Risk Volume of Sediment (cubic yards)	Total Volume of Contaminated Sediment (cubic yards)
3	17,502	43,063	43,063	1	648	1,595	1,595
5A	0	50,672	50,672	1	0	1,877	1,877
15	31,907	40,757	40,757	1	1,182	1,510	1,510
16	13,859	13,859	13,859	1	513	513	513
18A	6,344	79,355	79,355	1	235	2,939	2,939
18B	4,785	4,785	4,785	1	177	177	177
48	92,967	92,967	92,967	1	3,443	3,443	3,443
64	291,235	594,650	671,076	1	10,786	22,024	24,855

Areas of concern (AOC) for each wetland determined by GIS
The depth of sediment was assumed to be 1 foot.
Volume of Sediment (cubic yards) = (Area of Concern [ft^2] x Depth of Sediment [ft]) / (27 feet/1 cubic yard)
The total AOC contains the ecological and HHRA AOCs
All Site 41 wetlands, with the exception of Wetland 5A, have overlapping Ecological and HHRA AOCs

APPENDIX E

PRELIMINARY DATA REPORT

Wetland 64: Groundwater Discharge Zone & Integrated In Situ Sediment Assessments

Preliminary Data Report

Wetland 64: Groundwater Discharge Zone & Integrated In Situ Sediment Assessments

19 January 2010

SPAWAR Systems Center Pacific
53560 Hull St.
San Diego, CA 92152

Background

As part of SERDP Project ER1550, Sediment Ecosystem Assessment Protocol (SEAP) integrated assessment strategies for contaminated sediment were tested at Naval Air Station (NAS) Pensacola, located in Pensacola, FL. The study focused on Wetland 64 (OU2), which was the subject of an extensive remedial investigation that revealed metals, PAHs, PCBs, DDTs, and VOCs to be of potential ecological risk, particularly at the south end of the water body. Primary components of the study included a groundwater discharge zone assessment for OU2 Site 11, and an integrated in-situ sediment assessment at four focus stations in Wetland 64.

Groundwater Discharge Zone Evaluation

Groundwater discharge was assessed using the Trident and UltraSeep systems. Potential discharge zones were mapped using the Trident conductivity temperature probe (Figure 1) Trident sensor readings were taken at 3 ft below the sediment surface Areas of potential discharge were identified based on low subsurface conductivity Based on the sensor results a subset of stations were selected for collection of subsurface porewater samples (annotated by gwd) Porewater samples were collected at 3 ft below the sediment surface In addition an UltraSeep was deployed at one station in the discharge zone to quantify discharge rates

Trident Sensor Survey

Subsurface conductivity results from the Trident sensor survey indicated that the strongest evidence of groundwater discharge was along the near-shore areas adjacent to OU2 Site 11 particularly in the area of NASP5 NASP 25 and NASP 26 (Figure 2) An isolated instance of low conductivity was also observed further north along the marina shoreline at NASP 10, however this location was remote from known sources of groundwater contamination

Trident Porewater Survey

Based on the sensor results, five stations (NASP5, NASP7, NASP25, NASP26, NASP27, Figure 1) were selected in proximity to OU2 Site 11 for collection of subsurface porewater samples These samples were analyzed for VOCs and the results are shown in Table 1. VOCs were generally below reporting limits for all analytes at all stations Hexachlorobutadiene was detected below the reporting limit at stations NASP 5 and NASP7, but was detected in water blanks at comparable levels. Naphthalene and 1,2,4-Trichlorobenzene were detected below reporting limits at station NASP 5

UltraSeep Survey

An UltraSeep was deployed at station NASP25 to quantify the rate of groundwater seepage in the discharge zone identified by the Trident Seepage rates were measured over a 24 hour period and results are shown in Figure 3 along with the tidal variation during the deployment period The seepage rate varied from about -0.8 cm/day (recharge) to about +2 9 cm day (discharge), with strongest discharge in phase with low tide conditions. The mean discharge rate for the 24 hour period was 0 9 cm day No VOCs were detected in the discharge water collected by the UltraSeep

Groundwater Discharge Zone Summary

In general, the groundwater discharge zone evaluation revealed shoreline areas with evidence of groundwater discharge which was quantified at one location with a mean rate of about 1 cm/day. Porewater and discharge water chemical characterization indicated that there was no VOC discharge associated with the groundwater discharge with the possible exception of trace levels of Naphthalene and 1,2,4-Trichlorobenzene in porewater at NASP5.

Integrated In-Situ Sediment Assessment

The integrated in-situ sediment assessment utilized a range of new and emerging technologies together with traditional measures to characterize exposure, uptake and response at four stations in Wetland 64 The stations were selected to represent a gradient of contamination primarily on the basis of historical data from the remedial investigation at the site and included NASP6B, NASP9, NASP11 and NASP25 (Figure 1) Multiple measures of exposure included bulk sediment chemistry (metals, PAHs, pesticides), porewater, discharge and interface water chemistry (metals, VOCs, PAHs, pesticides) and passive sampler chemistry (metals by DGT PAHs by SPME) In-situ and laboratory uptake of PAHs was measured for two benthic organisms including *Leptocheirus plumulosus* (marine amphipod) and *Mercenaria mercenaria* (hard clam) In-situ toxicity tests were conducted for three species including *L. plumulosus*, *Neanthes arenaceodentata* (polychaete), and *Americamysis bahia* (mysid shrimp) with parallel lab toxicity testing for *L. plumulosus*. The Sediment Ecotoxicity Assessment Ring (SEA Ring) system was used for passive sampler deployment, as well as in-situ uptake and in-situ toxicity test exposures. Porewater (one foot depth) and interface water samples were collected using the Trident probe Seepage rates and discharge samples were collected using the UltraSeep. Surface sediment samples were collected by diver deployed cores.

Bulk Sediment Chemistry

Results for the bulk sediment analysis are shown in Table 2 – Table 4 The results confirm the expected concentration gradient, with generally higher chemical levels at NASP25 and NASP6B and lower levels at NASP11, and clean reference conditions at NASP9. Concentrations of selected individual PAHs,g-BHC, DDE, DDT cadmium, chromium and lead exceeded ERM or PEL screening thresholds at NASP 6B At NASP25, selected individual PAHs, g-BHC, cadmium, chromium, copper, lead, mercury, silver and zinc exceeded ERM or PEL screening thresholds. At NASP11 and NASP9 levels were always below ERM or PEL screening thresholds, with some exceedences of ERL or TEL screening thresholds

Porewater, Discharge and Interface Water Chemistry

Results for porewater, discharge water and interface water samples are shown in Table 5 – Table 7 The only toxic metals above reporting limits were chromium and nickel in porewater at NASP6B, and nickel in discharge water at NASP25. PAHs were not above reporting limits at any station. DDE and DDD were measured slightly above reporting limits at NASP6B.

Passive Sampler Chemistry

Results for porewater metal DGT measurements are shown in Table 8 and Figure 4 DGT copper concentrations were generally low, ranging from 0.38 to 2 15 ug/L with the maximum concentration measured in the near-surface 0-1 cm interval at NASP11. Zinc concentrations ranged from 0.87 to 16.55 ug/L with the maximum concentration measured in the 2-3 cm interval at NASP11 Nickel concentrations ranged from 0 32 to 2.34 ug/L with the maximum concentration measured in the near-surface 2-3 cm interval in the NASP6X sample, however the replicate samples for that station had levels generally <1 ug/L. Lead concentrations ranged from 0.03 to 0.41 ug/L with the maximum concentration measured in the overlying water measurement at NASP6B. Cadmium levels were near or below detection limits for deeper intervals, ranging from 0.008 to 0.18 ug L with the maximum level in the overlying water at NASP6X and a comparable level in the shallow 0-1 cm interval at NASP11 Results generally indicate an increase in concentrations near the sediment interface Results for the SPME sampler measurements of PAHs are not currently available

In-Situ Bioaccumulation

Results for in-situ and laboratory PAH bioaccumulation measurements for *L plumulosus* and *M mercenaria* are shown in Table 9. In-situ measurements were conducted for 4-day exposures, and lab measurements were conducted for 4 and 28-day exposures (*L plumulosus*) with survival and lipid content of the amphipods being substantially reduced in the latter Therefore, 28-day *L plumulosus* bioaccumulation data should be interpreted with caution For the in-situ results, PAHs were only detected in the *L plumulosus* tissues, all samples for *M mercenaria* were below detection limits. For *L plumulosus* tissues, PAHs were detected at stations NASP6B and NASP25. Lab results showed similar trends in the 4-day exposures with very low levels in *M mercenaria*, and higher levels in *L plumulosus* at NASP6B and NASP25 Interestingly levels were generally lower in the longer term 28-day lab exposures versus the 4-day exposures.

