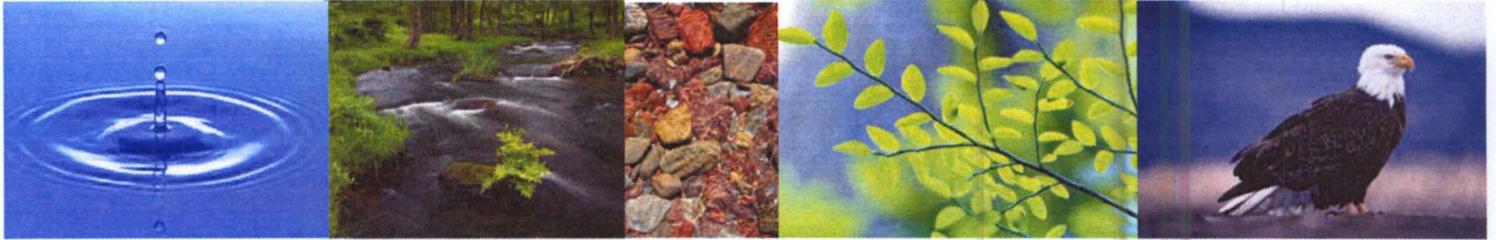


N62604.AR.000666
NCBC GULFPORT
5090.3a

FINAL ENGINEERING EVALUATION/COST ANALYSIS FOR CANAL ROAD DREDGE PILES
SITE 8 NCBC GULFPORT MS
3/1/2007
TETRA TECH NUS

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055



Rev. 1
03/21/07

Final Engineering Evaluation/ Cost Analysis for Canal Road Dredge Piles

Naval Construction Battalion Center
Gulfport, Mississippi

Contract Task Order 0049

March 2007



Southeast

2155 Eagle Drive

North Charleston, South Carolina 29406

REVISION 1
MARCH 2007

**FINAL ENGINEERING EVALUATION/COST ANALYSIS
FOR
CANAL ROAD DREDGE PILES**

**NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
Naval Facilities Engineering Command
Southeast
2155 Eagle Drive
North Charleston, SC 29406**

**Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220**

**CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 0049**

MARCH 2007

PREPARED UNDER THE SUPERVISION OF:



**ROBERT FISHER
TASK ORDER MANAGER
TETRA TECH NUS, INC.
TALLAHASSEE, FLORIDA**

APPROVED FOR SUBMITTAL BY:

**DEBRA M. HUMBERT
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA**

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE NO.</u>
ACRONYM LIST	v
1.0 INTRODUCTION	1-1
1.1 SCOPE.....	1-1
1.2 PURPOSE.....	1-1
1.3 REGULATORY FRAMEWORK	1-1
1.4 ORGANIZATION.....	1-2
2.0 SITE CHARACTERIZATION	2-1
2.1 SITE DESCRIPTION.....	2-1
2.2 SITE HISTORY	2-2
2.3 PREVIOUS INVESTIGATIONS	2-3
2.4 SOURCE, NATURE, AND EXTENT OF CONTAMINATION	2-3
2.4.1 Estimated Extent of Contaminated Media.....	2-3
2.5 ANALYTICAL DATA.....	2-4
3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES	3-1
3.1 REMOVAL ACTION OBJECTIVES	3-1
3.2 REMOVAL ACTION SCOPE	3-1
3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED CRITERIA	3-1
3.3.1 Land Disposal Restrictions	3-3
4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES	4-1
4.1 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES	4-1
4.1.1 Alternative 1 – Excavation and Off-Site Disposal	4-1
4.1.2 Alternative 2 – Excavation, Consolidation, and Stabilization	4-2
4.2 EVALUATION OF REMOVAL ACTION ALTERNATIVES.....	4-4
4.2.1 Alternative 1 – Excavation and Off-Site Disposal	4-5
4.2.2 Alternative 2 – Excavation, Consolidation, and Stabilization	4-6
5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES	5-1
5.1 EFFECTIVENESS.....	5-1
5.2 IMPLEMENTABILITY	5-2
5.3 COST	5-3
6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE	6-1
REFERENCES	R-1

TABLE OF CONTENTS (Continued)

APPENDICES

A	SUMMARY OF SITE 8 HISTORICAL INFORMATION
B	TOPOGRAPHIC SURVEY, CANAL ROAD DREDGE PILES
C	COST ESTIMATES

TABLES

NUMBER

2-1	Summary of Canal Road Dredge Piles Delineation Sampling
3-1	ARARs and TBC Criteria

FIGURES

NUMBER

2-1	Vicinity Map
2-2	Installation Map
2-3	Off-Base AOC
2-4	On-Base Surface Water Drainage, Areas 1 through 6
2-5	Drainage Area 1
2-6	Drainage Area 2
2-7	Drainage Area 3
2-8	Sample Locations

ACRONYM LIST

2,4-D	2,4-Dichlorophenoxyacetic acid
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
AO	Agreed Order
AOC	Area of Contamination
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chemical of concern
DoD	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
FFS	Focused Feasibility Study
HO	Herbicide orange
LDR	Land Disposal Restriction
MDEQ	Mississippi Department of Environmental Quality
MTR	Minimum Technological Requirement
NAVFAC SE	Naval Facilities Engineering Command Southeast
NCBC	Naval Construction Battalion Center
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
ng/kg	Nanogram per kilogram
NPV	Net present value
NTCRA	Non-time-critical removal action
OSHA	Occupational Safety and Health Administration
PRSC	Post-removal site control
RCC	Roller compacted concrete
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SRT	Sediment recovery trap
TBC	To Be Considered
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TRG	Target remediation goal

TtNUS	Tetra Tech NUS, Inc.
UCL	Upper confidence limit
µg/kg	Microgram per kilogram
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UTS	Universal treatment standard
yd ³	Cubic yards

1.0 INTRODUCTION

1.1 SCOPE

Tetra Tech NUS, Inc. (TtNUS), under contract to the United States Department of the Navy (Navy), Naval Facilities Engineering Command Southeast (NAVFAC SE), has prepared this Engineering Evaluation/ Cost Analysis (EE/CA) for the Canal Road Dredge Piles located west of Canal Road in the off-Base¹ Area of Contamination (AOC) associated with Site 8 – Herbicide Orange Storage Area (Site 8) that pose a potential threat to human health, welfare, and the environment due to exposure to dioxins. This EE/CA was prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) III, Contract No. N62467-04-D-0055, Contract Task Order 0049.

1.2 PURPOSE

The Navy has determined that a non-time-critical removal action (NTCRA) under the guidance provided by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 is necessary to prevent, minimize, or mitigate damage to public health or welfare based on the potential for environmental contamination from dioxin-contaminated sediment and soil located in the off-Base AOC. This EE/CA has been prepared in general accordance with the procedures developed under CERCLA as amended by SARA and to provide CERCLA documentation in support of an NTCRA for the Canal Road Dredge Piles.

1.3 REGULATORY FRAMEWORK

This EE/CA has been prepared in accordance with the Defense Environmental Installation Restoration Program, a program formally established by statute that provides for the cleanup of hazardous substances associated with past Department of Defense (DoD) activities consistent with the provisions of CERCLA, as amended by SARA, and as implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This document is also intended to comply with the National Environmental Policy Act (NEPA) of 1969.

NCBC Gulfport and Site 8 are not listed in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) and therefore do not have a United States Environmental Protection Agency (USEPA) identification number.

¹ "Off-Base" refers to the area outside the limits of the Naval Construction Battalion Center (NCBC) Gulfport ("Base"), Gulfport, Mississippi.

Activities to date and this EE/CA have been performed pursuant to an Agreed Order (AO) between the Mississippi Department of Environmental Quality (MDEQ), USEPA, and United States Air Force (USAF) (MDEQ, 1997). Under the CERCLA program, an EE/CA is prepared to document the decision-making process for conducting an NTCRA. This EE/CA has been prepared using USEPA's Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (USEPA, 1993).

1.4 ORGANIZATION

The EE/CA is organized into six sections. Section 1.0 provides an introduction to the EE/CA, including the scope, purpose, and regulatory framework. Section 2.0 presents the Base description and site characterization. Section 3.0 identifies the removal action objectives. Section 4.0 identifies and analyzes potential removal technologies and alternatives, and Section 5.0 compares the removal action alternatives with respect to their ability to achieve the objectives presented in Section 3.0. Section 6.0 presents the recommended removal action alternative. A list of references and appendices are provided at the end of the EE/CA.

2.0 SITE CHARACTERIZATION

2.1 SITE DESCRIPTION

NCBC Gulfport is located in the southeastern corner of Mississippi, approximately 2 miles north of the Gulf of Mexico, in southeastern Harrison County in the western portion of the City of Gulfport. Figure 2-1 shows the location of the Base in relation to the City of Gulfport and the Gulf of Mexico. The Base occupies 1,100 acres with an average elevation of approximately 30 feet above sea level. A map of NCBC Gulfport is provided as Figure 2-2.

The Canal Road Dredge Piles are the result of dredging activities conducted in 1974 and 1975 in Canal No. 1 between 28th Street and the Turkey Creek Bridge. Canal No. 1 receives surface water discharge from Site 8, among other areas of the Base.

Site 8 consists of three contiguous herbicide orange (HO) drum storage areas (referred to as Site 8A, Site 8B, and Site 8C) located in the north-central portion of the Base (Figure 2-2). After completion of remedial activities in October 2006, Site 8A (the main former HO storage area) was regraded, dioxin-contaminated material stabilized within the limits of Site 8A, and a roller compacted concrete (RCC) cover constructed over the stabilized contaminated material. The off-Base AOC is located north of the Base, across 28th Street, and includes the area between Canal No. 1 and 53rd Avenue. A map of the off-Base AOC is provided as Figure 2-3.

The surface water hydrology information presented below was derived from the Remediation Planning Document [Harding Lawson Associates (HLA), 2000a] and the Focused Feasibility Study (FFS) for Site 8 (TtNUS, 2003).

NCBC surface water drainage is collected and transported to several outfalls via a network of drainage channels. These drainage channels collect surface water from six drainage areas throughout the NCBC (see Figure 2-4). Site 8A, Site 8B, and Site 8C contribute to Drainage Areas 1, 2, and 3 (see Figures 2-5, 2-6, and 2-7, respectively). Throughout the year, flow throughout the majority of the on-Base drainage channels is perennial. Surface drainage from Site 8A flows to the northwest, exiting the Base at Outfall 3 into a drainage system that feeds Canal No. 1, which flows north to Turkey Creek.

As shown on Figures 2-5 and 2-6, Drainage Areas 1 and 2 drain to the northwestern corner of the Base and exit the Base at Outfall 3 (Figure 2-4). Prior to 1995, surface water leaving the Base via Outfall 3 flowed north under 28th Street into the off-Base AOC. Surface water in the off-Base AOC flowed north, and at approximately 1,700 feet north of 28th Street, flowed either west under Canal Road to Canal No. 1

via a culvert or, during storm events, northeast to the natural drainageway (the southern branch of Turkey Creek) until it reached the confluence with the main branch of Turkey Creek.

In 1974 and 1975, the Navy reduced the flooding potential for the Base by dredging Canal No. 1 between 28th Street and the Turkey Creek Bridge. The dredge spoils were piled on the western side of Canal No. 1 on privately owned residential property.

Beginning in 1995, efforts were initiated to limit the flow of surface water into the off-Base AOC to minimize the migration of dioxin-contaminated sediments. These efforts resulted in the permanent rerouting of Outfall 3 flow on the northern side of 28th Street to Canal No. 1, effectively bypassing the off-Base AOC. These measures included the replacement of three 18-inch-diameter reinforced concrete pipe culverts under 28th Street with a single 5-foot-wide reinforced concrete box culvert and construction of a drainage ditch on the northern side of 28th Street to convey storm water to the west under Canal Road and into Canal No. 1.

2.2 SITE HISTORY

As stated in Section 2.1, dredging activities in Canal No. 1 were conducted by the Navy in 1974 and 1975 to reduce the flooding potential for the Base. The dredging was conducted in Canal No. 1 between 28th Street and the Turkey Creek Bridge, and the dredge piles were placed along the western side of Canal No. 1. Local community members identified the presence of the Canal Road Dredge Piles and expressed concerns that the material may have been impacted by HO-related dioxins. From 2004 to 2006, the Canal Road Dredge Piles were sampled, samples analyzed, and a survey completed. The Canal Road Dredge Piles extend approximately 4,400 feet from the northern side of the Ladnier Home complex north to Turkey Creek, range in height from 3 to 10 feet above pre-dredge pile grade, vary in width from approximately 5 to 35 feet, and contain approximately 6,500 cubic yards (yd³) of material. The Canal Road Dredge Pile samples contained the primary congener 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which links the dredge pile dioxin contamination to Site 8.

HO is an herbicide formulation employed during the Vietnam War to defoliate trees and shrubbery. It is an equal mixture of two agricultural herbicides [2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)] in a diesel or jet fuel mixture. Spills and leaks of HO occurred within Site 8, contaminating surface soil and sediment with the mixture components, 2,4,5-T and 2,4-D, as well as byproduct contaminants (dioxins and furans), primarily TCDD. Concentrations of 2,4,5-T and 2,4-D have degraded over time; however, dioxin and furan concentrations have remained at concentrations greater than regulatory limits. Throughout this EE/CA, TCDD and its chemically related dioxin and furan congeners are collectively referred to as "dioxins."

Historical information related to Site 8, including previous removal actions and previous investigations, is presented in Appendix A.

2.3 PREVIOUS INVESTIGATIONS

Dredge pile delineation studies were conducted to delineate the extent of dioxin contamination in dredge piles located west of Canal No. 1 in the off-Base AOC (TtNUS, 2006). The evaluation of the Canal Road Dredge Piles is discussed in the Site Investigation Report for Canal Road (TtNUS, 2005). Sampling was conducted in three phases, and the findings were as follows:

- The dredge piles are located on private property that is zoned residential; therefore, the MDEQ Tier 1 soil/sediment target remediation goal (TRG) concentration of 4.26 nanograms per kilogram (ng/kg) for unrestricted residential use is the appropriate benchmark.
- The 95 percent upper confidence limit (UCL) of the mean dioxin concentration for the 39 samples collected was 20.43 ng/kg, indicating the need for further action. Concentrations in 30 of the 39 samples exceeded the MDEQ unrestricted Tier 1 TRG for dioxin.
- The primary congener was TCDD, clearly linking the reported dioxin contamination to Site 8.
- Concentrations of dioxin in the dredge piles did not vary with distance from NCBC Gulfport or with depth in the dredge piles. Therefore the entire length of the dredge pile, approximately 4,400 feet, is considered impacted by HO-related dioxins.
- The volume of the Canal Road Dredge Piles, as derived from detailed topographic profiling, is approximately 6,500 yd³. The topographic survey information is provided in Appendix B.

2.4 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The source of contamination for the Canal Road Dredge Piles is assumed to be Site 8. Section 2.3 discusses the nature and extent of contamination based on the Final Letter Report, Site 8B and 8C Verification Sampling and Associated Drainage Systems (TtNUS, 2006).