In-Situ Toxicity Testing

Results for in-situ and laboratory toxicity tests for *L. plumulosus* *N arenaceodentata*, and *A. bahia* are shown in Table 10 High control survival was observed in both short-term lab and *in situ* toxicity exposures. Toxicity was not observed in *in situ* tests conducted in the water column nor the sediment-water interface. Amphipod survival was significantly lower (t-tests, p<0 05) at one station (NASP 6B) relative to the controls in both the field and lab tests. *In situ* survival (50%) at NASP 6B, however, was considerably lower than in the lab (85%) from the 4-day toxicity exposures. Polychaetes (*N arenaceodentata*) exhibited reduced feeding (based on mean) in the laboratory following 48 hour field exposure at NASP 6B, but the reduction was not statistically significant. Although pore water concentrations were low to non-detect for essentially all chemical classes, bulk sediment pesticides (e.g. DDx), PAH, and several metals were present in excess of ERM concentrations The low pore water concentrations, and apparently low bioavailability, at the two stations where some contaminants were elevated in the bulk chemistry, may be reflective of relatively high total organic carbon in those samples Analysis of tissues revealed elevated TPAH at stations NASP 6B and 25, however, these concentrations do not alone explain toxicity based on critical body residue (CBR) theory Body residues responsible for inducing mortality by PAH narcosis in *L plumulosus* are substantially higher than those observed. VOCs were essentially non-detect in all samples, and are not believed to have contributed to any observed toxicity

Water quality parameters measured in representative *in situ* sediment chambers (sensor positioned at sediment-water interface in sediment chamber) indicate that water quality was sufficient at station 6B (and all stations) to maintain organism health. Interestingly, salinity, pH, and ORP, however, were noticeably lower at 6B when compared to the other three *in situ* locations Ammonia was not suspected to contribute to toxicity at station NASP 6B based on concentrations measured in discrete pore water samples that were below those expected to cause toxicity to *L plumulosus*

Integrated In-Situ Sediment Assessment Summary

The integrated in-situ sediment assessment generally reflects areas of low to moderate chemical loading in the bulk sediment with limited bioavailability uptake or response While bulk concentrations in sediment sometimes exceeded screening benchmarks other measures of exposure including porewater discharge water interface water and passive samplers generally indicate a lack of mobility and bioavailability This is supported by the lack or limited uptake in tissues of exposed organisms and the general absence of toxicity in either laboratory or in situ exposed organisms. The disparity between the lab and field data show that results from lab studies do not necessarily explain effects that may be observed in the field, highlighting the relevance of *in situ* studies Subsequent toxicity identification evaluations (TIE) might help improve understanding of the toxicity observed at the one station.

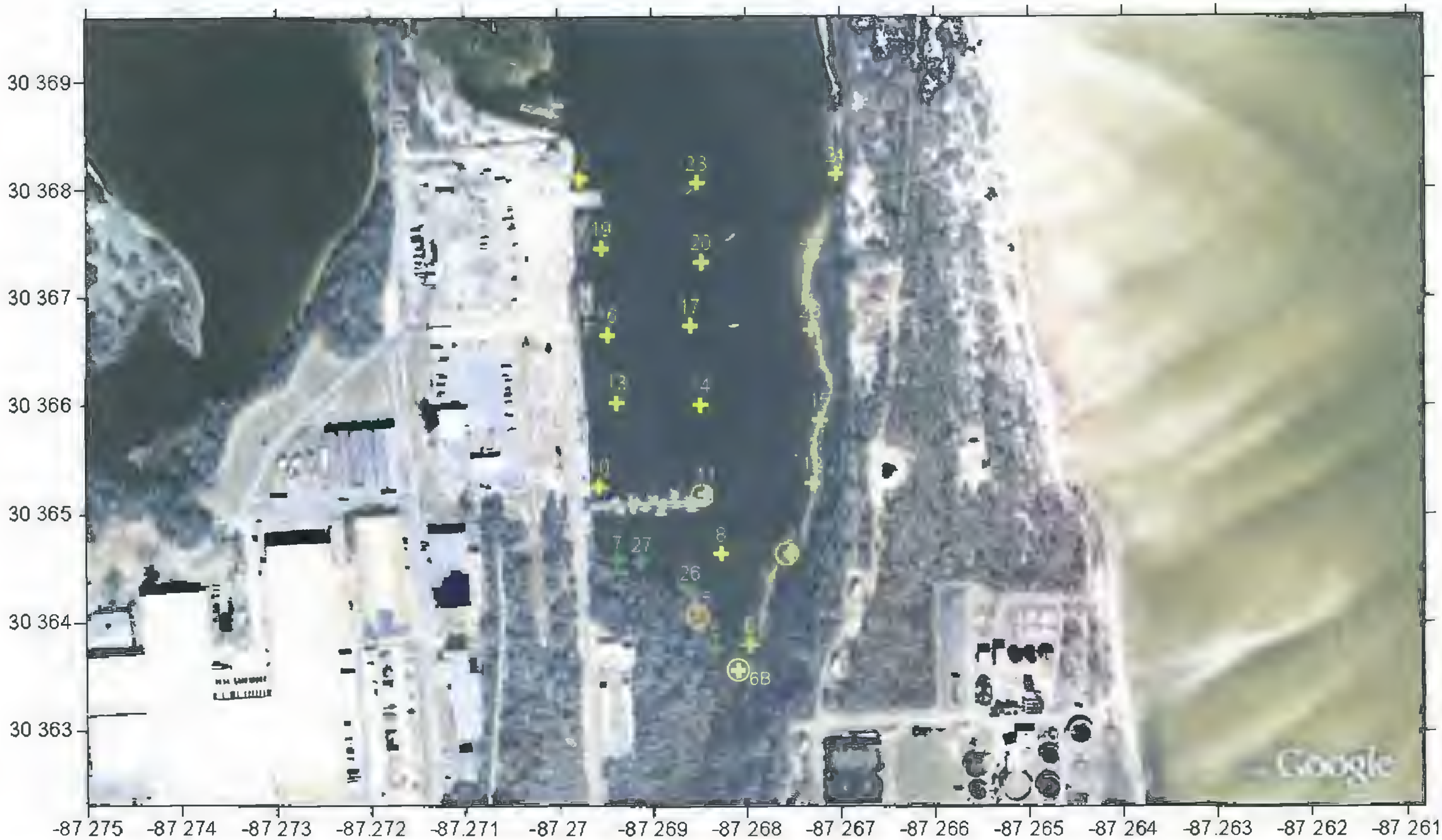


Figure 1. Station location map. Yellow stations indicate Trident sensor survey locations. Green stations indicate sensor and subsurface groundwater discharge sampling locations. The orange station indicates sensor, subsurface groundwater and seepage meter discharge sampling locations. Circles indicate focus stations for the in-situ sediment assessment.

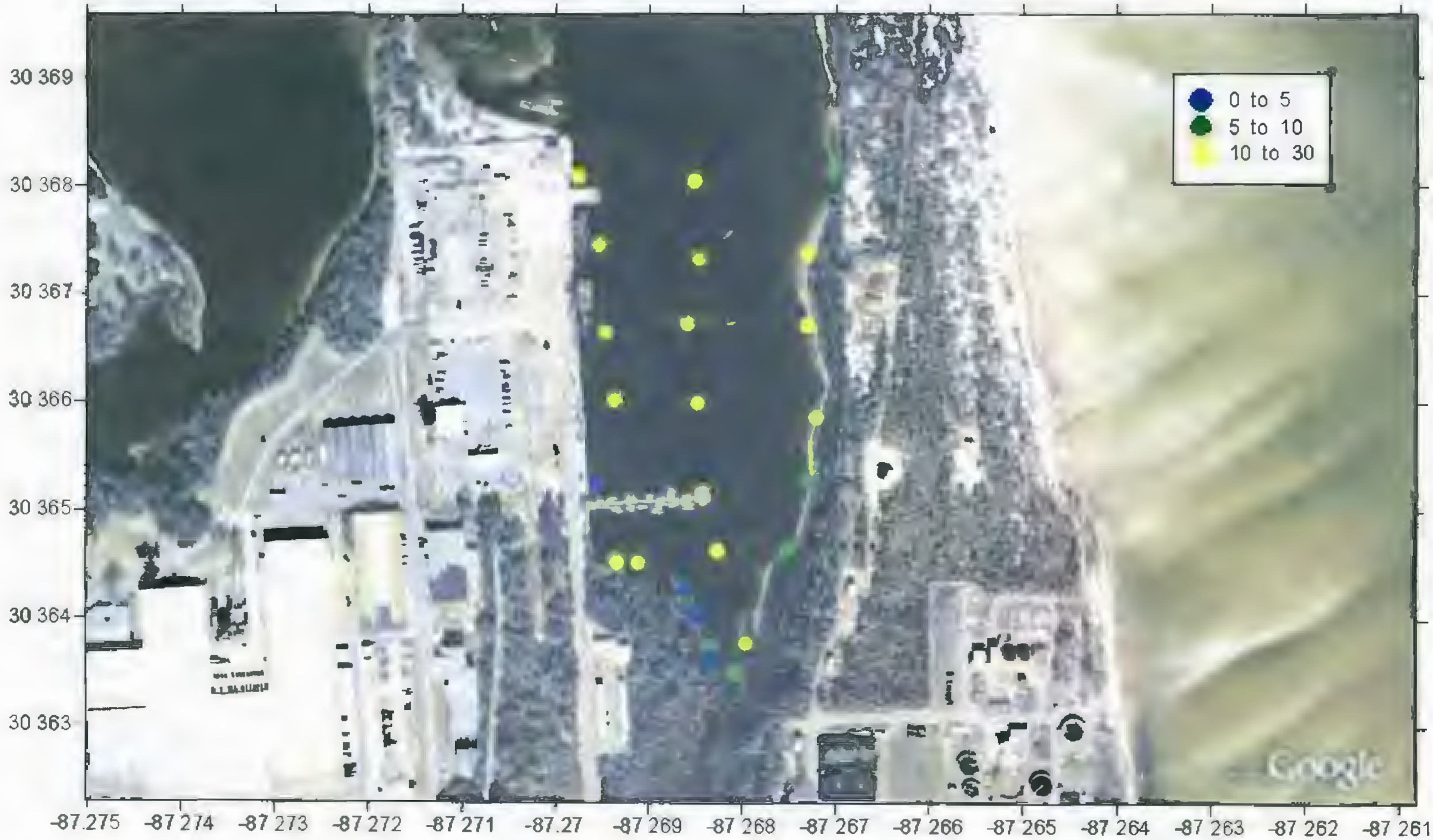


Figure 2. Trident sensor survey results for subsurface conductivity (mS/cm).