2.4.1 Estimated Extent of Contaminated Media

Based on the Canal Road Dredge Piles delineation sampling conducted in the off-Base AOC during 2005 and 2006, it was estimated that approximately 6,500 yd³ of off-Base sediment (Canal Road Dredge Piles)

has dioxin concentrations greater than the MDEQ Tier 1 soil/sediment TRG concentration of 4.26 ng/kg for unrestricted residential use.

2.5 ANALYTICAL DATA

Sampling at the Canal Road Dredge Piles occurred in two phases and included a sediment sample collected from the adjacent water body. The sampling strategy incorporated the use of bio-assay analysis (USEPA Method 4025) in conjunction with high resolution analysis (USEPA Method 8290). A more focused sampling approach in Phase 2 required only the high resolution analysis.

Results are presented in Table 2-1 and are summarized as follows:

- Two of the samples analyzed using USEPA Method 8290 had dioxin concentrations that exceeded the 38 ng/kg MDEQ Tier 1 restricted TRG – sample CR26 (40.1 ng/kg) and sample CR28 (39.5 ng/kg).
- In total, 30 of the 39 samples had dioxin concentrations that exceeded the 4.26 ng/kg MDEQ unrestricted Tier 1 TRG.
- The 95 percent UCL of the mean dioxin concentration for the samples collected at the Canal Road Dredge Piles was 20.43 ng/kg.
- These results indicate that a removal action is necessary for the Canal Road Dredge Piles.
- Dioxin concentrations are distributed throughout the dredge piles with no discernable pattern; therefore, additional characterization will not likely result in a reduced volume estimate of material to be removed.

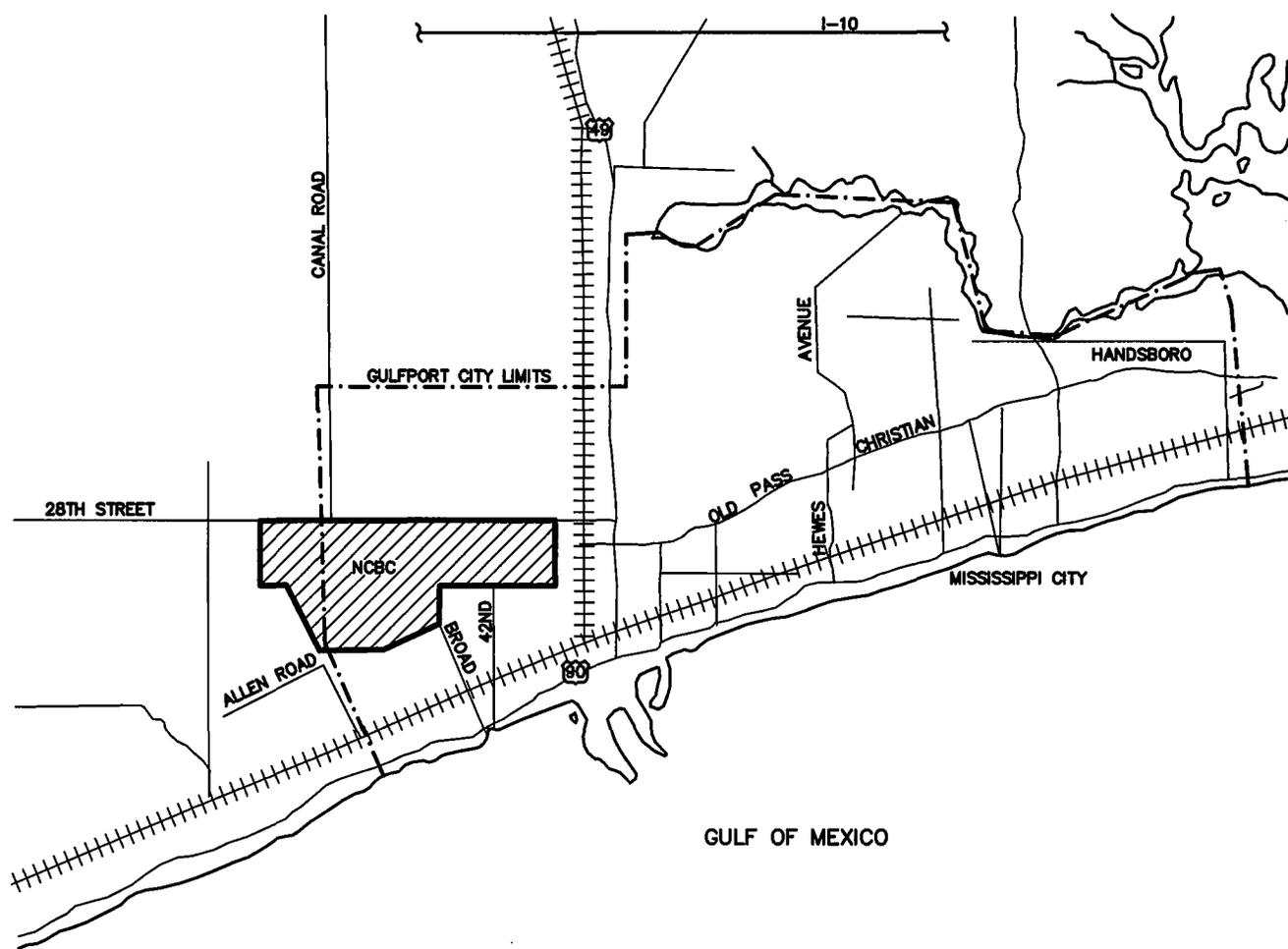
TABLE 2-1

SUMMARY OF CANAL ROAD DREDGE PILES DELINEATION SAMPLING
 CANAL ROAD DREDGE PILES EE/CA
 NCBC GULFPORT, MISSISSIPPI

Sample Identification	Dioxin Concentration		Sample Identification	Dioxin Concentration	
	Bio-Assay Analysis	High Resolution Analysis		Bio-Assay Analysis	High Resolution Analysis
CR01	17	11.00	CR21	NT	14.214
CR02	11	37.26	CR22	NT	4.98
CR03	25	NT	CR23	NT	4.313
CR04	16	10.57	CR24	NT	7.213
CR05	19	NT	CR25	NT	7.519
CR06	9	7.508	CR26	NT	40.157
CR07	19	NT	CR27	NT	9.149
CR08	23	13.33	CR28	NT	39.506
CR09	15	NT	CR29	NT	2.063
CR10	17	NT	CR30	NT	3.126
CR11	16	NT	CR31	NT	3.526
CR12	28	19.50	CR32	NT	5.497
CR13	10	NT	CR33	NT	2.245
CR14	20	6.925	CR34	NT	13.895
CR15	32	25.45	CR35	NT	1.767
CR16	21	7.640	CR36	NT	3.833
CR17	15	NT	CR37	NT	4.569
CR18	19	3.112	CR38	NT	0.082
CR19	10	NT	CRPOND	NT	2.448
CR20	NT	0.867			

- 1 Samples tested using bio-assay analysis (USEPA Method 4025) and high resolution analysis (USEPA Method 8290).
- 2 All results are reported in nanograms per kilogram (ng/kg).
- 3 Highlighted values exceed the 38 ng/kg Tier 1 restricted target remediation goal designated by MDEQ.

NT – Not tested.

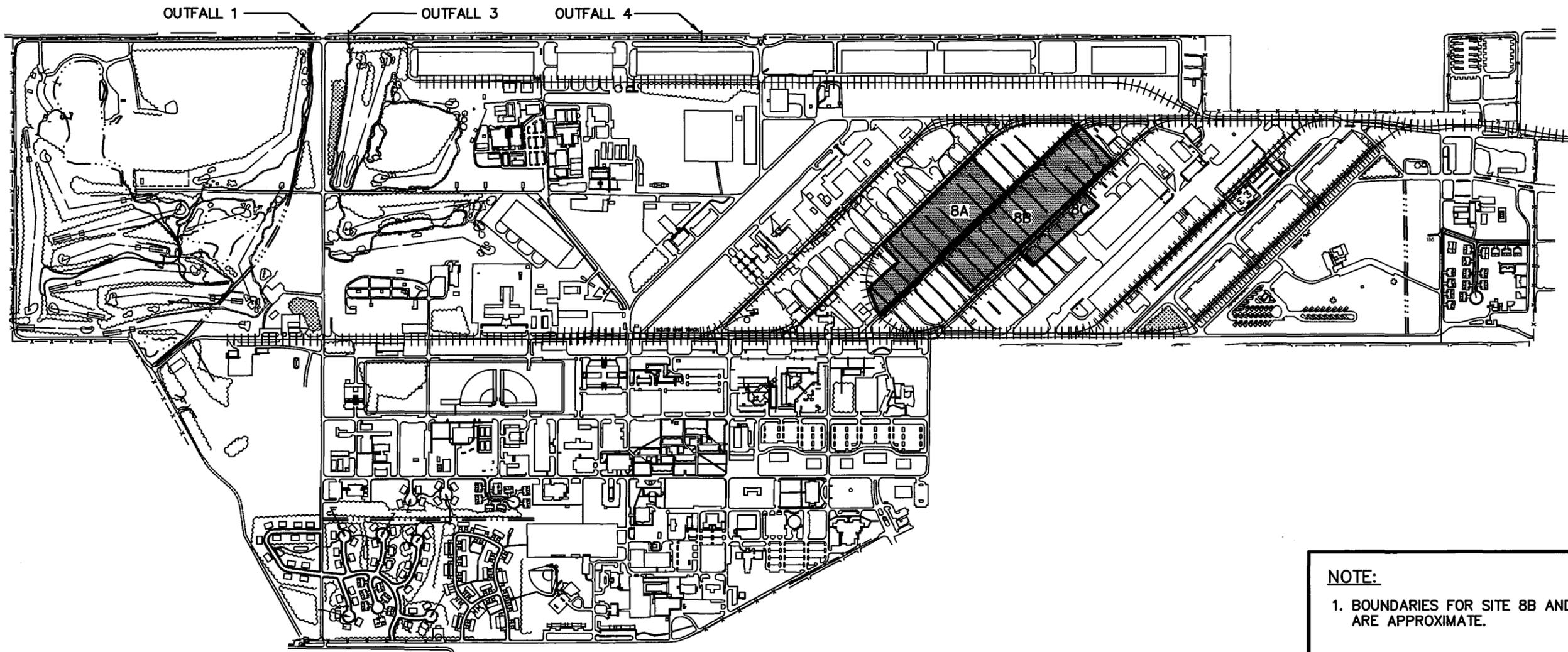


DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE NOT TO SCALE	

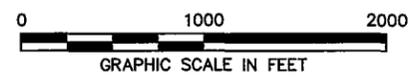


VICINITY MAP
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-1	REV. 0



NOTE:
 1. BOUNDARIES FOR SITE 8B AND SITE 8C ARE APPROXIMATE.



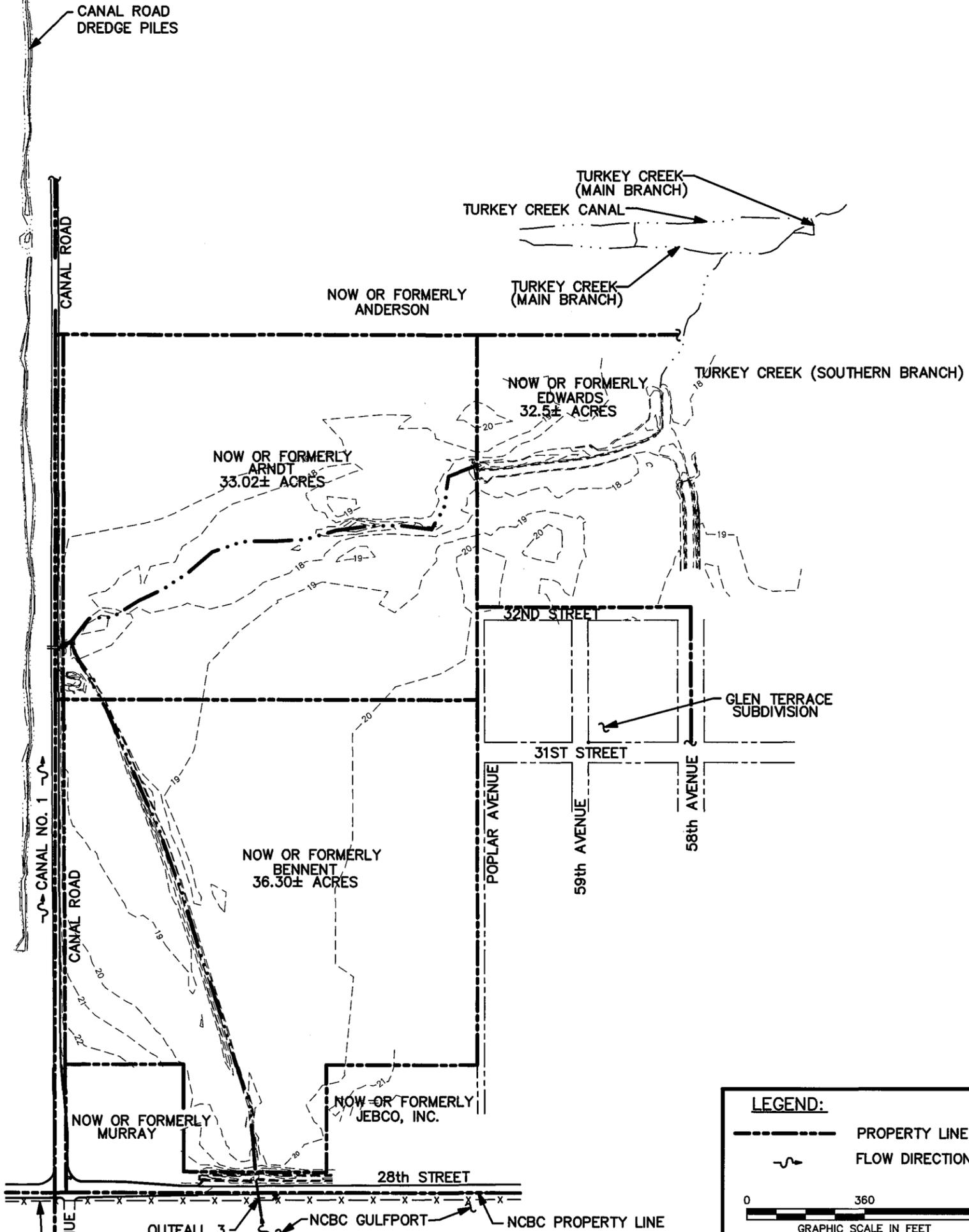
DRAWN BY	DATE
HJB	1/9/07
CHECKED BY	DATE
REVISD BY	DATE
SCALE AS NOTED	



INSTALLATION MAP
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-2	REV. 0

SOURCE: BASEMAP.DWG, PUBLIC WORKS DEPARTMENT, NAVAL CONSTRUCTION BATTALION CENTER, GULFPORT, MS, JUNE 2001



LEGEND:

----- PROPERTY LINE

~ FLOW DIRECTION

0 360 720
GRAPHIC SCALE IN FEET

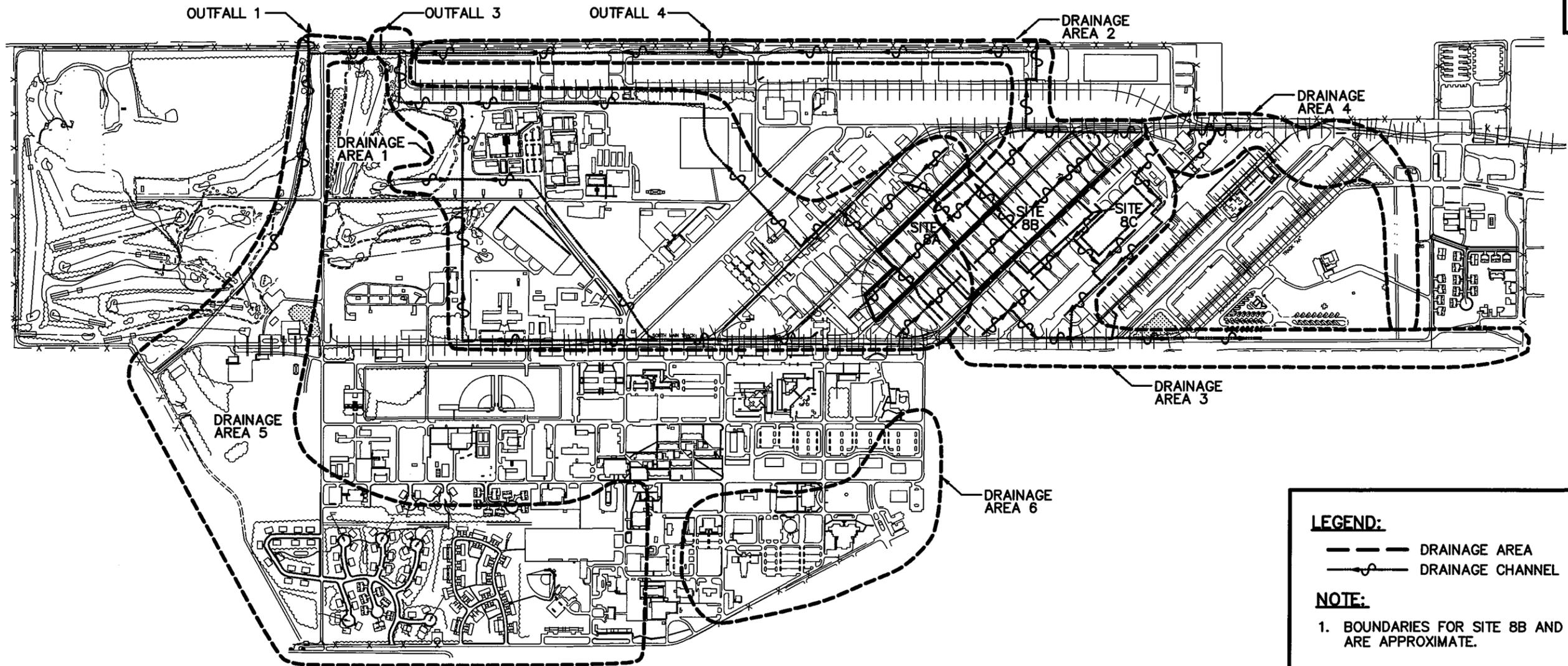
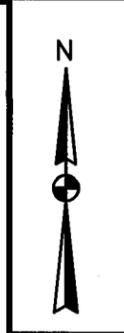
OUTFALL 1
COLBY AVENUE
CANAL NO. 1
CANAL ROAD

DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	



OFF-BASE AOC
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-3	REV. 0



LEGEND:

--- DRAINAGE AREA
 --- DRAINAGE CHANNEL

NOTE:

1. BOUNDARIES FOR SITE 8B AND SITE 8C ARE APPROXIMATE.

0 1000 2000
 GRAPHIC SCALE IN FEET

SOURCE: REMEDIATION PLANNING DOCUMENT, HARDING LAWSON ASSOCIATES, AUGUST 2000

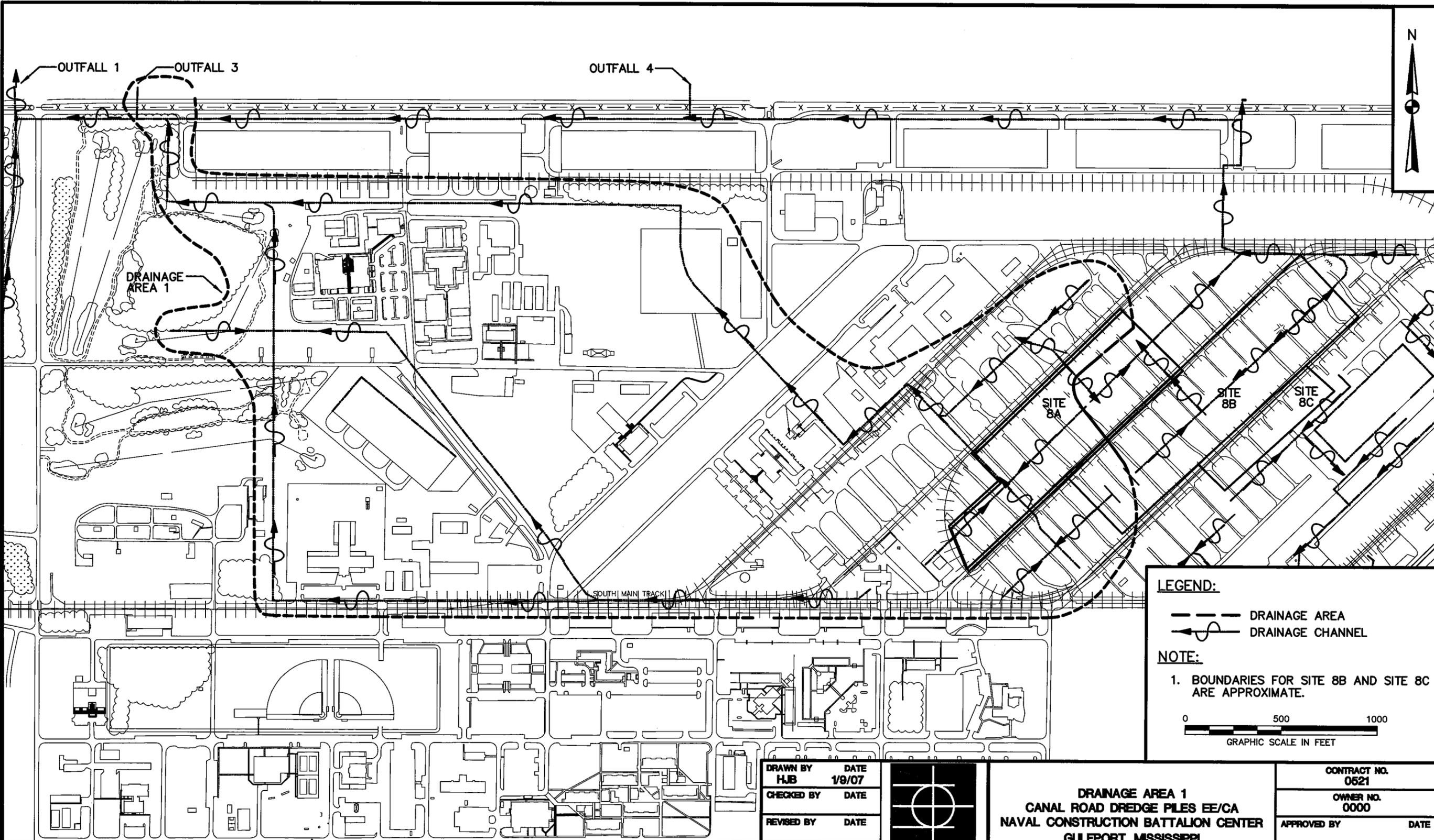
DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	



ON-BASE SURFACE WATER DRAINAGE
 AREAS 1 THROUGH 6
 CANAL ROAD DREDGE PILES EE/CA
 NAVAL CONSTRUCTION BATTALION CENTER
 GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-4	REV. 0

ACAD: 0521CP03.dwg 03/01/07 MF PIT

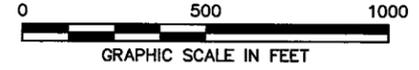


LEGEND:

- DRAINAGE AREA
- DRAINAGE CHANNEL

NOTE:

1. BOUNDARIES FOR SITE 8B AND SITE 8C ARE APPROXIMATE.



DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE

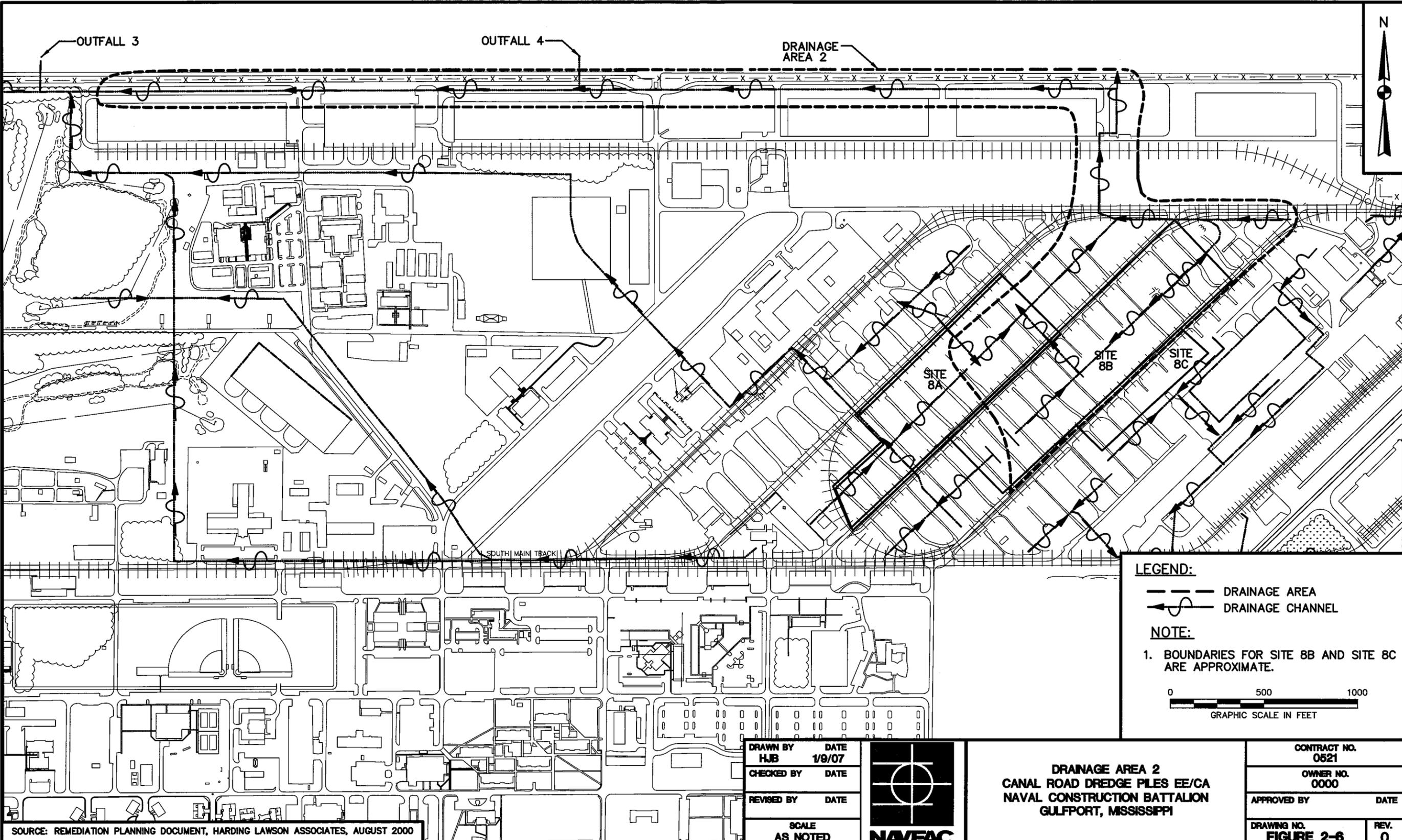


DRAINAGE AREA 1
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-5	REV. 0

SOURCE: REMEDIATION PLANNING DOCUMENT, HARDING LAWSON ASSOCIATES, AUGUST 2000

ACAD: 0521CP04.dwg 03/01/07 MF PIT



LEGEND:
 - - - DRAINAGE AREA
 - - -> DRAINAGE CHANNEL

NOTE:
 1. BOUNDARIES FOR SITE 8B AND SITE 8C ARE APPROXIMATE.

0 500 1000
 GRAPHIC SCALE IN FEET

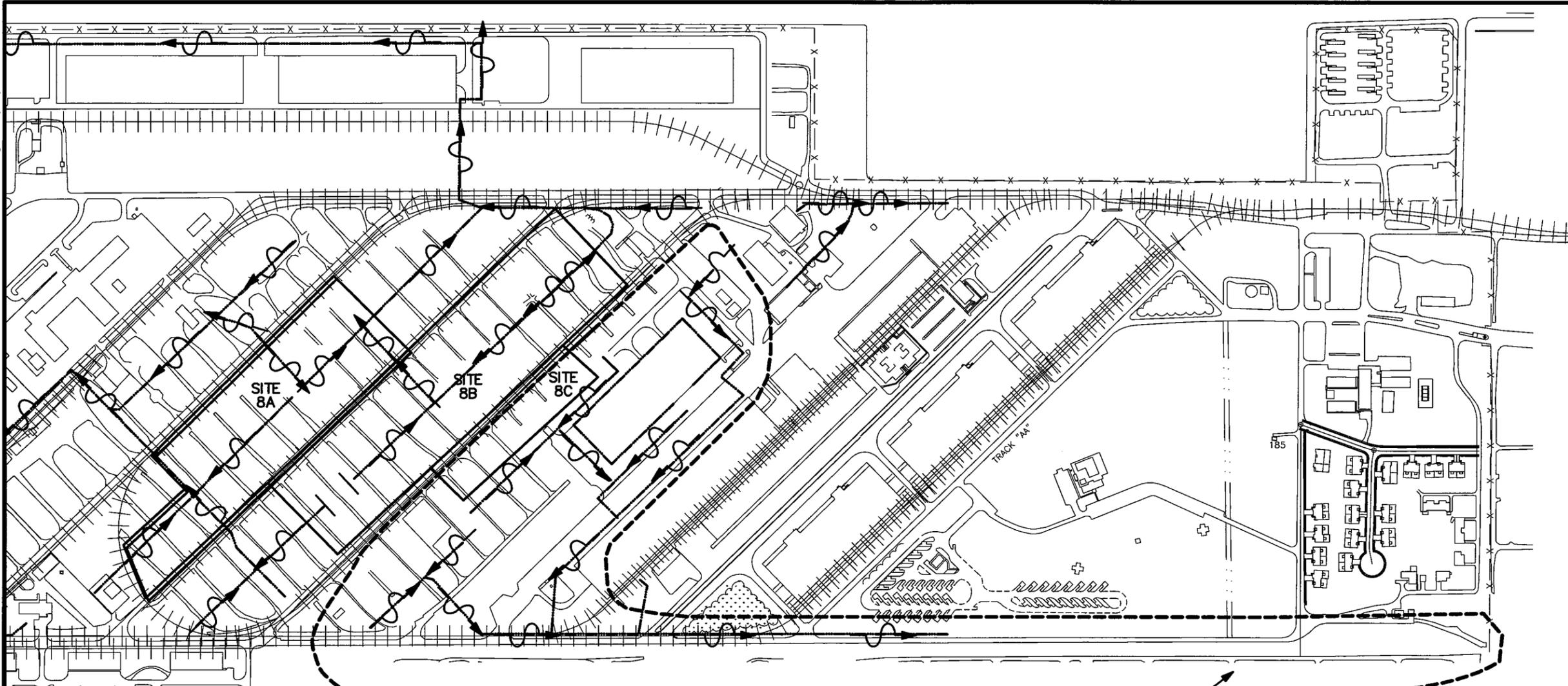
DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	



DRAINAGE AREA 2
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION
GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-6	REV. 0

SOURCE: REMEDIATION PLANNING DOCUMENT, HARDING LAWSON ASSOCIATES, AUGUST 2000



DRAINAGE AREA 3
OUTFALL 2 SOUTH

LEGEND:
 --- DRAINAGE AREA
 ← S WAVE DRAINAGE CHANNEL

NOTE:
 1. BOUNDARIES FOR SITE 8B AND SITE 8C ARE APPROXIMATE.