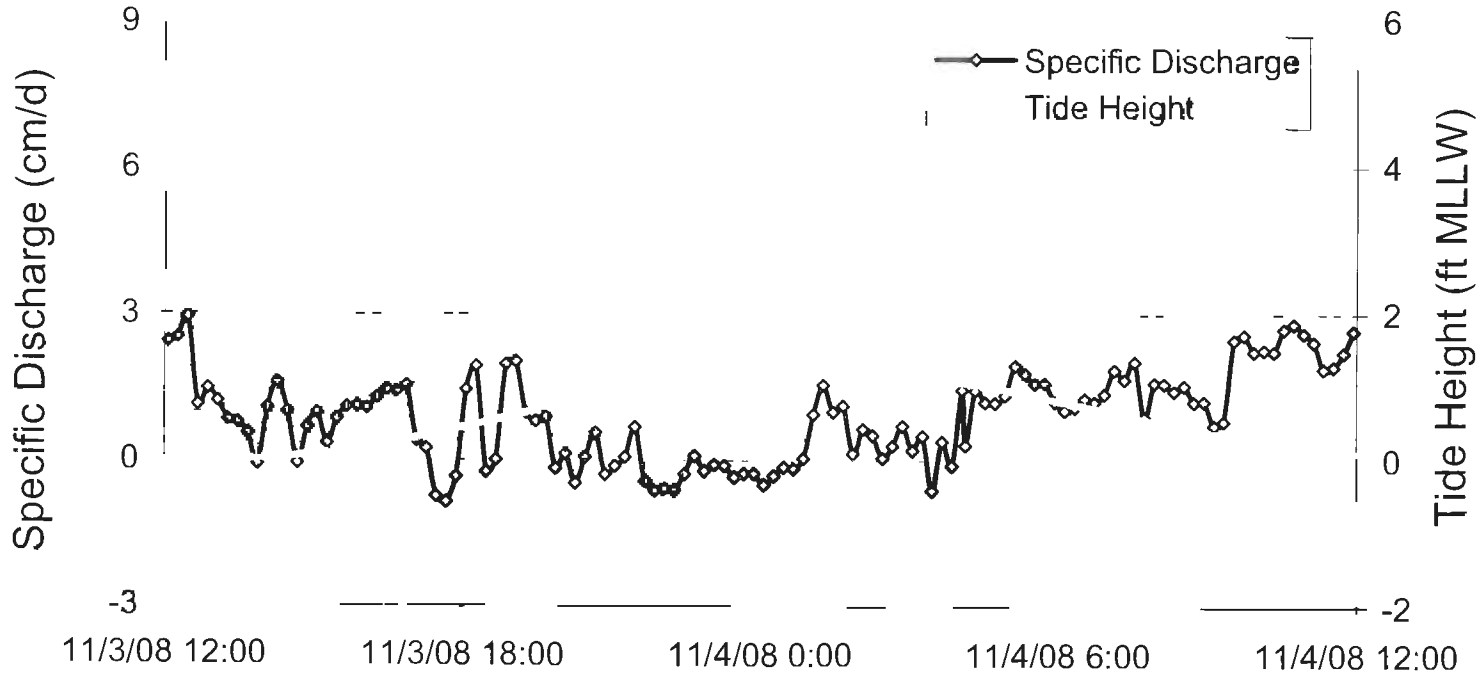


Figure 3. Specific discharge and tide stage at station NASP25.

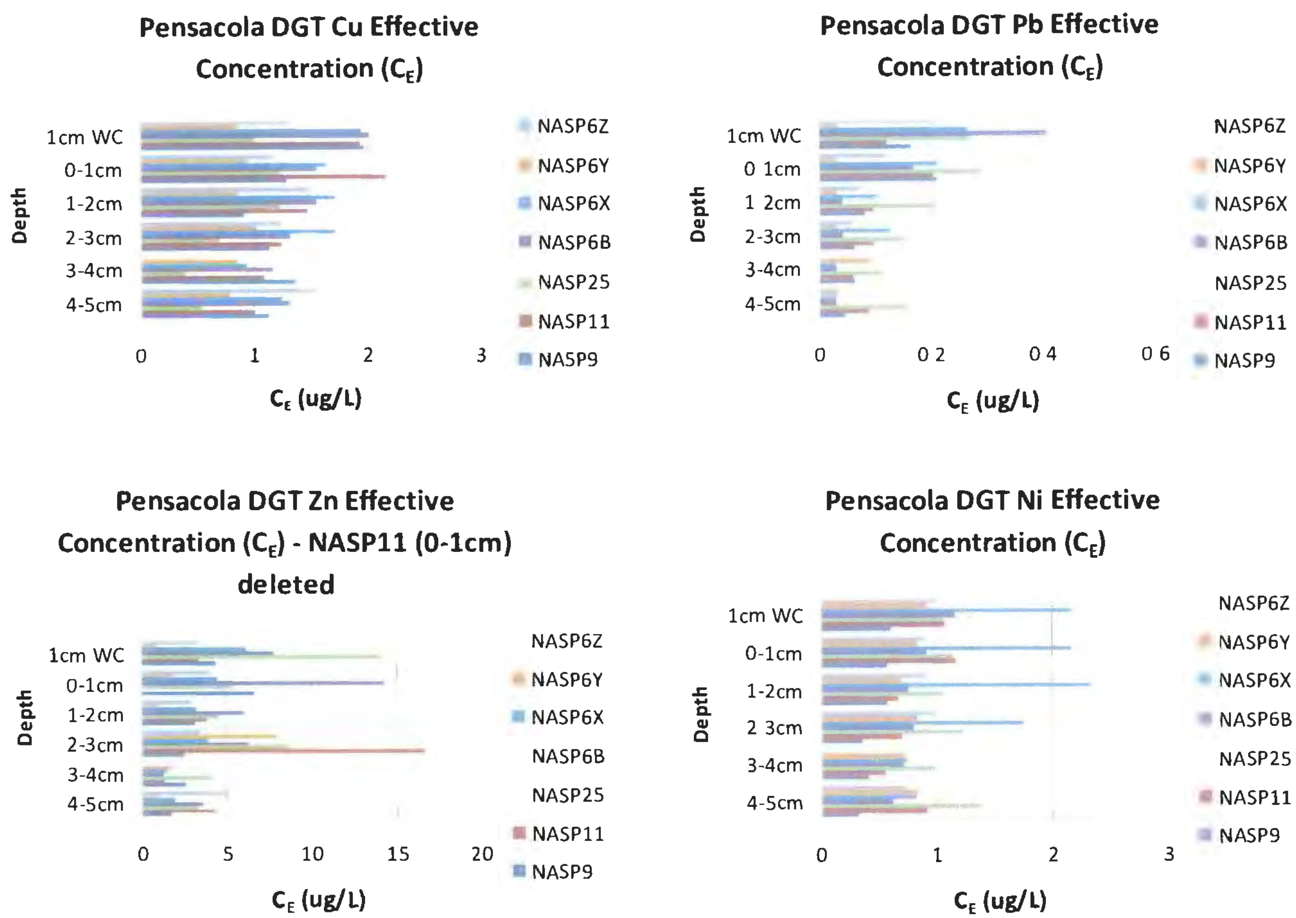


Figure 4. Bioavailable metal concentrations at different sediment depths, as measured with diffusive gradients in thin film (DGT). Station NASP 6B is represented by three replicate DGTs (X, Y, Z).

Sample Number	Water Blank B 111108-2		**NASP-5-gwd**		**NASP-7-gwd**		**NASP-26-gwd**		**NASP-27-gwd**	
Sample Location:			NAS Pensacola		NAS Pensacola		NAS Pensacola		NAS Pensacola	
Dilution Factor	1		1		1		1		1	
File:	BV9932.D		BV9938.D		BV9939.D		BV9940.D		BV9941.D	
Analyte	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L
Dichlorodifluoromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chloromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Vinyl Chloride	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromomethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Trichlorofluoromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Acetone	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0
1,1-Dichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Methylene Chloride	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Carbon Disulfide	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Methyl tert-Butyl Ether	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
trans-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1 Dichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2-Butanone	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2,2-Dichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
cis-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chloroform	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1-Dichloropropene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,1-Trichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Carbon Tetrachloride	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Benzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Trichloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromodichloromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Dibromomethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
cis-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
trans-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,2-Trichloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,3-Dichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Dibromochloromethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dibromoethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromoform	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
4-Methyl-2-Pentanone	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Toluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2-Hexanone	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Tetrachloroethene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Chlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,1,2-Tetrachloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Ethylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
p&m-Xylene	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0
o-Xylene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Styrene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Isopropylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,1,2,2-Tetrachloroethane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2,3-Trichloropropane	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
n-Propylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
Bromobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,3,5-Trimethylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
2-Chlorotoluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
4-Chlorotoluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
tert-Butylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2,4-Trimethylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
sec-Butylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
p-Isopropyltoluene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,3-Dichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,4-Dichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
n-Butylbenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00
1,2-Dibromo-3-Chloropropane	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0
1,2,4-Trichlorobenzene	U	5.00	2.90 J	5.00	U	5.00	U	5.00	U	5.00
Hexachlorobutadiene	2.59 J	20.0	2.71 B	20.0	1.29 B	20.0	U	20.0	U	20.0
Naphthalene	U	20.0	3.86 J	20.0	U	20.0	U	20.0	U	20.0
1,2,3-Trichlorobenzene	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00

Table 1. VOC results for the Trident and UltraSeep survey adjacent to OU2 Site 11. Note: gwd = 3 ft subsurface sample, sp = seepage meter sample.