0 500 1000
 GRAPHIC SCALE IN FEET

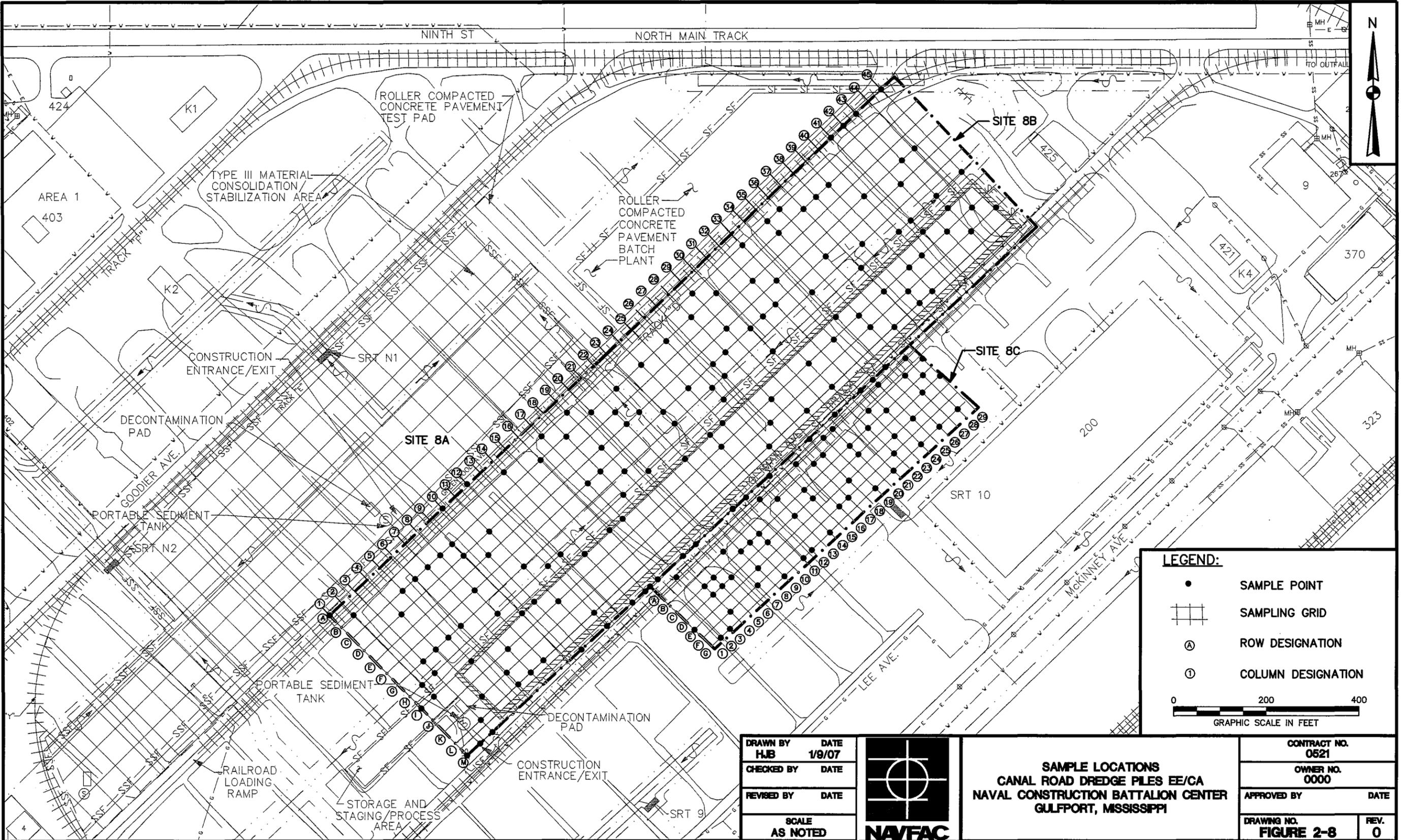
DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	



DRAINAGE AREA 3
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-7	REV. 0

SOURCE: REMEDIATION PLANNING DOCUMENT, HARDING LAWSON ASSOCIATES, AUGUST 2000



LEGEND:

- SAMPLE POINT
- ▣ SAMPLING GRID
- Ⓐ ROW DESIGNATION
- ① COLUMN DESIGNATION

0 200 400
GRAPHIC SCALE IN FEET

DRAWN BY HJB	DATE 1/9/07
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	



**SAMPLE LOCATIONS
CANAL ROAD DREDGE PILES EE/CA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI**

CONTRACT NO. 0521	
OWNER NO. 0000	
APPROVED BY	DATE
DRAWING NO. FIGURE 2-8	REV. 0

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

3.1 REMOVAL ACTION OBJECTIVES

Removal action objectives are based on the contaminated media, potential human health and environmental threats, and regulatory standards, requirements, and guidance. Based on previous investigations and human health and ecological risk assessments, the media of concern is Canal Road Dredge Piles sediment. The chemicals of concern (COCs) are dioxins.

The removal action objectives are as follows:

- Protect human health from the potential carcinogenic and noncarcinogenic risks associated with incidental ingestion of, inhalation of, and dermal contact with contaminated surface soil and sediment.
- Protect human health from the carcinogenic risks associated with ingestion of and dermal contact with on-site and off-site groundwater based on potential residential future use scenarios.
- Comply with federal and State regulations and guidance criteria in accordance with accepted USEPA and MDEQ guidelines.

3.2 REMOVAL ACTION SCOPE

Based on the Canal Road Dredge Pile delineation studies conducted during 2005 and 2006 and documented in the Site 8B and 8C Verification Sampling and Associated Drainage Systems Final Letter Report (TtNUS, 2006), approximately 6,500 yd³ of off-Base sediments (Canal Road Dredge Piles) have dioxin concentrations greater than the MDEQ Tier 1 soil/sediment TRG concentration of 4.26 ng/kg for unrestricted residential use. The contaminated off-Base sediments should be removed and stabilized at Site 8B and Site 8C.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED CRITERIA

Applicable or Relevant and Appropriate Requirements (ARARs) for this EE/CA are the federal and state environmental requirements used to define the appropriate extent of site cleanup, identify sensitive land areas or land uses, develop remedial action alternatives, and direct site remediation. CERCLA and the NCP require remedial actions to comply with state ARARs when they are more stringent than federal ARARs.

The NCP defines two ARAR components: (1) applicable requirements and (2) relevant and appropriate requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws specifically addressing a hazardous substance, pollutant, contaminant, remedial action, or other circumstances found at a CERCLA site. Applicable state standards are only those (1) identified by the state in a timely manner, (2) consistently enforced, and (3) more stringent than federal requirements.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, under federal and state environmental and facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the CERCLA site so their use is well suited to the particular site. Only those state standards (1) identified in a timely manner and (2) more stringent than federal requirements may be relevant and appropriate.

“Applicability” is a legal determination of jurisdiction of existing statutes and regulations, whereas “relevant and appropriate” is a site-specific determination of the appropriateness of existing statutes and regulations. Therefore, relevant and appropriate requirements allow flexibility not provided by applicable requirements in the final determination of cleanup levels. After a requirement is identified as an ARAR, the selected remedy must comply with or be waived from the ARAR, even if the ARAR is not required to assure protectiveness. Applicable requirements apply to both on- and off-site remedial actions.

To Be Considered (TBC) guidance criteria are federal and state non-promulgated advisories or guidance that are not legally binding and do not have the status of potential ARARs. However, if there are no specific ARARs for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment.

Under the description of ARARs set forth in the NCP and SARA, state and federal ARARs are categorized as follows:

- Chemical-Specific: Controlling the extent of site remediation with regard to specific contaminants and pollutants.
- Location-Specific: Governing site features such as wetlands, floodplains, and sensitive ecosystems (including features of historical significance).

- Action-Specific: Pertaining to the proposed site remedies and governing the implementation of the selected site remedy.

During the detailed evaluation of alternatives, each alternative will be analyzed to determine its compliance with ARARs. Chemical-, location-, and action-specific ARARs are presented in Table 3-1.

3.3.1 Land Disposal Restrictions

The Land Disposal Restriction (LDR) program included under the Resource Conservation and Recovery Act (RCRA) requires that hazardous wastes undergo physical or chemical changes to reduce the toxicity or mobility of the hazardous constituents so that the wastes pose less of a threat to groundwater, surface water, and air prior to disposal. Both listed and characteristic wastes must meet the LDR treatment standards before they are eligible for land disposal. The treatment standards for most characteristic hazardous wastes entail rendering the waste nonhazardous. However, some characteristic waste treatment standards have additional requirements for “underlying hazardous constituents” that may pose a threat and must therefore be treated to meet contaminant-specific levels referred to as universal treatment standards (UTSs). The “underlying hazardous constituent” is generally defined as any constituent listed that can reasonably be expected to be present at the point of generation of the hazardous waste at a concentration greater than the constituent-specific UTS. The nonwastewater UTS for tetrachlorodibenzo-p-dioxins (i.e., dioxin) contained in 40 Code of Federal Regulations (CFR) 268.48 is 1.0 microgram per kilogram ($\mu\text{g}/\text{kg}$) (1,000 ng/kg).

TABLE 3-1
ARARs AND TBC CRITERIA
CANAL ROAD DREDGE PILES EE/CA
NCBC GULFPORT, MISSISSIPPI
PAGE 1 OF 3

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
Federal			
USEPA Region III RBC Table	Provides RBCs for screening of soil and groundwater.	Relevant and appropriate. These guidelines aid in the screening of chemicals in soil and groundwater.	Chemical-specific
Safe Drinking Water Act MCLs (40 CFR 140-143)	Protective levels for groundwater that is current or potential drinking water sources.	Applicable if on-Base and off-Base groundwater were to be used for potable purposes in the future.	Chemical-specific
CERCLA and NCP Regulations (CFR, Section 300.430)	Discusses the types of PRSCs to be established at CERCLA sites.	Applicable. These requirements may be used as guidance in establishing appropriate PRSCs at Site 8.	Action-specific
OSHA (29 CFR Part 1910)	Requires establishment of programs to ensure worker health and safety at hazardous waste sites.	Applicable. These requirements apply to response activities conducted in accordance with the NCP. During the implementation of any remedial alternative, these regulations must be followed.	Action-specific
Hazardous Materials Transportation Act Regulations (49 CFR 171-179)	Provides requirements for packaging, labeling, manifesting, and transporting hazardous materials.	Applicable. If soil or sediment is excavated and transported and is found to be hazardous, the material would need to be handled, manifested, and transported as a hazardous waste.	Action-specific
National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61)	Standards promulgated under the Clean Air Act for significant sources of hazardous air pollutants.	Relevant and appropriate. Remedial action (e.g., soil excavation) may result in release of hazardous air pollutants.	Action-specific
RCRA Treatment, Storage, and Disposal of Hazardous Waste (40 CFR 262-266)	Regulates the treatment, storage, and disposal of hazardous waste.	Relevant and appropriate. Hazardous waste generated by site remediation must meet RCRA generator and treatment, storage, or disposal requirements.	Action-specific
LDRs (40 CFR Part 268)	Restricts certain listed or characteristic hazardous waste from placement or disposal on land without treatment.	Relevant and appropriate. Excavated soil and sediment or treatment residuals (e.g., spent granular activated carbon) may require disposal in a landfill.	Action-specific

TABLE 3-1

**ARARs AND TBC CRITERIA
CANAL ROAD DREDGE PILES EE/CA
NCBC GULFPORT, MISSISSIPPI
PAGE 2 OF 3**

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
Guidance on Demonstrating Compliance with Land Disposal Restrictions – Alternative Soil Treatment Standards (EPA 530-D-00-002)	Encourages the selection of cost-effective cleanup of hazardous/contaminated soils subject to LDRs.	Relevant and appropriate.	Guidance
Hazardous Waste Identification Rule for Contaminated Media (HWIR-Media) (40 CFR Part 260, et al.)	Relieves contaminated media of MTRs and would give USEPA and authorized states the authority to exempt certain contaminated media from regulation as hazardous waste under Subtitle C of RCRA.	Applicable. The dioxin concentrations in this removal are less than the “bright line” and have been exempted from the requirement for treatment prior to land disposal.	Chemical-specific
Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (EPA 540-R-93-057)	Provides guidance on aspects of the removal action process focusing on non-time critical removal actions with context on how these actions fit within the CERCLA program.	Applicable. These requirements were used as guidance in the preparation of this EE/CA.	Action-specific
State			
MDEQ TRGs (Mississippi Code Section 49-35-21)	Default screening levels. Human health risk-based cleanup goals for soil and groundwater.	Applicable. These regulations apply to all remedial actions in the State of Mississippi.	Chemical - specific
MDEQ Risk Evaluation Procedures for Voluntary Cleanup and Redevelopment	Risk-based procedures and rationale for site evaluation and remediation.	TBC. These regulations apply to all Voluntary Cleanup and Brownfield actions in the State of Mississippi.	Guidance
MDEQ Sample Strategy and Statistical Training Materials for Part 201 Cleanup Criteria	Provides for the appropriate use of statistically based site characterization and confirmation sampling.	Applicable.	Guidance
MDEQ Office of Pollution Control Hazardous Waste Management Regulations	Adopts by reference, specific sections of the federal hazardous waste regulations.	Relevant and appropriate. These regulations may apply if material is removed from the Base.	Action-specific

TABLE 3-1

**ARARs AND TBC CRITERIA
CANAL ROAD DREDGE PILES EE/CA
NCBC GULFPORT, MISSISSIPPI
PAGE 3 OF 3**

ARAR	Applicable or Relevant and Appropriate Requirement.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act.
CFR	Code of Federal Regulations.
EE/CA	Engineering Evaluation/Cost Analysis.
LDRs	Land Disposal Restrictions.
MCLs	Maximum Contaminant Levels.
MDEQ	Mississippi Department of Environmental Quality.
MTRs	Minimum Technological Requirements.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan.
OSHA	Occupational Safety and Health Administration.
PRSCs	Post-removal site controls.
RBC	Risk-Based Concentration.
RCRA	Resource Conservation and Recovery Act.
TBC	To Be Considered.
TRG	Target remediation goal.
USEPA	United States Environmental Protection Agency.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

4.1 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

Two removal action alternatives judged to meet the removal action objectives were identified for this removal action. The two alternatives involve traditional approaches to the type of environmental impact associated with the Canal Road Dredge Piles.