Method: REAC SOP 1806

Sample Number	Water Blank B 111108-2		NASP-25-gwd		NASP-25-sp	
Sample Location:			NAS Pensacola		NAS Pensacola	
Dilution Factor	1		1		1	
File:	BV9932.D		BV9942.D		BV0036.D	
Analyte	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L	Result µg/L	*RL* µg/L
Dichlorodifluoromethane	U	5.00	U	5.00	U	5.00
Chloromethane	U	5.00	U	5.00	U	5.00
Vinyl Chloride	U	5.00	U	5.00	U	5.00
Bromomethane	U	5.00	U	5.00	U	20.0
Chloroethane	U	5.00	U	5.00	U	5.00
Trichlorofluoromethane	U	5.00	U	5.00	U	5.00
Acetone	U	20.0	U	20.0	U	20.0
1,1-Dichloroethene	U	5.00	U	5.00	U	5.00
Methylene Chloride	U	5.00	U	5.00	U	5.00
Carbon Disulfide	U	5.00	U	5.00	U	5.00
Methyl tert-Butyl Ether	U	5.00	U	5.00	U	5.00
trans-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00
1,1 Dichloroethane	U	5.00	U	5.00	U	5.00
2-Butanone	U	5.00	U	5.00	U	5.00
2,2-Dichloropropane	U	5.00	U	5.00	U	5.00
cis-1,2-Dichloroethene	U	5.00	U	5.00	U	5.00
Chloroform	U	5.00	U	5.00	U	5.00
1,1-Dichloropropene	U	5.00	U	5.00	U	5.00
1,2-Dichloroethane	U	5.00	U	5.00	U	5.00
1,1,1-Trichloroethane	U	5.00	U	5.00	U	5.00
Carbon Tetrachloride	U	5.00	U	5.00	U	5.00
Benzene	U	5.00	U	5.00	U	5.00
Trichloroethene	U	5.00	U	5.00	U	5.00
1,2-Dichloropropane	U	5.00	U	5.00	U	5.00
Bromodichloromethane	U	5.00	U	5.00	U	5.00
Dibromomethane	U	5.00	U	5.00	U	5.00
cis-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00
trans-1,3-Dichloropropene	U	5.00	U	5.00	U	5.00
1,1,2-Trichloroethane	U	5.00	U	5.00	U	5.00
1,3-Dichloropropane	U	5.00	U	5.00	U	5.00
Dibromochloromethane	U	5.00	U	5.00	U	20.0
1,2-Dibromoethane	U	5.00	U	5.00	U	5.00
Bromoform	U	5.00	U	5.00	U	20.0
4-Methyl-2-Pentanone	U	5.00	U	5.00	U	5.00
Toluene	U	5.00	U	5.00	U	5.00
2-Hexanone	U	5.00	U	5.00	U	5.00
Tetrachloroethene	U	5.00	U	5.00	U	5.00
Chlorobenzene	U	5.00	U	5.00	U	5.00
1,1,1,2-Tetrachloroethane	U	5.00	U	5.00	U	20.0
Ethylbenzene	U	5.00	U	5.00	U	5.00
p&m-Xylene	U	10.0	U	10.0	U	10.0
o-Xylene	U	5.00	U	5.00	U	5.00
Styrene	U	5.00	U	5.00	U	5.00
Isopropylbenzene	U	5.00	U	5.00	U	5.00
1,1,2,2-Tetrachloroethane	U	5.00	U	5.00	U	5.00
1,2,3-Trichloropropane	U	5.00	U	5.00	U	5.00
n-Propylbenzene	U	5.00	U	5.00	U	5.00
Bromobenzene	U	5.00	U	5.00	U	5.00
1,3,5-Trimethylbenzene	U	5.00	U	5.00	U	5.00
2-Chlorotoluene	U	5.00	U	5.00	U	5.00
4-Chlorotoluene	U	5.00	U	5.00	U	5.00
tert-Butylbenzene	U	5.00	U	5.00	U	5.00
1,2,4-Trimethylbenzene	U	5.00	U	5.00	U	5.00
sec-Butylbenzene	U	5.00	U	5.00	U	5.00
p-Isopropyltoluene	U	5.00	U	5.00	U	5.00
1,3-Dichlorobenzene	U	5.00	U	5.00	U	5.00
1,4-Dichlorobenzene	U	5.00	U	5.00	U	5.00
n-Butylbenzene	U	5.00	U	5.00	U	5.00
1,2-Dichlorobenzene	U	5.00	U	5.00	U	5.00
1,2-Dibromo-3-Chloropropane	U	20.0	U	20.0	U	5.00
1,2,4-Trichlorobenzene	U	5.00	U	5.00	U	5.00
Hexachlorobutadiene	2.59 J	20.0	U	20.0	U	5.00
Naphthalene	U	20.0	U	20.0	U	20.0
1,2,3-Trichlorobenzene	U	5.00	U	5.00	U	5.00

Table 1. (cont.)

Analyte		NASP-6B-Sed Conc µg/kg	NASP-6B-Sed RL µg/kg	NASP-9-Sed Conc µg/kg	NASP-9-Sed RL µg/kg	NASP-11-Sed Conc. µg/kg	NASP-11-Sed RL µg/kg	NASP-25-Sed Conc. µg/kg	NASP-25-Sed RL µg/kg
Acenaphthene	ug/kg	8		45	L	55	U		J
Acenaphthylene	ug/kg		L	45	L	55	U		J
Anthracene	ug/kg	440		45	U	55	U		
Benzo(a)anthracene	ug/kg	981		29.2	J	54 3	J	798	
Benzo(a)pyrene	ug/kg	886		32.6	J	72.3		967	
Benzo(b)fluoranthene	ug/kg	1080		42.8	J	105		1320	
Benzo(g,h,i)perylene	ug/kg	475		24.9	J	52.2	J	556	
Benzo(k)fluoranthene	ug/kg	573		25.8	J	37.1	J	685	
Chrysene	ug/kg	959		35.7	J	57 9		899	
Dibenzo(a,h)anthracene	ug/kg	155		45	U	55	U	157	
Fluoranthene	ug/kg	2820		65		99.4		600	
Fluorene	ug/kg	262		45	L	55	L		J
Indeno(1,2,3-cd)pyrene	ug/kg	505		45	U	55	L	515	
Naphthalene	ug/kg			45	U	55	U	120	U
Phenanthrene	ug/kg	990		45	L	30 6	J		
Pyrene	ug/kg			51.3		9 1			
TPAH	ug/kg	39		**667.3**		**972.9**		4.	
TPAH	mg/kg			**0.6673**		**0.9729**		14	
TPAH OC norm	**ug/kg OC**	**225076**		**106427**		**66637**		**132557**	
TPAH OC norm	**mg/kg OC**	**225**		**106**		**67**		**133**	
TEL ERL		**2**		**0**		**0**		**4**	
PEL ERM		**10**		**0**		**0**		**7**	
Genera Chemistry									
TOC		5 95		0 627		46		63	
Tot l Organic Carbo	mg kg	59500		6270		14600		6300	
Solids, Percent		40 5		3 6		0 5		2 9	
% Gra el	o	0 32		0.63		1.4		0 79	
% Sand	o	9 9		87 7		8 8		46	
% Silt Clay Colloids	%	19 8		11.7		9		53.1	

Blue exceeds TEL ERL
Red exceeds PEL ERM

Table 2 Bulk sediment PAH concentrations at the four focus stations (dry weight).

Client ID		SBLK111408		NASP-6B-Sed		NASP-9-Sed		NASP-11-Sed		NASP-25-Sed	
Percent Solid		100		43		71		61		27	
Analyte		Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg	Conc. µg/kg	RL µg/kg
a-BHC		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
g-BHC		U	3.33	[illegible]	J 7.75	U	4.69	U	5.46	[illegible]	J 12.3
b-BHC		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
d-BHC		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
HEPTACHLOR		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ALDRIN		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
HEPTACHLOR EPOXIDE		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
g-CHLORDANE		U	3.33	3.74	J 7.75	U	4.69	U	5.46	U	12.3
a-CHLORDANE		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ENDOSULFAN (I)		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
DIELDRIN		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ENDRIN		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ENDOSULFAN (II)		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ENDRIN ALDEHYDE		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
METHOXYCHLOR		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ENDOSULFAN SULFATE		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
ENDRIN KETONE		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
p,p'-DDE		U	3.33	[illegible]	7.75	U	4.69	[illegible]	J 5.46	[illegible]	12.3
p,p'-DDD		U	3.33	[illegible]	7.75	U	4.69	U	5.46	U	12.3
p,p'-DDT		U	3.33	U	7.75	U	4.69	U	5.46	U	12.3
Sum DDX (µg/kg OC)	ug/kg OC			1230.3		0 0		153.4		349.9	
Sum DDX (mg/kg OC)	mg/Kg OC			1.23		0.00		0.15		0.35	
Sum DDX (µg/kg)	**ug/kg**			**73.2**		**0**		**2.24**		**[illegible]**	
#>TEL/ERL				0		0		1		1	
#>PEL/ERM				3		0		0		1	
Total organic carbon	%			5 95		0.627		1 46		7 63	

Blue exceeds TEL or ERL
Red exceeds PEL or ERM

Table 3. Bulk sediment pesticide concentrations at the four focus stations (dry weight).