Excavation and off-site disposal of dioxin-contaminated material from the Canal Road Dredge Piles was developed as Alternative 1. Excavation of dioxin-contaminated material from the Canal Road Dredge Piles, and consolidation and stabilization of excavated dredge pile material within the limits of Site 8B and Site 8C was developed as Alternative 2. The two removal action alternatives are described below.

4.1.1 Alternative 1 – Excavation and Off-Site Disposal

The Canal Road Dredge Piles consist of approximately 6,500 yd³ of off-Base sediment with dioxin concentrations greater than the MDEQ Tier 1 soil/sediment TRG of 4.26 ng/kg for unrestricted residential use and must therefore be removed. The maximum dioxin concentration in the Canal Road Dredge Piles is more than an order of magnitude less than the UTS for dioxin of 1,000 ng/kg; treatment of Canal Road Dredge Pile material to meet the UTS is therefore not required. To protect human health and the environment, the Canal Road Dredge Pile material with dioxin concentrations greater than the 4.26 ng/kg criterion would be excavated and disposed at an approved and permitted off-site waste disposal facility.

Alternative 1 removes the source from the off-Base AOC thus eliminating potential risk to human and ecological receptors.

Under this alternative, contaminated material with dioxin concentrations greater than the 4.26 ng/kg criterion would be excavated from the Canal Road Dredge Piles located immediately west of Canal No. 1. Prior to excavating the dredge pile material, temporary erosion and sediment control features would be installed to prevent transport of sediment, and the excavation and contiguous area would be cleared of trees, brush, other vegetation, and debris. The excavated Canal Road Dredge Pile material would be transported and disposed off site at an approved and permitted off-site waste disposal facility. Transportation would be by either over the road haulers or by rail. Based on the sampling and topographic survey performed for the Canal Road Dredge Piles, approximately 8,900 yd³ of material would be excavated resulting in approximately 9,600 tons of dredge pile material for off-site disposal.

Following excavation of the dredge pile material, sampling would be performed at the base of the excavation to verify that dioxin concentrations are less than the MDEQ unrestricted Tier 1 TRG of 4.26 ng/kg. Samples would likely be subject to bio-assay analysis (USEPA Method 4025), with high resolution laboratory analysis (USEPA Method 8290) used to confirm the results. The excavated areas would then be backfilled with clean fill and graded to pre-dredge material placement elevations. The Canal Road Dredge Pile area would be covered with 6 inches of topsoil and revegetated with a permanent seed mixture to minimize erosion. The removal action activities would be completed in approximately 4 months.

Alternative 1 would not involve institutional controls or post-removal site controls (PRSCs) for the Canal Road Dredge Piles because the contaminated material would be removed and disposed off site.

Alternative 1 would be considered the application of the removal presumptive remedy. This alternative will be considered for further evaluation.

4.1.2 Alternative 2 – Excavation, Consolidation, and Stabilization

The Canal Road Dredge Piles consist of approximately 6,500 yd³ of off-Base sediment with dioxin concentrations greater than the MDEQ Tier 1 soil/sediment TRG of 4.26 ng/kg for unrestricted residential use and must therefore be removed. The maximum dioxin concentration in the Canal Road Dredge Piles is more than an order of magnitude less than the UTS for dioxin of 1,000 ng/kg; treatment of Canal Road Dredge Pile material to meet the UTS is therefore not required. To protect human health and the environment, the Canal Road Dredge Pile material would be placed and stabilized within the limits of Site 8B and Site 8C.

Alternative 2 removes the source from the off-Base AOC thus eliminating potential risk to human and ecological receptors in an area zoned for residential use. Further, Alternative 2 consolidates and stabilizes this material at the original site on-Base, where industrial land use and PRSCs will prevent unacceptable residential exposure scenarios.

Similar to Alternative 1, contaminated material with dioxin concentrations greater than the 4.26 ng/kg criterion would be excavated from the Canal Road Dredge Piles located immediately west of Canal No. 1. Prior to excavating the dredge pile material, temporary erosion and sediment control features would be installed to prevent transport of sediment, and the excavation and contiguous area would be cleared of trees, brush, other vegetation, and debris. For Alternative 2, the excavated Canal Road Dredge Pile material would be placed on Site 8B and Site 8C, consolidated (i.e., blended) with contaminated Site 8B and Site 8C soil, and chemically stabilized in place using Portland cement or another stabilizing agent. Based on the sampling and topographic survey performed for the Canal Road Dredge Piles

approximately 8,900 yd³ of material would be excavated. Based on the area, depth of contamination, removal actions to date, and assuming an average of 1 foot of contaminated material over the 16.6-acre Site 8B and 3.4-acre Site 8C areas, 32,300 yd³ of Site 8B and Site 8C material would be stabilized. The total stabilized material volume at Site 8B and Site 8C would be approximately 41,200 yd³.

Following excavation of the dredge piles, sampling would be performed at the base of the excavation to verify that dioxin concentrations are less than the MDEQ unrestricted Tier 1 TRG of 4.26 ng/kg. Samples will be subject to high resolution laboratory analysis (USEPA Method 8290) to confirm the results. The dredge pile excavation area would then be backfilled with clean fill and graded to pre-dredge material placement elevations. The Canal Road Dredge Pile area would be covered with 6 inches of topsoil and revegetated with a permanent seed mixture to minimize erosion. The stabilized dioxin-contaminated material would be graded to preclude ponding of stormwater. The drainage channels within the Site 8B and Site 8C limits would primarily be restored with a geotextile separation layer and riprap to minimize erosion in the channels. The remainder of the drainage channels would be restored using topsoil and a permanent seed mixture to minimize erosion. The removal action activities would be completed in approximately 4 months.

With Alternative 2, the consolidated and stabilized material at Site 8B and Site 8C will be used as a hardstand surface storage area. With contaminant levels at Site 8B (11.07 ng/kg) and Site 8C (16.08 ng/kg) below the industrial standard of 38 ng/kg, industrial activities, such as surface storage, are permitted with the following PRSCs:

- No residential (temporary or permanent) occupation of structures would be allowed.
- No development of groundwater for any purpose would be permitted.
- Sediment recovery traps (SRTs) at each (3) of the locations where channelized surface water exits Site 8B and Site 8C would be installed.
- A sediment monitoring program: consisting of a baseline event, followed by monitoring events every six months for the first 2 years and annually thereafter would be implemented. Sediment samples would be collected from upgradient and downgradient locations at each of the SRTs. For consistency and comparability, the locations would be marked and revisited during each sampling event.
- Every 5 years, the status of the site would be formally reviewed and evaluated to determine the continued effectiveness of this alternative.

While Alternative 2 may be upgraded with a surfacing action in the future, the contaminant levels in the soil at Site 8B and Site 8C, as well as the Canal Road dredge piles (20.43 ng/kg), are less than the TRG for industrial use and therefore do not pose unacceptable risk for industrial use activities. Appendix A contains the source data for the statistical evaluation of soil contamination levels presented above.

4.2 EVALUATION OF REMOVAL ACTION ALTERNATIVES

In accordance with USEPA's Guidance on Conducting Non-Time Critical Removal Action Under CERCLA (1993), each retained alternative is evaluated with respect to effectiveness, implementability, and cost as follows:

- Effectiveness of the alternatives is evaluated in terms of overall protection of public health and the environment and ability to achieve removal action objectives. Protectiveness of public health and the environment is evaluated in terms of protection of public health and the community, protection of workers during implementation, protection of the environment, and compliance with ARARs. The ability to achieve removal action objectives is evaluated in terms of expected level of containment, residual effects, and ability to maintain long-term control.
- Implementability of the alternatives is evaluated based on technical feasibility, availability, and administrative feasibility. Technical feasibility is evaluated in terms of construction and operational considerations, demonstrated performance and useful life, adaptability to environmental conditions, contribution to remedial performance, and ability to be implemented within 1 year. Availability is evaluated in terms of equipment, personnel and services, outside laboratory testing capacity, off-site treatment and disposal capacity, and PRSCs. Administrative feasibility is evaluated in terms of permits required, easements or right-of-ways required, impact on adjoining property, ability to impose institutional controls, and likelihood of obtaining exemptions from statutory limitations (if needed).
- Cost of the alternatives is evaluated by considering the capital cost, PRSC cost, and net present value (NPV).

Retained Alternatives 1 and 2 are evaluated below.

4.2.1 Alternative 1 – Excavation and Off-Site Disposal

4.2.1.1 Effectiveness

Long-term risk to human health and the environment is effectively eliminated at the Canal Road Dredge Pile area by excavation and off-site disposal of dioxin-contaminated material. However, this alternative does not satisfy the regulatory preferences for on-site treatment over off-site disposal.

Short-term risk to human health and the environment would be effectively addressed by use of engineering controls. Engineering controls would consist of controlling fugitive emissions during excavation, load-out, and transport of contaminated material; controlling off-site transport of contaminated material and clean material through use of equipment tracking pads and decontamination pads; and use of silt fence and SRTs to control migration of water-borne contaminated sediment during removal action implementation.

Monitoring is an effective tool used to evaluate potential migration of contaminants and to determine the direction of future actions if adverse effects to human or ecological receptors occur. Sediment, surface water, and groundwater sampling is ongoing and will continue on a periodic basis. Monitoring would be conducted during the removal action to minimize adverse effects to human health and the environment.

This alternative achieves removal action objectives by protecting human health and the environment from risks associated with ingestion, inhalation, or contact with the contaminated material.

4.2.1.2 Implementability

Excavation of contaminated material is performed extensively for site remediations and is applicable to almost all site conditions. The Canal Road Dredge Pile excavation area would be readily accessible by tracked and off-road heavy-construction equipment following removal of trees, brush, vegetation, and debris. The depth of excavation would range from surficial to up to 10 feet below ground surface (bgs). The depth to groundwater, under normal conditions, would be below the anticipated base of the excavation.

Permits and temporary easements or right-of-ways would be required for access to, and work within, the Canal Road Dredge Pile area. The property is privately owned, and access to and from the work area would likely require construction of a crossing over Canal No. 1 and a temporary road entrance onto Canal Road near Turkey Creek. Transport equipment would also travel on public roadways (i.e. Canal Road and 28th Street).

4.2.1.3 Cost

Excavation and off-site disposal capital costs are estimated to be approximately \$8.0 million. A detailed cost estimate is provided in Appendix C.

4.2.2 Alternative 2 – Excavation, Consolidation, and Stabilization

4.2.2.1 Effectiveness

Long-term risk to human health and the environment is effectively eliminated at the Canal Road Dredge Pile area by excavation and consolidation of the contaminated material within the limits of Site 8B and Site 8C. Long-term risk to human health and the environment is effectively eliminated at Site 8B and Site 8C by chemically stabilizing (i.e., treating) the contaminated material. Chemical stabilization would reduce the mobility and prevent migration of dioxin-contaminated material. Chemical stabilization would also be effective in reducing contaminant migration by erosion. Based on the contaminant concentrations, soil type, and contaminated material volume, on-site treatment would be effective as evidenced by implementation of the same technology at Site 8A. The alternative satisfies regulatory preferences of on-site (i.e., within the limits of Site 8B and Site 8C) treatment over off-site disposal. The long-term effectiveness would be assured provided PRSCs are maintained.

Short-term risk to human health and the environment would be effectively addressed by use of engineering controls. Engineering controls would consist of controlling fugitive emissions during excavation, transport, grading, blending, and stabilization of contaminated material; controlling off-site transport of contaminated material and clean material through use of equipment tracking pads and decontamination pads; and use of silt fence and SRTs to control migration of water-borne contaminated sediment during removal action implementation.

Institutional controls (i.e., PRSCs) would be effective in preventing unacceptable risk by preventing exposure of human receptors to contaminated soil, sediment, surface water, and groundwater in an industrial scenario. After completion of the chemical stabilization at Site 8B and 8C, the Base Master Plan should be revised to allow the use of the site for industrial activities and indicate the PRSCs. The PRSCs will remain in place for Site 8B and Site 8C. Legal requirements for property transfer would need to be met in the event of Base closure.

Monitoring is an effective tool used to evaluate potential migration of contaminants and to determine the direction of future actions if adverse effects to human or ecological receptors occur. Sediment sampling will be conducted on a periodic basis until the site is resurfaced or a petition to end the monitoring

program is accepted by MDEQ. Monitoring will be conducted during the removal action to minimize adverse effects to human health and the environment.

The alternative achieves removal action objectives by protecting human health and the environment from risks associated with ingestion, inhalation, or contact with the contaminated material for the industrial scenario. The contaminated material would be consolidated in an area of the Base where residential future use would not occur and restrictions have been placed on land and associated groundwater use.

4.2.2.2 Implementability

Excavation of contaminated material is performed extensively for site remediations and is applicable to almost all site conditions. The Canal Road Dredge Pile excavation area would be readily accessible by tracked and off-road heavy-construction equipment following removal of trees, brush, vegetation, and debris. The depth of excavation would range from surficial to up to 10 feet bgs. The depth to groundwater, under normal conditions, would be below the anticipated base of the excavation.

For Site 8B and Site 8C, grading, blending, consolidation, stabilization, and compaction of contaminated materials would be performed using both common and specialty heavy-construction equipment. The specialty equipment would consist of self-propelled mixing equipment for soil stabilization. Site 8B and Site 8C are large, flat, and within the Base and would therefore not pose any restrictions on implementability.

Permits and temporary easements or right-of-ways would be required for access to, and work within, the Canal Road Dredge Pile area. The property is privately owned, and access to and from the work area would likely require construction of a crossing over Canal No. 1 and a temporary road entrance onto Canal Road near Turkey Creek. Transport equipment would also travel on public roadways (i.e. Canal Road and 28th Street).

4.2.2.3 Cost

Excavation, consolidation, and stabilization capital costs and PRSC associated with sediment monitoring up- and downstream of SRTs is estimated to be approximately \$3.5 million. A detailed cost estimate is provided in Appendix C.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section compares the evaluations presented for Alternatives 1 and 2 in Section 4.0.