Analyte	SBLK111408 Result mg/kg	RL mg/kg	NASP-6B-Sed Result mg/kg	RL mg/kg	NASP-9-Sed Result mg/kg	RL mg/kg	NASP-11-Sed Result mg/kg	RL mg/kg	NASP-25-Sed Result mg/kg	RL mg/kg	TEL	PEL	ERL	ERM	AET
Percent Solid	100		43		71		61		27		From Squirt Tables (mg/kg)				
Aluminum	U	20.0	6050	30.6	1490	19.2	4150	21.0	15200	49.4					
Antimony	U	1.40	U	2.14	U	1.34	U	1.47	U	3.46					
Arsenic	U	1.50	5.17	2.29	U	1.44	3.13	1.58	[illegible]	3.70	7.24	41.6	8.2	70	3[illegible]
Barium	U	0.400	11.4	0.61	2.49	0.384	6.61	0.420	71.3	0.988					
Beryllium	U	0.300	U	0.46	U	0.288	U	0.315	[illegible]	0.741					
Cadmium	U	0.400	[illegible]	0.61	[illegible]	0.384	[illegible]	0.420	[illegible]	0.988	0.68	4.21	1.2	9.6	
Calcium	U	9.90	[illegible]	15.1	308	9.50	1720	10.4	10400	24.4					
Chromium	U	0.500	[illegible]	0.77	32.9	0.480	[illegible]	0.526	[illegible]	1.23	52.3	160	81	370	6[illegible]
Cobalt	U	0.400	2.22	0.61	U	0.384	1.05	0.420	4.80	0.988					
Copper	U	0.400	[illegible]	0.61	9.64	0.384	[illegible]	0.420	[illegible]	0.988	18.7	108	34	270	39[illegible]
Iron	U	15.0	9920	22.9	2040	14.4	5810	15.8	27200	37.0					
Lead	U	1.00	[illegible]	1.53	15.0	0.959	35.7	1.05	[illegible]	2.47	30.2	94	46.7	218	40[illegible]
Magnesium	U	20.0	2550	30.6	605	19.2	1500	21.0	5620	49.4					
Manganese	U	0.400	44.2	0.61	8.70	0.384	38.4	0.420	127	0.988					
Mercury	U	0.040	[illegible]	0.07	U	0.044	[illegible]	0.045	[illegible]	0.0914	0.13	0.7	0.15	0.71	0.4
Nickel	U	0.600	8.41	0.92	1.11	0.576	2.96	0.631	[illegible]	1.48	15.9	42.8	20.9	51.6	11[illegible]
Potassium	U	25.0	730	38.2	215	24.0	521	26.3	1790	61.7					
Selenium	U	1.30	U	1.99	U	1.25	U	1.37	[illegible]	3.21					
Silver	U	0.500	[illegible]	0.77	U	0.480	U	0.526	[illegible]	1.23	0.73	1.77	1	3.7	3
Sodium	U	100	9470	153	2340	95.9	4760	105	17200	247					
Thallium	U	1.80	U	2.75	U	1.73	U	1.89	U	4.44					
Vanadium	U	0.400	12.4	0.61	2.77	0.384	7.09	0.420	31.8	0.988					
Zinc	U	3.10	[illegible]	4.74	21.8	2.97	62.1	3.26	[illegible]	7.65	124	271	150	410	41[illegible]
#TEL/ERL			4		1		4		2						
#>PEL/ERM			3		0		0		7						

Blue exceeds T[illegible] ERL
Red exceeds PE[illegible] ERM

Table 4. Bulk sediment metal concentrations at the four focus stations (dry weight).

Sample No	Method Blank-111208		NASP-6B-pw		NASP-9-pw		NASP-11-pw		NASP-25-pw		NASP-6B
Location	Lab		Naval air Station (NAS) Pensaco a		N va air Station (NA sacola		Na al air Statio (NAS) Pen acola		Naval air Station (NAS) Pensacola		Naval air Statio Pensacc
Analyte	Result µg/L	RL µg/L	Result µg/L	RL µg/L	Result µg/L	R µg/L	Result µg/L	RL µg/L	Result µg/L	RL µg/L	Result µg/L
Aluminum	U	100	U	100	U	500	U	500	U	100	U
Antimony	U	14.0	U	14 0	J		U	14.0	U	14 0	U
Arsenic	U	17.0	U	17.0	U	7 0	U	17 0	U	17.0	U
Barium	U	2.00	87 2	2.00	23 9	2 00	34 4	2.00	6.49	2.00	15.1
Beryllium	U	2.00	U	2.00	J	2 00	U	2 00	U	2.00	U
Cadmium	U	3.00	U	3.00	U	3 00		3.00	U	3.00	U
Calcium	U	60.0	93600	60.0	239000	60.0	270000	60.0	35400	60.0	257000
Chromium	U	3.00	76.4	3.00	J	3.00	U	3.00	U	3.00	U
Cobalt	U	3.00	U	3.00	J	3.00	U	3 00	U	3.00	U
Copper	U	4 00	U	4 00	U	4 00	U	4.00	U	4.00	U
Iron	U	60.0	U	60.0	U	300	J	600	14600	60.0	U
Lead	U	10.0	U	10.0	U	0.0	U	10.0	U	10.0	U
Magnesium	U	160	242000	160	824000	800	918000	800	13200	160	880000
Manganese	U	2.00	37.7	2.00	4.4	2 00	39 0	2.00	126	2.00	6.76
Mercury	U	0.200	U	0.200	U	0 200	U	0.200	U	0.200	U
Nickel	U	5 00	8.65	5 00	U	5.00	U	5.00	U	5.00	U
Potassium	U	200	124000	1000	271000	2000	310000	2000	7190	200	294000
Selenium	U	15 0	U	5 0	U	15 0	U	15 0	U	15 0	U
Silver	U	4.00	U	4.00	U	4 00	J	4.00	U	4 00	U
Sodium	U	1200	2500000	60000	6320000	120000	7120000	120000	105000	6000	6780000
Thallium	U	18.0	U	18 0	U	18 0	U	18 0	U	18.0	U
Vanadium	U	3.00	U	3.00	U	3 00	J	3.00	U	3.00	U
Zinc	U	6.00	U	300	U	600	J	600	U	6.00	U

Table 5. Metal concentrations in porewater (pw), interface (swi), and discharge (sp) water samples.

Sample No	NASP-9-swi		NASP-11-swi		NASP-25-swi		NASP-25-sp	
Location	Naval air Station (NAS) Pensacola		Naval air Station (NAS Pensacola		Naval air Station (NAS Pensacola		Naval air Station (NAS) Pensacola	
Analyte	Result µg/L	RL µg/L	Result µg/L	RL µg/L	Result µg/L	RL µg/L	Result µg/L	RL µg/L
Aluminum	U	500	U	500	U	500	U	500
Antimony	U	14.0	U	14.0	U	14.0	U	14.0
Arsenic	U	17.0	U	17.0	U	17.0	U	17.0
Barium	13.5	2.00	22.3	2.00	17.9	2.00	27.6	2.00
Beryllium	U	2.00	U	2.00	U	2.00	U	2.00
Cadmium	U	3.00	U	3.00	U	3.00	U	3.00
Calcium	256000	60.0	274000	60.0	266000	60.0	262000	60.0
Chromium	U	3.00	U	3.00	U	3.00	U	3.00
Cobalt	U	3.00	U	3.00	U	3.00	U	3.00
Copper	U	4.00	U	4.00	U	4.00	U	4.00
Iron	U	600	U	600	U	600	U	600
Lead	U	10.0	U	0 0	U	10.0	U	10.0
Magnesium	876000	800	931000	800	882000	800	884000	800
Manganese	5.49	2.00	8.22	2.00	5.50	2.00	172	2.00
Mercury	U	0.200	U	0.200	U	0.200	U	0.200
Nickel	U	5.00	U	5.00	U	5.00	15.0	5.00
Potassium	297000	2000	316000	2000	296000	2000	296000	2000
Selenium	U	15.0	U	15.0	U	15.0	U	15.0
Silver	U	4.00	U	4.00	U	4.00	U	4.00
Sodium	6790000	120000	7110000	12000	6840000	120000	6750000	120000
Thallium	U	18.0	U	18.0	U	18.0	U	18.0
Vanadium	U	3.00	U	3.00	U	3.00	U	3.00
Zinc	U	600	U	6.00	U	600	U	600

Table 5. (cont.)

		18049		18049		18050		8050		18051		18051		18052		18052	
SAMPLING ID		NASP-6B-PW		NASP-6B-PW		NASP-9-PW		NASP-9-PW		NASP-11-PW		NASP-11-PW		NASP-25-PW		NASP-25-PW	
LABORATORY ID:		JA5292-1F		JA5292-1		JA5292-2		JA5292-2F		JA5292-3F		JA5292-3		JA5292-4F		JA5292-4	
SAMPLING DATE:		11/6/2008		11/6/2008		11/6/2008		1/6/2008		11/5/2008		11/5/2008		11/6/2008		11/6/2008	
SAMPLING TIME:		0:00		0:00		0 00		0·00		0:00		0:00		0:00		0:00	
SAMPLE MATRIX		Water Filtered		Water		Water		Water Fi tered		Water Filtered		Water		Water Filtered		Water	
GC/MS Semi-volatiles																	
Acenaphthene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0.21	U
Acenaphthylene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0.21	U
Anthracene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0.21	U
Benzo(a)anthracene	ug/l	NA		0.10	U	0.1	U	NA		NA		0.10	U	NA		0.10	U
Benzo(a)pyrene	ug/l	NA		0.10	U	0 11	U	NA		NA		0.10	U	NA		0.10	U
Benzo(b)fluoranthene	ug/l	NA		0 21	U	0.2	J	NA		NA		0.21	U	NA		0.21	U
Benzo(g,h,i)perylene	ug/l	NA		0.21	U	0.21	U	NA		NA		0.21	U	NA		0.21	U
Benzo(k)fluoranthene	ug/l	NA		0.21	U	0 2	U	NA		NA		0.21	U	NA		0.21	U
Chrysene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0 21	U
Dibenzo(a,h)anthracene	ug/l	NA		0.21	U	0.21	U	NA		NA		0.21	U	NA		0.21	U
Fluoranthene	ug/l	NA		0.21	U	0 21	U	NA		NA		0 21	U	NA		0.21	U
Fluorene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0.21	U
Indeno(1,2,3-cd)pyrene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0.21	U
Naphthalene	ug/l	NA		0.21	U	0.21	U	NA		NA		0.21	U	NA		0.21	U
Phenanthrene	ug/l	NA		0 21	U	0.21	U	NA		NA		0.21	U	NA		0.21	U
Pyrene	ug/l	NA		0.21	U	0 21	U	NA		NA		0.21	U	NA		0.21	U
General Chemistry																	
Dissolved Organic Carbon	mg/l	15 8		NA		NA		11 3		15 9		NA		5 0	U	NA	

Table 6. PAH and DOC concentrations in porewater (pw), interface (swi), and discharge (sp) water samples.

		18053		18053		8054		8054		18055		18055		18056		18056	
SAMPLING ID		NASP-6B-SWI		NASP-6B-SWI		NASP-9 SWI		NASP 9 SWI		NASP-11-SWI		NASP-11-SWI		NASP-25-SWI		NASP-25-SWI	
LABORATORY ID		JA5292-5F		JA5292-5		JA5292 6F		JA5292 6		JA5292-7F		JA5292-7		JA5292-8		JA5292-8F	
SAMPLING DATE		11/6/2008		11/6/2008		11/6/2008		1/6/2008		11/5/2008		11/5/2008		11/6/2008		11/6/2008	
SAMPLING TIME.		0 00		0:00		0:00		0 00		0 00		0 00		0:00		0:00	
SAMPLE MATRIX		Water Filtered		Water		Water Filtered		Water		Water Filtered		Water		Water		Water Filtered	
GC/MS Semi-volatiles																	
Acenaphthene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Acenaphthylene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Anthracene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Benzo(a)anthracene	ug/l	NA		0.10	U	NA		0 10	U	NA		0.10	U	0.10	U	NA	
Benzo(a)pyrene	ug/l	NA		0.10	U	NA		0 0	U	NA		0 10	U	0.10	U	NA	
Benzo(b)fluoranthene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Benzo(g,h,i)perylene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Benzo(k)fluoranthene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Chrysene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Dibenzo(a,h)anthracene	ug/l	NA		0.20	U	NA		0.20	U	NA		0.21	U	0.20	U	NA	
Fluoranthene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Fluorene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Indeno(1,2,3-cd)pyrene	ug/l	NA		0 20	U	NA		0.20	U	NA		0.21	U	0.20	U	NA	
Naphthalene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
Phenanthrene	ug/l	NA		0.20	U	NA		0.20	U	NA		0.21	U	0.20	U	NA	
Pyrene	ug/l	NA		0.20	U	NA		0 20	U	NA		0.21	U	0.20	U	NA	
General Chemistry																	
Dissolved Organic Carbon	mg/l	9 5		NA		9 6		NA		5 0	U	NA		NA		5 0	U

Table 6. (cont.)

		18057		18057		
SAMPLING ID.		NASP-25-SP		NASP-25-SP		
LABORATORY ID		JA5292-9F		JA5292-9		
SAMPLING DATE		11/3/2008		11/3/2008		
SAMPLING TIME		0:00		0 00		
SAMPLE MATRIX		Water Filtered		Water		
GC/MS Semi-volatiles						
Acenaphthene	ug/l	NA		0 21	U	
Acenaphthylene	ug/l	NA		0.21	U	
Anthracene	ug/l	NA		0 21	U	
Benzo(a)anthracene	ug/l	NA		0.11	U	
Benzo(a)pyrene	ug/l	NA		0.11	U	
Benzo(b)fluoranthene	ug/l	NA		0.21	U	
Benzo(g,h,i)perylene	ug/l	NA		0.21	U	
Benzo(k)fluoranthene	ug/l	NA		0 21	U	
Chrysene	ug/l	NA		0.21	U	
Dibenzo(a,h)anthracene	ug/l	NA		0.21	U	
Fluoranthene	ug/l	NA		0 21	U	
Fluorene	ug/l	NA		0.21	U	
Indeno(1,2,3-cd)pyrene	ug/l	NA		0 21	U	
Naphthalene	ug/l	NA		0.21	U	
Phenanthrene	ug/l	NA		0.21	U	
Pyrene	ug/l	NA		0 21	U	
General Chemistry						
Dissolved Organic Carbon	mg/l	5 0	U	NA		

Table 6. (cont.)

Client ID	WBLK111208		NASP-6B-PW		NASP-9-PW			NASP-11-PW		NASP-25-PW	
Analyte	Conc µg/L	RL µg/L	Conc µg/L	RL µg/L	Conc µg/L		RL µg/L	Conc µg/L	RL µg/L	Conc. µg/L	RL µg/L
p,p'-DDE	U	0.0200	0.0218	0.021	U		0.0211	U	0.0200	U	0.0211
p,p'-DDD	U	0.0200	0.0507	0.02	U		0.0211	U	0.0200	U	0.0211
p,p'-DDT	U	0.0200	U	0.0211	0.00784	J	0.0211	U	0.0200	U	0.0211

Client ID	NASP-6B-SWI		NASP-9-SWI		NASP-25-SWI	
Analyte	Conc µg/L	RL µg/L	Conc µg/L	RL µg/L	Conc µg/L	RL µg/L
p,p'-DDE	U	0.0200	U	0.0200	U	0.0206
p,p'-DDD	U	0.0200	U	0.0200	U	0.0206
p,p'-DDT	U	0.0200	U	0.0200	U	0.0206

Table 7. Pesticide concentrations in porewater (pw), interface (swi), and discharge (sp) water samples.

Copper							
Depth	Station						
	NASP9	NASP11	NASP25	NASP6B	NASP6X	NASP6Y	NASP6Z
4-5cm	1.13	1.00	0.53	1.31	1.24	0.77	1.55
3-4cm	1.35	1.08	0.38	1.16	0.93	0.85	NA
2-3cm	1.13	1.23	0.68	1.31	1.70	1.00	1.24
1-2cm	0.90	1.46	1.22	1.55	1.70	0.85	1.47
0-1cm	1.28	2.15	1.22	1.55	1.62	0.93	1.16
1cm WC	1.95	1.92	0.99	2.01	1.93	0.85	1.31
Zinc							
Depth	Station						
	NASP9	NASP11	NASP25	NASP6B	NASP6X	NASP6Y	NASP6Z
4-5cm	1.69	4.33	3.27	3.57	1.90	1.03	4.99
3-4cm	2.54	1.34	4.13	1.27	1.59	1.82	NA
2-3cm	2.46	16.55	8.57	6.18	3.88	7.93	3.41
1-2cm	3.08	3.78	4.60	5.94	3.17	0.95	2.93
0-1cm	6.62	NA	5.45	14.27	4.44	1.82	4.04
1cm WC	4.31	3.31	14.02	7.77	6.10	0.87	3.33
Nickel							
Depth	Station						
	NASP9	NASP11	NASP25	NASP6B	NASP6X	NASP6Y	NASP6Z
4-5cm	0.32	0.91	1.39	0.63	0.83	0.83	0.73
3-4cm	0.41	0.56	0.98	0.72	0.75	0.73	NA
2-3cm	0.36	0.71	1.23	0.81	1.75	0.83	1.00
1-2cm	0.58	0.66	1.07	0.76	2.34	0.70	0.92
0-1cm	0.58	1.16	1.15	0.92	2.17	0.83	0.92
1cm WC	0.61	1.08	1.07	1.17	2.17	0.92	1.00
Lead							
Depth	Station						
	NASP9	NASP11	NASP25	NASP6B	NASP6X	NASP6Y	NASP6Z
4-5cm	0.05	0.09	0.16	0.03	0.03	0.03	0.04
3-4cm	0.06	0.06	0.11	0.03	0.03	0.09	NA
2-3cm	0.06	0.10	0.15	0.04	0.13	0.03	0.06
1-2cm	0.08	0.10	0.21	0.04	0.10	0.03	0.07
0-1cm	0.21	0.20	0.29	0.17	0.21	0.03	0.12
1cm WC	0.16	0.12	0.27	0.41	0.26	0.03	0.21
Cadmium							
Depth	Station						
	NASP9	NASP11	NASP25	NASP6B	NASP6X	NASP6Y	NASP6Z
4-5cm	0.008	0.016	0.016	0.008	0.008	0.008	0.008
3-4cm	0.008	0.008	0.016	0.008	0.008	0.008	NA
2-3cm	0.008	0.024	0.031	0.008	0.087	0.008	0.008
1-2cm	0.008	0.055	0.039	0.008	0.040	0.008	0.008
0-1cm	0.116	0.181	0.055	0.040	0.135	0.008	0.016
1cm WC	0.146	0.079	0.101	0.174	0.182	0.016	0.048

Table 8. Bioavailable metal concentrations at different sediment depths, as measured with diffusive gradients in thin film (DGT) Station NASP 6B is represented by three replicate DGTs (X, Y, Z).

Species	Exposure Duration	Location Unit	Lab (µg/kg ww)		Lab (µg/kg lipid)		*In Situ* (µg/kg ww)		*In Situ* (µg/kg lipid)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
L. plumulosus	4 days	Control	98.7	28 6	6763	1959		-		
		6B	350.2	129 6	19392	7177	155 3	*	10641	*
		9	105.4	33 6	7601	2419	0	*	0	*
		11	25 3	9 4	1710	636	0	*	0	*
		25	477 7	306 5	29599	18991	159 1	*	10902	*
	28 days	Control	*ND*	*ND*	*ND*	*ND*	-		-	-
		6B	*ND*	*ND*	*ND*	*ND*	-	-	-	-
		9	*32 3*	*34 1*	*3,585*	*3,792*	-	-	-	-
		11	*0 0*	*0*	*0.0*	*0*		-	-	-
		25	*147 5*	*8 4*	*492*	*27 9*		-	-	-
M mercenaria	4 days	Control	0.0	-	0		BDL	-	BDL	-
		6B	17.3	15.3	1040	921	BDL	-	BDL	-
		9	36.9	43.5	2878	3399	BDL	-	BDL	-
		11	0.0	-	0	-	BDL	-	BDL	-
		25	0.0	-	0		BDL		BDL	-
	28 days	Control	17 833	15.4	1783	1544	-	-	-	-
		6B	9	16.1	715	1239	-	-	-	-
		9	BDL	-	BDL		-	-	-	-
		11	BDL	-	BDL	-	-	-	-	-
		25	BDL	-	BDL	-	-	-	-	-

ND=no data due to poor survival of L. plumulosus at day 28
BDL=below method detection limits
Dash indicates measurements not made
*Indicates no standard deviation calculated due to need to combine replicates
Italics indicate that 28 day exposed *L. plumulosus* had poor survival and variable lipid content therefore, data are suspect

Table 9. Total PAH (EPA 16 priority) tissue concentrations for lab and in situ bioaccumulation exposures with Leptocheirus plumulosus (marine amphipod) and Mercenaria mercenaria (hard clam).