5.1 EFFECTIVENESS

Alternative 1 would be the most protective alternative because the dioxin-contaminated Canal Road Dredge Pile material would be removed from the off-Base AOC and sent to an approved and permitted off-site waste disposal facility. Alternative 2 would also be protective because the dioxin-contaminated Canal Road Dredge Pile material would be removed from the off-Base AOC. Stabilization of the Canal Road Dredge Pile material within the limits of Site 8B and Site 8C would also increase the level of protection for human health and the environment at Site 8B and Site 8C. Stabilization would reduce the mobility and prevent migration of dioxin-contaminated soil and sediment to unrestricted residential use areas (i.e., the off-Base AOC). The filling and stabilization activities at Site 8B and Site 8C would provide the additional benefits of providing the final repository for the treated Canal Road Dredge Pile material, restoring the surface of Site 8B and Site 8C to pre-remediation grades, improving surface water drainage, reducing stormwater infiltration, and creating a durable surface.

Alternative 1 would comply with chemical-, location-, and action-specific ARARs and TBCs because the contaminated material would be removed from the off-Base AOC. Alternative 2 would not comply with chemical-specific ARARs and TBCs due to the presence of dioxin at Site 8B and Site 8C. It would comply with location- and action-specific ARARs and TBCs.

Alternative 2 would remove the contaminated Canal Road Dredge Piles from their present location and effectively chemically stabilize them on Site 8B and Site 8C, thereby reducing the risk of exposure to dioxin. Alternative 1 would be more long-term effective and permanent than Alternative 2 because it would remove the contaminated Canal Road Dredge Pile material from the site. Alternative 2 would be effective as long as the PRSCs are implemented and maintained.

Alternative 1 would not achieve a reduction in toxicity of dioxin-contaminated media through treatment because no treatment is proposed. Alternative 2 would achieve a reduction in toxicity of dioxin-contaminated media through treatment and would achieve a reduction in mobility through treatment.

Implementation of Alternatives 1 and 2 would potentially expose construction workers and residents to dioxin contamination during removal action activities. However, the risk of exposure would be effectively controlled by implementing engineering controls (e.g., fugitive dust suppression) and compliance with applicable Occupational Safety and Health Administration (OSHA) regulations and proper site-specific

health and safety procedures. Implementation of Alternatives 1 and 2 would potentially impact the surrounding community because the dioxin-contaminated material from the Canal Road Dredge Piles would be transported over public roads. The impacts would be effectively controlled by measures such as decontaminating transportation vehicles, covering transportation vehicle loads, providing traffic control, selecting a travel route that minimizes potential exposure, and implementing a spill prevention and emergency response plan. Alternative 1 would attain the removal action objectives immediately upon removal of the contaminated material. Alternative 2 would attain the removal action objectives in the Canal Road area immediately upon removal of the contaminated material and at Site 8B and Site 8C immediately after stabilization of the contaminated material.

5.2 IMPLEMENTABILITY

The technical implementability of Alternative 1 would be slightly difficult because it would require the excavation, load-out, and transport of contaminated dredge pile material to an approved and permitted off-site waste disposal facility. The technical implementability of Alternative 2 would be moderately difficult because it would require the excavation of contaminated dredge pile material and the consolidation and chemical stabilization of this material within the Site 8B and Site 8C limits. However, the activities associated with Alternative 2 would be technically implementable and their effectiveness was proven through pilot- and full-scale activities performed at Site 8A. Material, equipment, and labor are readily available to perform the tasks associated with Alternatives 1 and 2.

Administratively, Alternative 1 would not require any PRSCs because the dioxin-contaminated Canal Road Dredge Pile material would be removed from the off-Base AOC and sent to an approved and permitted off-site waste disposal facility. Alternative 1 would require access agreements for the excavation, load-out, and transport of the off-Base AOC dredge pile material.

Administratively, Alternative 2 would not require any additional PRSCs because PRSCs have been in place since the end of the soil incineration project in 1986. The completion of the chemical stabilization would allow the resumption of surface storage at Site 8B and Site 8C which is a significant component of the war material storage and transfer mission at NCBC Gulfport. Alternative 2 would also require access agreements for the excavation, load-out, and transport of the off-Base AOC dredge pile material. Long-term monitoring and 5-year site reviews would continue to be performed.

5.3 COST

Capital cost for the alternatives is summarized below:

Alternative	Capital Cost (\$)	PRSC (\$) ⁽¹⁾	Total Cost (\$)
1	8,000,000	0	8,000,000
2	3,300,000	200,000	3,500,000

(1) Additional PRSC not currently included in long-term monitoring program.

The detailed cost estimates for Alternatives 1 and 2 are provided in Appendix C.

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Alternative 2 – Excavation, Consolidation, and Stabilization is recommended for the Canal Road Dredge Piles. Upon completion of this alternative, potential risks to human health and the environment would be significantly reduced. In addition, the completion of the chemical stabilization would allow the resumption of surface storage at Site 8B and Site 8C which is a significant component of the war material storage and transfer mission at NCBC Gulfport.

In accordance with 40 CFR 300.415(n) and 300.820, the local community will be kept informed about the EE/CA process using procedures described in the Community Relations Plan. A copy of the final EE/CA will be placed both in the Information Repository and the Administrative Record at the Environmental Office at NCBC. The original Administrative Record was destroyed along with the main branch of the Harrison County library during Hurricane Katrina in 2005. A newspaper notice will be published announcing both the availability of the EE/CA for review and a 30-day public comment period. Following the comment period, written responses to comments will be provided in the Administrative Record.

REFERENCES

HLA (Harding Lawson Associates), 2000. Remediation Planning Document, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

MDEQ (Mississippi Department of Environmental Quality), 1997. Agreed Order No. 3466-97. November.
TtNUS (Tetra Tech NUS, Inc.), 2001. Report for Pilot-Scale Soil/Sediment Treatability Study, Site 8, Herbicide Orange Storage Area at Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for SOUTHDIVNAVFACENCOM, North Charleston, South Carolina. December.

TtNUS (Tetra Tech NUS, Inc.), 2003. Focused Feasibility Study, Site 8, Herbicide Orange Storage Area at Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for SOUTHDIVNAVFACENCOM, North Charleston, South Carolina. March 24 (Revision 2).

TtNUS, 2005. Site Investigation Report for Canal Road, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for SOUTHDIVNAVFACENCOM, North Charleston, South Carolina. November.

TtNUS, 2006. Final Letter Report, Site 8B and 8C Verification Sampling and Associated Drainage Systems, ECC, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Naval Facilities Engineering Command, Southeast, North Charleston, South Carolina. September.

USEPA (United States Environmental Protection Agency), 1993. Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (EPA/540-R-93-057), August.

APPENDIX A

SUMMARY OF SITE 8 HISTORICAL INFORMATION

ACRONYM LIST

2,4-D	2,4-Dichlorophenoxyacetic acid
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
ABB-ES	ABB Environmental Services, Inc.
AFESC	Air Force Engineering and Service Center
AOC	Area of Contamination
bgs	Below ground surface
CCI	CH2MHill Constructors, Inc.
COPC	Chemical of potential concern
EE/CA	Engineering Evaluation/Cost Analysis
FFS	Focused Feasibility Study
HLA	Harding Lawson Associates
HO	Herbicide orange
MCL	Maximum Contaminant Level
MDEQ	Mississippi Department of Environmental Quality
NCBC	Naval Construction Battalion Center
ng/kg	Nanogram per kilogram
PCB	Polychlorinated biphenyl
pg/L	Picograms per liter
RBC	Risk-Based Concentration
RME	Reasonable maximum exposure
SRT	Sediment recovery trap
SVOC	Semivolatile organic compound
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ	Toxicity equivalent
TPH	Total petroleum hydrocarbons
TRG	Target remediation goal
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper confidence limit
µg/kg	Microgram per kilogram
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
yd ³	Cubic yards

Site History

Prior to 1968, the Site 8 – Herbicide Orange Storage Area (Site 8) was used as an equipment storage and staging area. Around 1961, site surface soils were stabilized with Portland cement to provide a hardened surface for heavy equipment operation and storage. Between 1968 and 1977, Site 8 was used by the United States Air Force (USAF) as a storage area for drums containing Herbicide Orange (HO), which is a herbicide formulation used during the Vietnam War to defoliate trees and shrubbery. It is an equal mixture of two agricultural herbicides [2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)] in a diesel or jet fuel mixture. Spills and leaks of HO occurred within Site 8, contaminating surface soil and sediment with the mixture components, 2,4,5-T and 2,4-D, as well as byproduct contaminants (dioxins and furans), primarily 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Concentrations of 2,4,5-T and 2,4-D have degraded over time; however, dioxin and furan concentrations have remained at concentrations greater than regulatory limits. Throughout this Appendix, TCDD and its chemically related dioxin and furan congeners are collectively referred to as “dioxins.” In 1977, the HO drums were removed from Site 8, transported to port by railroad, and placed on a ship for destruction by incineration in the South Pacific. The release of dioxins at Site 8 was confirmed in 1977, and the site was fenced and left inactive until 1985 [Tetra Tech NUS, Inc. (TtNUS), 2003b]. It was originally believed that 13 acres of Site 8 were used to store approximately 850,000 gallons of HO. This 13-acre area is currently referred to as Site 8A [Harding Lawson Associates (HLA), 2000a].

Previous Removal Actions

In 1985, the USAF began operations to clean up the dioxin-contaminated soils that remained on site following the removal of drums of HO. The contamination of soils resulted from spills and leaks during the 10 years that HO was stored at Site 8. Through a Research, Development and Demonstration permit obtained through the United States Environmental Protection Agency (USEPA) Region IV, the USAF conducted test burns to demonstrate that incineration was capable of reducing dioxin concentrations in site soils to less than the USEPA criterion (as of 1985) of 1.0 microgram per kilogram ($\mu\text{g}/\text{kg}$). During the test burns, two additional areas outside the original 13 acres were identified and verified as previous storage locations for drums containing HO. These two areas were designated Site 8B and Site 8C. Following USEPA acceptance of the test burn data, full-scale incineration of dioxin-contaminated soils from Site 8A, Site 8B, and Site 8C was conducted. The incineration process was conducted within the boundaries of Site 8A and was completed in 1988. The ash that remained from the incineration process was stored on Site 8A. Although the soils within Site 8A, Site 8B, and Site 8C were incinerated, the drainage channels that carried surface water and sediment from Site 8 to the lower reaches of the local drainage basin were not addressed during this remedial effort (HLA, 2000a).

Between 1987 and January 2001, access to Site 8A was restricted and operations were not conducted within site boundaries. Between January 2001 and 2003, activities conducted within Site 8 included the construction of a new loading ramp in anticipation of using the site as a storage and staging area (TtNUS, 2003b) and performance of a pilot-scale treatability study for remediating soil ash and contaminated on-Base and off-Base Area of Contamination (AOC) (Edwards property) sediments (TtNUS, 2001).

In July 1995, the Navy performed a time-critical removal action of sediments and surface soil from the ditches along the northern boundary of the Base at Outfalls 1, 3, and 4. Approximately 287 cubic yards (yd³) of sediments and surface soil were excavated from the three outfalls. The Outfall 1 excavation extended from the headwall on the northern side of 28th Street approximately 100 feet north. Approximately 114 yd³ of sediments were excavated from Canal No. 1 (i.e., Outfall 1). The excavated sediments and surface soil were transported to Site 8A [ABB Environmental Services, Inc. (ABB-ES), 1995e and ABB-ES, 1997a].

As part of pilot-scale treatability study activities in November and December 2001, dioxin-contaminated sediment located within the off-Base AOC was excavated and transported to Site 8A. Approximately 1,030 yd³ of material located on property owned by Mr. H. A. Edwards (the Edwards property) were excavated. A sediment recovery trap (SRT) was installed at the western extent of the excavation to prevent recontamination of this area from upgradient sources. Verification sampling at the remediated Edwards property determined that the 95 percent upper confidence limit (UCL) of the mean dioxin concentration [total toxicity equivalents (TEQs) of TCDD] was less than the Mississippi Department of Environmental Quality (MDEQ) unrestricted Tier 1 target remediation goal (TRG) of 4.26 nanograms per kilogram (ng/kg) (TtNUS, 2002).

In August 2002, the Navy performed a sediment removal action in the Site 8B and Site 8C drainage channels. Approximately 2,600 yd³ of sediments were excavated from 3,800 linear feet of drainage channels and were transported to Site 8A [CH2MHill Constructors Inc. (CCI), 2003].

In April 2003, 30 yd³ of dioxin-contaminated sediment were excavated from an area adjacent to a culvert located beneath Canal Road, and an SRT was installed at the eastern extent of the excavation. The excavation was conducted to enable the City of Gulfport to perform a culvert replacement project (TtNUS, 2003c).

Remedial activities were performed at Site 8 and contiguous on-Base drainage channels and the Arndt and Bennett property portions of the associated off-Base AOC from 2004 through 2006 to remove dioxin-contaminated materials. The remedial alternative was identified and selected in the Focused Feasibility Study (FFS) for Site 8 (TtNUS, 2003b), and subsequent remedial design was presented in the 100%

Remedial Design for Site 8 and the off-Base AOC (TtNUS, 2004). The remedial activities included excavation of approximately 16,417 yd³ of contaminated sediment from on-Base drainage channels outside of Site 8 and 27,725 yd³ of contaminated material located on property owned by Mr. G. D. Arndt (the Arndt property) and Mr. P. W. Bennett (the Bennett property). The excavated materials, 23,068 yd³ of soil ash resulting from the incineration process completed in 1988, 287 yd³ of contaminated sediment and surface soil excavated from Outfalls 1, 3, and 4 during 1995, 1,030 yd³ of contaminated sediment excavated from the Edwards property during 2001 and 2003, 2,600 yd³ of contaminated sediment excavated from the Site 8B and Site 8C drainage channels during 2002, and 1,198 yd³ of Site 8A drainage channel sediment, were stabilized using Portland cement within the limits of Site 8A. Additional remedial activities consisted of the following:

- Consolidation, homogenization, and stabilization of the soil ash and contaminated sediment within Site 8A.
- Construction of an RCC cover over the stabilized material.
- Performance of verification sampling of excavation areas.
- Restoration of the on-Base drainage channels and off-Base AOC areas affected by excavation activities.
- Implementation of land use controls.
- Performance of long-term monitoring.

Previous Investigations

Dioxin-related investigations at Site 8 have been conducted since 1977 to determine the nature and extent of contamination and also to verify removal of contaminated material.

Delineation Investigations

Delineation investigations included the Initial HO Monitoring Programs (1977 to 1984), Comprehensive Soil Characterization and Confirmation Studies (1984 to 1988), Dioxin Delineation Studies (1995 to 1999), and Site Characterization Report for the off-Base AOC (2002). The information source regarding these investigations is the FFS (TtNUS, 2003b). A summary of each investigation is provided below.