	Species	*L plumulosus*		*L plumulosus*		*A. bahia*		*A. bahia*		*N arenaceodentata*	
	Location	Lab		*In Situ*		*In Situ*		*In Situ*		*In Situ*	
	Exposure Type	SED		SED		WC		SWI		SED	
	Endpoint	% Survival		% Surviva		% Survival		% Survival		Feeding Rate*	
Duration	**Sample ID**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
48 hours	Lab Control	-	-	98	5.0	98	5.0	98	5.0	76	16.7
	Travel Control	-	-	94	6.3	88	9 6	88	9.6	71	12.2
	NASP 9	-		89	11 1	100	0.0	100	0.0	73	10.1
	NASP 25	-	-	80	18.0	100	0.0	100	0.0	80	6.2
	NASP 6B	-	-	**35**	**15.8**	93	5.8	93	5.8	61	27 8
	NASP 11	-	-	90	8 2	100	0.0	100	0.0	84	7.1
96 hours	Lab Control	92	3.0	98	5.0	98	5 0	98	5.0	-	-
	Travel Control	NA	NA	94	6 3	88	9.6	88	9.6	-	-
	NASP 9	92	3.0	81	16.5	98	5 0	90	8.2	-	-
	NASP 25	94	5.3	87	10.4	97	5.8	93	5.8	-	-
	NASP 6B	**85**	**5.0**	**50**	**13.2**	100	0.0	87	23.1	-	-
	NASP 11	93	3.0	87	7.6	93	5.0	88	15.0	-	-

Bold indicates statistically lower than associated Lab or Travel Control using unequal variance t-tests (p<0 05)
SED=surficial sediment; WC=water column; SWI=sediment-water interface
*Number of brine shrimp nauplii consumed in one hour following a 48 hour sediment exposure

Table 10. Results summary of in situ and laboratory toxicity tests conducted at Wetland 64 adjacent to NAS Pensacola.

generate a wastewater residual from the on-site sediment dewatering operations, but it is anticipated that this wastewater could be discharged to the wetland from which it was derived after some minimal treatment (e.g., hydraulic settling of particulates, filtration and/or granular activated carbon).

Short-Term Effectiveness

SED-4 will have some short-term negative impacts to the community because truck traffic may increase noise levels and present the possibility of spillage. Potential negative short-term impacts to the surrounding community and environment from fugitive emissions and/or spillage of contaminated sediment could be minimized through the implementation of appropriate engineering controls (e.g., perimeter air monitoring, spill prevention procedures, etc.). Some short-term risks could be incurred by workers from exposure to contaminated sediment during on-site remedial activities. However, the potential for exposure would be minimized by the implementation of engineering controls, wearing of appropriate PPE, and compliance with OSHA regulations and site-specific health and safety procedures.

SED-4 could be completed in approximately six months and would achieve the RAOs and attain the sediment PRGs at completion.

Implementability

SED-4 would be complicated to implement.

The excavation component of this alternative at Wetlands 3, 5A, 15, 18A, and 48 could be performed with specialized construction equipment, resources, and materials that would be available for this purpose. Because the excavation would be in wetland areas, dewatering and/or water flow diversion would be needed in some instances. Existing vegetation would need to be removed and restored after excavation. Because of the shallow excavation depth and nature of the wetlands, buried utilities may not be affected. Mats would be required to support excavation equipment. A temporary containment structure would be required to dewater the sediment to meet disposal requirements for moisture content by the off-site landfill. Additionally, treatment (e.g., hydraulic settling of particulates, filtration and/or granular activated carbon) of the water would be required prior to disposal in the wetland from which it was derived.

The dredging component of this alternative at Wetland 64 could be performed with specialized construction equipment, resources, and materials that would be available for this purpose. Because the dredging would be in the boat dock area, equipment movement would be quite difficult. A containment area would be required to dewater the sediment to meet disposal requirement of the off-site landfill.

Additionally, treatment (e.g., hydraulic settling of particulates, filtration and/or granular activated carbon) of the water would be required prior to disposal in the wetland from which it was derived.

Non-hazardous waste landfills for the off-site disposal of sediment and cleared vegetation would be readily available.

The administrative aspects of SED-4 would be moderately difficult to implement. Off-site transportation and disposal of the excavated sediment and vegetation would require the completion of administrative procedures, which could readily be accomplished. However, excavation/dredging and reconstruction of a wetland would require the involvement of the USACE, FDEP, and USEPA to properly permit construction activities. Special concerns are associated with the hydraulic dredging process to rapidly dewater and flocculate the sediment and minimize the volume of water requiring treatment. This requires the addition of polymers to the dredged sediment to flocculate the sediment particles to facilitate settlement at a storage area or facilitate dewatering using a filter press or sediment bags. Settling basins can be used, but dewatering using settling basins takes significantly longer than with a filter press or sediment bags because the sediment must fall through the water column rather than the water being filtered though a press or the sediment bag. Because of the time associated with the dewatering process, this FS assumes the use of sediment bags rather than a filter press or settling basin. There is a potential that the implementation of SED-4 could cause unintended or excessive damage to the existing and surrounding environments.

Cost

The estimated costs for Alternative SED-4 are as follows.

Wetland	Capital Cost
3	550,000
5A	$776,000
15	$882,000
18A	$787,000
48	$3,234,000
64	$4,597,000
Total	**$10,826,000**

The above cost figures have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. A detailed breakdown of estimated costs for this alternative is provided in Appendix B.

4.2.4.3 Sustainability Evaluation Results

Greenhouse Gas Emissions

Wetland 48 has the most GHG emissions at 244 tonnes, due to the amount of material to be excavated followed by Wetland 64 at 201 tonnes, the second most amount to be excavated.

Criteria Pollutant Emissions

Wetland 48 has the highest emissions for the three criteria pollutants at 0.224 tonnes for NO_x, 0.0508 tonnes for SO_x and 0.033 tonnes for PM_{10}. These emissions can largely be attributed to the large volume of excavation that would need to be accomplished for this alternative. The criteria pollutant emissions are directly proportional to the amount of soil being excavated for each wetland. The equipment use sector has the largest amount of emissions for each wetland due to the dozers, excavators, and loaders that would be used during the remedial activities.

Energy Consumption

It is clear that Consumables is the sector that yields the highest energy use. The ratio of energy use by sector is analogous to GHG emissions. A limitation in this model is that "soil" or "fill" was not a material option, so "gravel" had to be used as a soil surrogate. Soil is likely to have lower energy consumption in its production phase than gravel, thus the energy consumption for Wetlands 3, 5A, 15, 18A, 18B, 48, and 64 is probably less.

Water Usage

Water consumption only occurs in the Equipment Use sector, and is the same for Wetlands 3, 5A, 15, and 18A, triple the amount for Wetland 48, and double for Wetland 64. Wetland 48 uses the most water, due to the large volume of the excavation area.

Cost of Remedy Alternatives

Wetland 64 appears to have the highest cost, but not the highest environmental footprint. However, since hydraulic dredging is not included in the SiteWise model, Wetland 64 is anticipated to have a higher environmental footprint than Wetland 48.

A detailed summary of the sustainability evaluation for this alternative is provided in Appendix C.

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the analyses for each of the remedial alternatives presented in Section 4.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

5.1 COMPARISON OF SEDIMENT REMEDIAL ALTERNATIVES BY CRITERIA

The following alternatives for sediment remediation have been developed for all Site 41 Wetlands (3, 5A, 15, 18A, 18B, 48, and 64):

- Alternative SED-1: No Action
- Alternative SED-2: Natural Recovery and Sediment Monitoring

An additional alternative has been included for Wetlands 3, 15, 18A, and 18B:

- Alternative SED-3: LUCs, Natural Recovery, and Sediment Monitoring

An additional alternative has been included for Wetlands 3, 5A, 15, 18A, 48, and 64:

- Alternative SED-4: Ex-Situ Treatment – Removal (Excavation or Dredging) and Disposal

5.1.1 Overall Protection of Health and Environment

Alternative SED-1 would not provide protection of human health and the environment. Under the current land use, there could be unacceptable risks to human health and/or ecological receptors from direct exposure to contaminated sediment. Because no sediment monitoring would be performed, potential fluctuations in COC concentrations would not be detected.

Alternative SED-2 would not be immediately protective of human and/or ecological receptors. However, natural processes could eventually reduce COC concentrations in wetland sediment to the PRGs. Annual sediment monitoring would provide data to evaluate the rate of natural recovery of each wetland. Ecological receptors would be protected over time through naturally occurring processes with COC concentrations greater than PRGs. Alternative SED-3 would be more protective of human health for Wetlands 3, 15, and 18A than Alternative SED-2. LUCs restricting access would be protective of human health by preventing unacceptable risks to workers from direct exposure to contaminated sediment. Alternative SED-4 would be more protective of human health and the environment for Wetlands 3, 5A, 15, 18A, 48, and 64 than Alternatives SED-2 and SED-3. Removal of sediment that is contaminated above PRGs would eliminate or reduce the potential for unacceptable human health and ecological risks as a result of exposure to contaminated sediment.

5.1.2 Compliance with ARARs

Compliance of Alternative SED-1 with location-specific ARARs would be purely incidental. Action-specific ARARs are not applicable to this alternative.