Initial HO Monitoring Programs (1977 to 1984) - Conducted by the USAF Occupational and Environmental Health Laboratory as part of the plan to incinerate all remaining HO stockpiles at sea [Air Force Engineering and Service Center (AFESC), 1998]. These programs focused on the following issues:

- Off-site migration of dioxin
- Migration levels of 2,4-D, 2,4,5-T, and dioxins at Site 8
- Long-term degradation potential of 2,4-D, 2,4,5-T, and dioxins
- Potential vertical migration

These studies included collection of soil, surface water, sediment, and biota samples for analysis using the best method available at that time (currently referred to as a low-resolution method). The findings were as follows:

- Confirmation that Site 8A was contaminated with HO and TCDD.
- 2,4-D and 2,4,5-T concentrations in soil were rapidly decreasing (a reported 60-percent reduction over a 6-month period in 1981 and 1982).
- TCDD concentrations remained relatively consistent over time, suggesting significant persistence in the environment.
- TCDD was not detected in surface water.
- Low concentrations (less than 50 ng/kg) of TCDD were detected in sediment and biota samples downstream of Site 8A.
- Migration of dioxin from Site 8 occurs primarily through soil erosion.

Comprehensive Soil Characterization and Confirmation Studies (1984 to 1988) - Conducted by EG&G Idaho, Inc. and AFESC to delineate the horizontal and vertical extent of HO and dioxin at Site 8 and to provide an estimate of contaminated soil potentially requiring remediation (AFESC, 1998).

Approximately 2,500 samples were collected and analyzed using a grid sampling approach with a 20-foot node spacing. The major findings of these studies were as follows:

- Concentrations of TCDD greater than 1 µg/kg in soil were restricted to 2 feet in depth.

- Soil samples contained a maximum TCDD concentration of 310 µg/kg.
- Portland cement-stabilized soil contained TCDD concentrations up to 1,000 µg/kg.
- Assuming an action level of 1.0 µg/kg for TCDD, approximately 27,000 yd³ of soil had TCDD concentrations greater than action levels at Site 8 in 1987.
- Analysis of confirmation samples collected from excavated areas and analysis of ash resulting from the incineration process showed that residual concentrations of dioxins were less than 4.7 µg/kg.

Dioxin Delineation Studies (1995 to 1999) - A series of studies (Phases I through VI) conducted to assess remaining dioxin-contaminated soil and sediment (ABB-ES, 1998; HLA 1998, 1999a, and 2000b). These studies included the following:

- Delineation and characterization of dioxin in on-Base soil and sediment.
- Delineation and characterization of dioxin in off-Base soil and sediment. Included in the off-Base studies were several phases of additional delineation activities north of Outfall 3 in an area known then as the Outfall 3 Swamp and referred to in this Appendix as the off-Base AOC.
- Examination of potential impacts to groundwater at Site 8. It was shown that dioxin contamination at Site 8 was restricted to a shallow zone of soil and that it was not migrating to groundwater.
- Performance of baseline human health and ecological risk assessments.

In addition to these studies, interim corrective measures at the Base were completed including the construction of two new SRTs, the replacement of two existing SRTs, and the rehabilitation of one SRT. These SRTs are located within the on-Base drainage channel system. SRTs significantly reduce the off-site migration of dioxin-contaminated soil and sediment (HLA, 2000a).

Site Characterization Report for NCBC Gulfport Off-Base Area of Contamination (February and April 2002) - A study to characterize the vertical extent of sediment contamination in the swamp north of Outfall 3 and shallow groundwater directly below sediment contamination (TtNUS, 2003d). This report represented the seventh phase of delineation at the off-Base AOC and included the following:

- Shallow groundwater samples collected from six temporary well locations.
- Seven sediment samples collected at the surface and at a depth of 18 to 24 inches below ground surface (bgs) on both the Arndt and Bennett properties.

The study found that sediment contamination was limited to the top 18 inches of sediment.

Verification Sampling

Verification sampling and analysis activities have been conducted at Site 8 and the off-Base AOC to verify removal of contaminated material. Verification sampling and analysis activities relevant to Site 8B and Site 8C are summarized below.

Final Letter Report, Site 8B and 8C Verification Sampling and Associated Drainage Systems (2005) - Conducted by TtNUS to verify removal of dioxin-contaminated surface soil from Site 8B and Site 8C using current higher resolution laboratory analysis (USEPA Method 8290) and bio-assay analysis (USEPA Method 4025) than the lower resolution (USEPA Method 8280) dioxin methodology used during the mid-1980s (TtNUS, 2006b).

One hundred and forty-five samples were collected at Site 8B, and 54 samples were collected at Site 8C, with sample locations determined using a statistically driven random sampling strategy. The major findings of the verification sampling were as follows:

- Dioxin concentrations in 1 of 145 samples at Site 8B and 3 of 54 samples at Site 8C exceeded the MDEQ restricted screening criterion for soil of 38 ng/kg.
- The 95 percent UCL of the mean dioxin concentration as determined using USEPA's ProUCL software (2004) was 11.07 ng/kg at Site 8B and 16.08 ng/kg at Site 8C.
- Confirmation sampling verified that the removal of contaminated soil completed in 1986 meets the current MDEQ standard for a restricted (non-residential) use area of 38 ng/kg.
- There were no discernable "hot spots" that require additional delineation or removal actions.
- At 160, or approximately 80 percent, of surface soil sample locations, Portland cement-stabilized soil was encountered within 6 inches of the surface. Although sampling was not conducted in storm ditch channels, these values provide a qualitative estimate for the amount of soil cement at the surface.

- Future site use, as indicated by Naval Construction Battalion Center (NCBC) Public Works, is projected to be an open surface storage and transfer facility.

Source, Nature, and Extent of Contamination

The nature and extent of contamination and associated risks at Site 8 and within the on-Base drainage channels and off-Base AOC were derived from investigations conducted by Versar, Inc., HLA, ABB-ES, and TtNUS. The reports generated from these studies include the following:

- Technical Memorandum No. 1, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 1 (ABB-ES, 1994).
- Technical Memorandum No. 2, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 2 (ABB-ES, 1995a).
- Technical Memorandum No. 3, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 3 (ABB-ES, 1995b).
- Technical Memorandum No. 4, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 4 (ABB-ES, 1995c).
- Technical Memorandum No. 5, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 5 (ABB-ES, 1995d).
- Letter Report, Interim Removal Action – 28th Street Road Construction (ABB-ES, 1995e).
- 28th Street Action Memorandum (ABB-ES, 1997a).
- Technical Memorandum No. 6, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 6 (ABB-ES, 1997b).
- Phase I Summary Report for Onsite and Off-site Delineation Activities (ABB-ES, 1998).
- Swamp Delineation Sampling, Phases III and IV (HLA, 1998).
- Swamp Delineation Sampling, Phases V and VI (HLA, 2000b).

- Surface Water and Sediment Dioxin Delineation Report (HLA, 1999a).
- Groundwater Monitoring Report (HLA, 1999b).
- Agreed Order Dioxin Delineation Studies (ABB-ES, 2000).
- Remediation Planning Document (HLA, 2000a).
- Human Health Risk Assessment and Screening Level Ecological Risk Assessment of Dioxins and Furans Associated with Former Herbicide Orange Storage (HLA, 2001).
- Report for Pilot-Scale Soil/Sediment Treatability Study, Site 8, Herbicide Orange Storage Area at NCBC, Gulfport, Mississippi (TtNUS, 2001).
- Excavation and Confirmation Sampling Report for the Edwards Property, Gulfport, Mississippi (TtNUS, 2002).
- Draft Human Health Risk Assessment of Groundwater Associated with Site 8 Former Herbicide Orange Storage Area (TtNUS, 2003a).
- Focused Feasibility Study, Revision 2, Site 8, Herbicide Orange Storage Area at Naval Construction Battalion Center Gulfport, Mississippi (TtNUS, 2003b).
- Draft Site Characterization Report, Off-Base Area of Contamination (TtNUS, 2003d).
- 100% Remedial Design for Site 8 – Herbicide Orange Storage Area and Off-Base Area of Contamination (TtNUS, 2004).
- Tier 3 Ecological Risk Evaluation, Steps 1 through 3 for Off-Base Area of Contamination Associated with Site 8 - Herbicide Orange Storage Area at NCBC Gulfport, Mississippi (TtNUS, 2005a).
- Site Investigation Report for Canal Road (TtNUS, 2005b).
- Final Confirmation Report for the Onbase Ditches and Offbase AOC (TtNUS, 2006a).

On-Base Soil, Sediment, and Surface Water

Investigations conducted prior to 1995 identified 2,4-D, 2,4,5-T, and dioxins in media as contaminants related to the storage and handling of HO at Site 8. Investigations occurring since 1995 confirmed earlier levels of dioxins, but 2,4-D or 2,4,5-T have not been detected. These observations have been attributed to the persistence (i.e., low volatility and resistance to chemical breakdown) of dioxins in the environment. The results of herbicide analyses have confirmed the chemical breakdown of 2,4-D and 2,4,5-T to less than detectable limits. All other analytes [volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), pesticides and polychlorinated biphenyls (PCBs)] were detected at concentrations that did not result in unacceptable human health or ecological risks. These results confirm historical data that HO and its related contaminants were the only hazardous material stored at Site 8 (TtNUS, 2003b).

The dioxin delineation studies (ABB-ES, 2000) identified a large area of surface soil and sediment contaminated with dioxin. The source for this dioxin contamination was the 55-gallon drums of HO formerly stored at Site 8. Spills and leaks from these drums contaminated surface soil over a large area of Site 8. The highly organophilic nature of dioxins prevented contamination from migrating deeper than approximately 2 feet bgs. Subsequent transport and deposition of contaminated sediments in the hydrologically connected network of on-Base drainage channels resulted in the contamination of these drainage channels. The contaminated sediment in on-Base drainage channels was excavated during the 2002 and 2005 and 2006 remedial activities. Verification sampling of Site 8B and Site 8C surface soil determined that the 95 percent UCL of the mean dioxin concentration was 11.07 ng/kg at Site 8B and 16.08 ng/kg at Site 8C, less than the MDEQ screening criteria for soil of 38 ng/kg for restricted use and greater than the MDEQ Tier 1 soil/sediment TRG concentration of 4.26 ng/kg for unrestricted residential use. In addition, there were no discernable contaminated soil "hot spots" that require additional delineation or removal actions (TtNUS, 2006b). Verification sampling of the remediated on-Base drainage channels determined that the 95 percent UCL of the mean dioxin concentrations was less than the MDEQ Tier 1 soil/sediment TRG of 4.26 ng/kg for unrestricted residential use (CCI, 2003).

Surface water has not been impacted by previous HO storage activities at Site 8. Surface water sample results consistently confirm that the dioxin transport mechanism in the drainage channels is through the bedload sediments and not as dissolved or suspended particles in surface water (ABB-ES, 1995a).

The results of the 156 samples collected from the excavated on-Base drainage channel sediment resulted in a 95 percent UCL of the mean dioxin concentration of 12.08 ng/kg (TtNUS, 2006a). This value is less than the remedial goal for on-Base ditches of 38 ng/kg.

Off-Base AOC Sediment

The TCDD concentrations in sediment are significantly lower in the off-Base AOC. The hydrogeologic conditions in the off-Base AOC [a combination of relatively low maximum stream velocity and highly organic sediment (ABB-ES, 1995a)] result in a favorable depositional environment. Hence, very low (less than 10 ng/kg) concentrations of dioxin migrated past the Edwards property located approximately 4,000 feet downgradient from NCBC's Outfall 3. In November and December 2001, contaminated sediment from the Edwards property, the farthest downgradient area of the drainage channels, was excavated and transported to Site 8A. Confirmation sampling on the remediated Edwards property determined that the 95 percent UCL of the mean dioxin concentrations was 4.07 ng/kg, which is less than the MDEQ Tier 1 TRG of 4.26 ng/kg for unrestricted residential use (TtNUS, 2002). The remaining contaminated sediment from the Arndt and Bennett properties was excavated and transported to Site 8A during 2004 and 2005. Verification sampling at the remediated Arndt and Bennett properties determined that the 95 percent UCL of the mean dioxin concentrations was greater than the MDEQ Tier 1 soil/sediment TRG concentration of 4.26 ng/kg for unrestricted residential use (TtNUS, 2006a).

The off-Base AOC is zoned for non-residential or "restricted" use. Therefore, the remedial goal for this area was established at 38 ng/kg (TtNUS, 2006a).

The results of the 94 samples collected and analyzed using bio-assay analysis (USEPA Method 4025) produced a 95 percent UCL of the mean dioxin concentration of 16.51 ng/kg, significantly less than the 38 ng/kg remedial goal required for restricted (zoned industrial) property.

On-Base and Off-Base Groundwater

Dioxin results reported for the 1999 groundwater samples collected at Site 8 do not exceed the current MDEQ TRG or the USEPA Maximum Contaminant Level (MCL) of 30 picograms per liter (pg/L). Dioxin results for several shallow groundwater samples collected within the off-Base AOC do exceed these criteria; however, turbidity levels reported for most of the shallow groundwater samples indicate that the dioxin concentrations detected may be, in part, a function of suspended particulates. Remedial actions taken to address soil and sediment contamination indirectly addressed dioxin impacts to groundwater.

Estimated Extent of Contaminated Media

Verification sampling of Site 8B and Site 8C surface soil conducted in 2005 determined that dioxin concentrations in 1 of 145 samples at Site 8B and 3 of 154 samples at Site 8C exceed the restricted (non-residential) MDEQ screening criterion for soil of 38 ng/kg. The 95 percent UCL of the mean dioxin concentration was 11.07 ng/kg at Site 8B and 16.08 ng/kg at Site 8C, less than the MDEQ screening

criterion for soil of 38 ng/kg for restricted use and greater than the MDEQ Tier 1 soil/sediment TRG concentration of 4.26 ng/kg for unrestricted residential use.

Analytical Data

Site 8B and Site 8C

The sampling strategy for Site 8B and Site 8C incorporated the use of bio-assay analysis (USEPA Method 4025) to increase the sampling density and decrease the cost of analysis. This strategy provides a 95 percent confidence level of determining any hot spot concentrations at this site. The sampling nodes are shown on Figure 2-8 of the Engineering Evaluation/Cost Analysis (EE/CA).

Results of the bio-assay analysis are presented in Tables A-1 and A-2 and are summarized as follows:

- One of 145 samples (8BJ28S14P, 50 ng/kg) at Site 8B analyzed using USEPA Method 4025 had a dioxin concentration that exceeded the 38 ng/kg Tier 1 restricted TRG designated by MDEQ.
- One of 145 samples (8BC35S18P, 62.4 ng/kg) at Site 8B analyzed using USEPA Method 8290 had a dioxin concentration that exceeded the 38 ng/kg Tier 1 restricted TRG.
- Three of 54 samples (8CD6S14P, 50 ng/kg; 8CD10S14P, 47 ng/kg; 8CF22S14P, 47 ng/kg) at Site 8C analyzed using USEPA Method 4025 had dioxin concentrations that exceeded the 38 ng/kg Tier 1 restricted TRG.
- None of the exceedances were greater than the 100 ng/kg maximum value limit established for this site and associated non-residential areas (TtNUS, 2005b).
- The 95 percent UCL of the mean dioxin concentration at Site 8B is 11.07 ng/kg.
- The 95 percent UCL of the mean dioxin concentration at Site 8C is 16.08 ng/kg.