Alternatives SED-2 and SED-3 would comply with location- and action-specific ARARs. Alternative SED-4 would comply with the location-, and action-specific ARARs for Wetlands 3, 5A, 15 18A, 48, and 64.

5.1.3 Long-Term Effectiveness and Permanence

Alternative SED-1 would have no long-term effectiveness and permanence because contaminated sediment would remain on site. Because there would be no LUCs to restrict the disturbance of sediment within the site boundaries, the potential would also exist for unacceptable risk to develop for human and ecological receptors. Because there would be no sediment monitoring, potential COC concentration fluctuations would not be detected. Although COC concentrations will eventually decrease to PRGs through natural recovery, no sediment monitoring would verify this.

Alternative SED-2 would not provide long-term effectiveness and permanence until COC concentrations are reduced to the PRGs through naturally occurring processes; however, sediment monitoring natural recovery processes that would allow for evaluation of risks over time. Alternative SED-3 would provide long-term effectiveness and permanence for human health receptors; however, would not provide long-term effectiveness and permanence to ecological until COC concentrations are reduced to the PRGs through naturally occurring processes. Restricting access would prevent unacceptable risk from direct exposure of workers.

Alternative SED-4 would provide long-term effectiveness and permanence. Removal of sediment with COC concentrations greater than PRGs would effectively and permanently prevent unacceptable risk from exposure to contaminants and migration of sediment contaminants to surface water.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives SED-1, SED-2, SED-3, and SED-4 would not reduce the toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of COCs is expected to occur through sedimentation, leaching, biodegradation, and other natural attenuating factors. Alternative SED-4 would reduce the mobility and volume of contaminants through permanent removal and off-site disposal of the sediment with concentrations greater than the PRGs. Alternative SED-4 would generate a wastewater residual from the on-site sediment dewatering operations, but it is anticipated that this wastewater could be discharged after some minimal treatment.

5.1.5 Short-Term Effectiveness

Because no action would occur, implementation of Alternative SED-1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative SED-1 would never achieve the RAOs and, although the PRGs are expected to eventually be achieved through natural recovery, this would not be verified through sediment monitoring.

Some short-term risks could be incurred by workers from exposure to contaminated sediment during on-site sampling activities in Alternatives SED-2 and SED-3 and during on-site remedial activities in Alternative SED-4. However, the potential for exposure would be minimized by the wearing of appropriate PPE and compliance with OSHA regulations and site-specific health and safety procedures. For Alternative SED-4, any potential negative short-term impacts to the surrounding community and environment from fugitive emissions and/or spillage of contaminated sediment could be minimized through the implementation of appropriate engineering controls (e.g., perimeter air monitoring, spill prevention procedures, etc.).

5.1.6 Implementability

Alternative SED-1 would be the easiest to implement because there would be no activities to implement.

Alternatives SED-2 and SED-3 would be easily implementable. The administration aspects of Alternatives SED-2 and SED-3 would be relatively simple to implement. If site ownership changed, appropriate provisions would be incorporated into the property transfer documents to ensure continued implementation of sediment monitoring for Alternatives SED-2 and SED-3 and land use restrictions for Alternative SED-3.

Alternative SED-4 would be the most complicated to implement. The excavation component (Wetlands 3, 5A, 15, 18A, and 48) and dredging component (Wetland 64) of Alternative SED-4 could be performed with specialized construction equipment, resources, and materials that would be available for this purpose. Because the excavation component of Alternative SED-4 would be in wetland areas, dewatering and/or water flow diversion would be needed in some instances. The dredging component for Wetland 64 would be slightly more difficult than the excavation component for Wetlands 3, 5A, 15, 18A, and 48, because the removal would be in the boat dock area where equipment movement would be more challenging. A dewatering area would be required to allow the sediment to drain at Wetland 64. Existing vegetation would need to be removed and restored after excavation/dredging for Alternative SED-4. Because of the shallow excavation depth and nature of the wetlands buried utilities may not be affected. Alternative SED-4 would require mats to support excavation equipment.

Non-hazardous waste landfills for the off-site disposal of the sediment and cleared vegetation would be readily available.

The administration aspects of Alternative SED-4 would be moderately difficult to implement. The off-site transportation and disposal of the excavated sediment and vegetation would require the completion of administrative procedures, which could readily be accomplished. However, to perform excavation/dredging and reconstruction of a wetland during Alternative SED-4, the involvement of the USACE, FDEP, and USEPA is required to properly permit construction activities. Special concerns would be associated with the hydraulic dredging process at Wetland 64. Hydraulic dredging would require the addition of polymers to the dredged sediment for pumping purposes. If the polymers and sediment bags are not compatible with one another, the sediment bags could clog and prevent the dewatering process. Settling basins could be used instead of sediment bags, but dewatering using settling basins is significantly longer than with sediment bags because the sediment must fall through the water column rather than the water being filtered though the sediment bags. Additionally, settling basins would require the addition of flocculants to help speed up the settlement process. Due to the time associated with the dewatering process, this FS assumes the use of sediment bags rather than settling basins.

5.1.7 Cost

The capital and O&M costs and NPW of the sediment alternatives for Wetland 3 are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$75,000	$84,000
SED-3	$23,000	$111,000	$134,000
SED-4	$550,000	---	---

The capital and O&M costs and NPW of the sediment alternatives for Wetland 5A are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$79,000	$88,000
SED-4	$776,000	---	---

The capital and O&M costs and NPW of the sediment alternatives for Wetland 15 are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$79,000	$88,000
SED-3	$23,000	$111,000	$134,000
SED-4	$882,000	---	---

The capital and O&M costs and NPW of the sediment alternatives for Wetland 18A are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$72,000	$81,000
SED-3	$23,000	$111,000	$134,000
SED-4	$787,000	---	---

The capital and O&M costs and NPW of the sediment alternatives for Wetland 18B are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$72,000	$81,000
SED-3	$23,000	$111,000	$134,000

The capital and O&M costs and NPW of the sediment alternatives for Wetland 48 are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$87,000	$96,000
SED-4	$3,234,000	---	---

The capital and O&M costs and NPW of the sediment alternatives for Wetland 64 are as follows.

Alternative	Capital Cost	NPW of O&M	NPW
SED-1	---	---	---
SED-2	$9,000	$126,000	$135,000
SED-4	$4,597,000	---	---

Detailed cost estimates are provided in Appendix B.

5.1.8 Sustainability Evaluation Results

It is apparent that SED-4 will have greater GHG emissions, criteria pollutant emissions, energy consumption, water usage, and worker risk than any corresponding SED-2 options. Each individual wetland must be looked at separately, and if SED-2 is capable of accomplishing the PRGs in a timely and cost effective manner, it will also be in a sustainable manner as well. A detailed summary of the sustainability evaluation for this alternative is provided in Appendix C.

5.2 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 5-1 summarizes the comparative analysis of the sediment remedial alternatives.

	Alternative SED-3: LUCs, Natural Recovery, and Sediment Monitoring (Wetlands 3, 15, 18A, and 18B)	Alternative SED-4: Ex-Situ Treatment - Removal (Excavation or Dredging) and Disposal (Wetlands 3, 5A, 15, 18A, 48, and 64)
) f f l	Would be protective of human health by preventing unacceptable risks to workers from direct exposure to contaminated sediment at Wetland 18A. Alternative SED-3 would not be protective of the environment at the time of implementation. However, protection of ecological receptors at Wetlands 3 and 15 would occur over time. Alternative SED-3 would be slightly more protective than Alternative SED-2 for Wetlands 3, 15, 18A, and 18B.	Would be more protective of human health and the environment than Alternatives SED-2 and SED-3 for Wetlands 3, 5A, 15, 18A, 48, and 64. Excavation of sediment PRGs would eliminate or reduce the potential for unacceptable human health and/or ecological risks as a result of exposure to contaminated sediment.
	Eventually would comply Would comply Would comply	Would comply Would comply Would comply
s s) e e l	Would provide long-term effectiveness and permanence. Although no active treatment of contaminated soil would occur, risks to human health would be controlled.	Would be effective in the long term because the COCs would be removed from the site and disposed in a suitable landfill outside the facility, resulting in residual levels that would no longer pose an unacceptable risk to recreational and ecological receptors.
r t e f , l l	Would not reduce the toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of COCs would occur through sedimentation, leaching, biodegradation, and other natural attenuating factors, which would be verified through sediment monitoring.	Would not reduce the toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Alternative SED-4, however, would result in the relocation of contaminated sediment from the wetlands to a landfill.
/ l . l e \ l	Short-term risks are not expected to be incurred by workers from exposure to contaminated sediment during LUC implementation. Some short-term risks could be incurred by workers from exposure to contaminated sediment during on site sampling activities. However, the potential for exposure would be minimized by the wearing of appropriate PPE, and compliance with OSHA regulations and site-specific health and safety procedures.	Some short-term risks could be incurred by workers from exposure to contaminated sediment during on-site remedial activities. However, the potential for exposure would be minimized by the wearing of appropriate PPE and compliance with OSHA regulations and site-specific health and safety procedures. Any potential negative short-term impacts to the surrounding community and environment from fugitive emissions and/or spillage of contaminated sediment could be minimized through the implementation of appropriate engineering controls (e.g., perimeter air monitoring, spill prevention procedures, etc.).
e /)	Would be easily implementable. The administration aspects of would be relatively simple to implement. If site ownership changed, appropriate provisions would be	Excavation equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Suitable TSDFs are available

	Alternative SED-3: LUCs, Natural Recovery, and Sediment Monitoring (Wetlands 3, 15, 18A, and 18B)	Alternative SED-4: Ex-Situ Treatment - Removal (Excavation or Dredging) and Disposal (Wetlands 3, 5A, 15, 18A, 48, and 64)
	$92,000 $444,000 $536,000	$10,826,000