Outfalls 4 and 5

A series of samples representing 3 years of study were collected to determine if dioxin-contaminated sediments from NCBC Gulfport were transported across 28th Street during large precipitation events and deposited in the depression extending to the northwest from 28th Street. Ten grab samples, CS001 through CS009 and CS017, were collected from the sediments in the area immediately north of 28th Street, between 53rd and 43rd Avenue. In addition, five composite samples were collected from a

series of dredge piles in wooded areas adjacent to storm water ditches north of 28th Street to determine if dioxin-contaminated sediments from NCBC Gulfport were transported across 28th Street and into residential neighborhoods via the network of storm water ditches. A total of 15 samples were analyzed for dioxin and furans using high resolution analysis (USEPA Method 8290).

Results are presented in Table A-3 and are summarized as follows:

- None of the grab sample dioxin concentrations exceeded the 38 ng/kg MDEQ restricted Tier 1 TRG.
- One grab sample (CS006) dioxin concentration exceeded the 4.26 ng/kg MDEQ unrestricted Tier 1 TRG.
- The grab sample dioxin concentration results from the low areas near Outfall 4 (CS001 through CS009 and CS017) did not exhibit a dioxin profile that would indicate a connection to Site 8.
- The reported 35.54 ng/kg dioxin concentration for grab sample CS006 was almost entirely due to non-HO related furans most likely associated with electrical transformers.
- None of the composite sample dioxin concentrations exceeded the 38 ng/kg MDEQ restricted Tier 1 TRG.
- Three composite sample dioxin concentrations exceeded the 4.26 ng/kg MDEQ unrestricted Tier 1 TRG.

Human Health And Ecological Risk Assessments

A risk assessment (HLA, 2001) was conducted to determine if contamination in surface soil, groundwater, and sediment related to the former storage and handling of HO at the Base poses potential health risks to individuals under current and/or foreseeable future site conditions. For additional information regarding the risk assessment performed for Site 8A and the associated drainage systems, refer to the FFS (TtNUS, 2003b) and the human health and ecological risk assessment (HLA, 2001).

Human Health - Surface soil and sediment samples were separated into two categories (on-Base and off-Base). Dioxin levels in surface soil and sediment at Site 8 and related drainage systems exceeded screening levels [USEPA Region III Risk-Based Concentrations (RBCs) and MDEQ Tier 1 screening levels] in both categories. Chemicals of potential concern (COPCs) were defined as HO-related chemicals detected in at least one sample at concentrations greater than these risk-based screening

concentrations. The results indicated that dioxin levels exceeded screening levels in soil and sediment at Site 8 and related drainage systems. None of the surface water sample concentrations exceeded screening concentrations. The primary on-Base risk driver for soil is the on-Base resident population, which has a reasonable maximum exposure (RME) risk greater than the MDEQ acceptable risk range. The primary risk driver for sediment is the on-Base residential population, which has a RME risk greater than the MDEQ acceptable risk range.

A human health risk assessment amendment was also performed for Site 8 to address groundwater risks for current and potential future land-use scenarios (TtNUS, 2003a). Similar to surface soil and sediment, groundwater samples were separated into on-Base and off-Base categories. Dioxin levels in groundwater (both on-Base and off-Base) exceeded screening levels established by the USEPA and MDEQ. However, many of the samples were turbid, which may account for much of the detected dioxin concentrations. The primary risk driver for groundwater is the hypothetical on-site resident that is exposed to surface water/groundwater in the off-Base AOC.

Ecological - In 2001, the Navy performed a screening level ecological risk assessment that evaluated potential risk to ecological receptors. In 2004, the Navy performed a Tier 3 Ecological Risk Evaluation in accordance with USEPA guidance (USEPA, 1997) for Step 3 of a baseline ecological risk assessment to estimate potential risks to ecological receptors. The Draft Tier 3 Ecological Risk Evaluation Report was submitted to the NCBC Gulfport Tier 1 Partnering Team in June 2004 and was finalized in August 2005. The following paragraphs contain a summary of the Tier 3 Ecological Risk Evaluation Report.

Exposure pathways evaluated in the report consisted of direct contact with sediment resulting in toxicity to invertebrates and ingestion of contaminated sediment and food items by wildlife that prey on fish and sediment invertebrates. Effects to wildlife were evaluated by comparing modeled ingested doses to threshold oral toxicity reference values, which are dioxin doses associated with adverse effects on growth, survival, or reproduction. The mink was used to represent mammals that prey on fish and sediment invertebrates in the off-Base AOC. Birds that prey on fish and sediment invertebrates in the off-Base AOC were represented by the green heron and the belted kingfisher.

Under current conditions, risks to sediment-dwelling invertebrates exist. However, the Navy excavated dioxin-contaminated sediment in the off-Base AOC to achieve the 38.2 ng/kg MDEQ Tier 1 TRG for restricted (industrial and occupational) use, a value based on human health risk rather than ecological risk. Because of the topography at the off-Base AOC, sample locations outside the remedial area delineated by 38.2 ng/kg concentrations are slightly higher in elevation, and these drier areas provide poor conditions (and consequently less exposure) for sediment-associated organisms. Sample locations where dioxin concentrations exceed 38.2 ng/kg coincide with areas of organic-rich muck sediment.

These areas comprise habitat for sediment organisms. Therefore, contamination remaining after remediation based on a sediment remediation goal of 38.2 ng/kg would be expected to pose minimal risk (due to minimal exposure) to sediment-associated organisms.

Sediment remedial goals for protection of wildlife were developed as indicated in the following table. A sediment remedial goal based on risk to wildlife is defined as the sediment concentration that would result in a food-chain hazard quotient of 1.0.

Receptor	Sediment Remedial Goal for Protection of Wildlife
Mink	86 ng/kg
Green heron	125 ng/kg
Belted kingfisher	142 ng/kg

Because these remedial goals are greater than the 38.2 ng/kg sediment remedial goal proposed and used for protection of human health in the off-Base AOC, the remediation of sediment to 38.2 ng/kg was also protective of ecological wildlife. The NCBC Gulfport Tier 1 Partnering Team also determined that the maximum permissible exposure point concentration would be 100 ng/kg to ensure long-term ecological health.

TABLE A-1

SUMMARY OF SITE 8B VERIFICATION SAMPLING
 CANAL ROAD DREDGE PILES EE/CA
 NCBC GULFPORT, MISSISSIPPI
 PAGE 1 OF 2

Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration
8BA1S14P	11 / NT	8BF23S14P	10 / NT	8BJ11S14P	10 / NT
8BA10S14P	10 / NT	8BF25S14P	12 / NT	8BJ24S14P	<10 / NT
8BA12S14P	12 / NT	8BF27S14P	<10 / NT	8BJ28S14P	50 / NT
8BA41S14P	<10 / NT	8BF28S14P	<10 / NT	8BJ31S14P	<10 / NT
8BA42S14P	10 / 6.71	8BF30S14P	<10 / NT	8BJ33S14P	<10 / NT
8BA43S14P	11 / NT	8BF31S14P	<10 / 12.0	8BJ35S14P	<10 / 3.72
8BA45S14P	<10 / NT	8BF32S14P	<10 / NT	8BJ37S14P	<10 / NT
8BB2S14P	<10 / NT	8BF36S14P	<10 / NT	8BJ39S14P	<10 / NT
8BB14S14P	<10 / NT	8BF42S14P	11 / NT	8BJ40S14P	<10 / NT
8BB17S14P	13 / NT	8BG3S14P	15 / NT	8BJ42S14P	10 / NT
8BB19S14P	14 / NT	8BG4S14P	<10 / NT	8BJ44S14P	<10 / NT
8BB29S14P	<10 / NT	8BG5S14P	<10 / 2.66	8BK4S14P	<10 / NT
8BB33S14P	10 / NT	8BG6S14P	<10 / NT	8BK6S14P	<10 / NT
8BB35S14P	18 / NT	8BG11S14P	<10 / NT	8BK27S14P	24 / 36.6
8BB36S14P	12 / NT	8BG19S14P	<10 / NT	8BK35S14P	<10 / NT
8BC5S14P	12 / NT	8BG23S14P	<10 / NT	8BK38S14P	<10 / NT
8BC6S14P	<10 / NT	8BG26S14P	<10 / NT	8BK43S14P	<10 / NT
8BC7S14P	12 / NT	8BG27S14P	11 / NT	8BK45S14P	<10 / NT
8BC8S14P	10 / NT	8BG34S14P	<10 / NT	8BL3S14P	<10 / NT
8BC9S14P	<10 / NT	8BG38S14P	<10 / NT	8BL6S14P	14 / NT
8BC16S14P	10 / NT	8BH2S14P	<10 / NT	8BL7S14P	11 / NT
8BC18S14P	21 / NT	8BH3S14P	<10 / NT	8BL8S14P	15 / NT
8BC20S14P	14 / NT	8BH8S14P	<10 / NT	8BL12S14P	11 / NT
8BC22S14P	<10 / NT	8BH12S14P	<10 / 0.676	8BL26S14P	27 / 21.5
8BC24S14P	<10 / NT	8BH13S14P	<10 / NT	8BL29S14P	<10 / NT
8BC26S14P	<10 / 1.21	8BH18S14P	<10 / NT	8BL31S14P	<10 / NT
8BC28S14P	<10 / NT	8BH20S14P	<10 / NT	8BL36S14P	16 / NT
8BC30S14P	<10 / NT	8BH26S14P	<10 / NT	8BL38S14P	14 / NT
8BC35S14P	16 / 62.4	8BH30S14P	10 / NT	8BL39S14P	10 / NT
8BC37S14P	10 / NT	8BH37S14P	<10 / NT	8BM1S14P	10 / NT
8BC38S14P	13 / NT	8BH40S14P	10 / NT	8BM2S14P	<10 / NT
8BC39S14P	13 / NT	8BH41S14P	<10 / 11.0	8BM3S14P	12 / NT
8BD4S14P	<10 / NT	8BH43S14P	<10 / NT	8BM10S14P	13 / NT
8BD9S14P	13 / NT	8BH45S14P	<10 / NT	8BM12S14P	18 / 12.6
8BD11S14P	<10 / NT	8BI1S14P	10 / NT	8BM14S14P	<10 / NT

TABLE A-1

**SUMMARY OF SITE 8B VERIFICATION SAMPLING
CANAL ROAD DREDGE PILES EE/CA
NCBC GULFPORT, MISSISSIPPI
PAGE 2 OF 2**

Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration
8BD21S14P	10 / 17.0	8BI2S14P	<10 / NT	8BM15S14P	16 / NT
8BD32S149	10 / NT	8BI5S14P	15 / NT	8BM16S14P	<10 / NT
8BE10S14P	13 / NT	8BI9S14P	15 / NT	8BM18S14P	<10 / NT
8BE19S14P	<10 / NT	8BI10S14P	11 / NT	8BM19S14P	12 / NT
8BE21S14P	26 / NT	8BI14S14P	12 / NT	8BM22S14P	<10 / NT
8BE22S14P	<10 / NT	8BI16S14P	<10 / NT	8BM23S14P	<10 / NT
8BE29S14P	12 / NT	8BI17S14P	<10 / 1.02	8BM25S14P	<10 / NT
8BE33S14P	11 / NT	8BI22S14P	<10 / NT	8BM28S14P	<10 / NT
8BE40S14P	10 / NT	8BI24S14P	<10 / NT	8BM30S14P	<10 / 7.99
8BE43S14P	14 / NT	8BI25S14P	<10 / NT	8BM32S14P	19 / NT
8BE44S14P	13 / NT	8BI34S14P	<10 / NT	8BM33S14P	15 / NT
8BF8S14P	10 / NT	8BI41S14P	<10 / NT	8BM34S14P	<10 / NT
8BF17S14P	15 / NT	8BI43S14P	<10 / NT		
8BF18S14P	14 / NT	8BJ7S14P	10 / NT		

- 1 Samples tested using bio-assay analysis (USEPA Method 4025) / high resolution analysis (USEPA Method 8290).
- 2 All results are reported in nanograms per kilogram (ng/kg).
- 3 Highlighted values exceed the 38 ng/kg Tier 1 restricted target remediation goal designated by MDEQ.
- 4 Sample locations are shown on Figure 2-8 of the EE/CA.

NT – Not tested.

TABLE A-2

SUMMARY OF SITE 8C VERIFICATION SAMPLING
CANAL ROAD DREDGE PILES EE/CA
NCBC GULFPORT, MISSISSIPPI

Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration
8CA3S14P	<10 / 2.98	8CC10S14P	<10 / NT	8CE23S14P	<10 / NT
8CA12S14P	<10 / NT	8CC15S14P	12 / NT	8CE25S149	14 / NT
8CA16S14P	12 / NT	8CC20S14P	<10 / NT	8CF4S14P	<10 / NT
8CA19S14P	15 / NT	8CC22S14P	<10 / NT	8CF7S14P	10 / NT
8CA20S14P	<10 / NT	8CC24S14P	<10 / NT	8CF16S14P	<10 / 0.0669
8CA25S14P	<10 / NT	8CC28S14P	<10 / NT	8CF17S14P	<10 / NT
8CA28S14P	<10 / NT	8CD4S14P	11 / NT	8CF22S14P	47 / NT
8CB7S14P	16 / NT	8CD5S14P	<10 / NT	8CG2S14P	<10 / NT
8CB13S14P	<10 / NT	8CD6S14P	50 / NT	8CG3S14P	<10 / NT
8CB17S14P	11 / NT	8CD10S14P	47 / NT	8CG9S14P	<10 / NT
8CB18S14P	10 / NT	8CD13S14P	<10 / 0.637	8CG11S14P	<10 / NT
8CB23S14P	10 / NT	8CD15S14P	<10 / NT	8CG12S14P	<10 / NT
8CB27S14P	5 / NT	8CD20S14P	<10 / NT	8CG14S14P	10 / NT
8CB29S14P	5 / 1.96	8CD27S14P	<10 / NT	8CG19S14P	18 / NT
8CC4S14P	5 / NT	8CD29S14P	<10 / NT	8CG21S14P	<10 / NT
8CC5S149	27 / NT	8CE1S14P	<10 / 1.99	8CG24S14P	<10 / NT
8CC8S14P	<10 / NT	8CE8S14P	12 / NT	8CG26S14P	<10 / NT
8CC9S14P	12 / NT	8CE18S14P	17 / NT	8CG28S14P	<10 / 23.4

- 1 Samples tested using bio-assay analysis (USEPA Method 4025) / high resolution analysis (USEPA Method 8290).
- 2 All results are reported in nanograms per kilogram (ng/kg).
- 3 Highlighted values exceed the 38 ng/kg Tier 1 restricted target remediation goal designated by MDEQ.
- 4 Sample locations are shown on Figure 2-8 of the EE/CA.

NT – Not tested.

TABLE A-3

**SUMMARY OF OUTFALL 4 AND 5 SAMPLING
CANAL ROAD DREDGE PILES EE/CA
NCBC GULFPORT, MISSISSIPPI**

Sample Identification	Dioxin Concentration	Sample Identification	Dioxin Concentration
CS001	2.02	CS009	0.39
CS002	0.21	CS017	0.33
CS003	9.87	CSOF401	5.538
CS004	0.80	CSOF402	4.340
CS005	2.08	CSOF501	9.646
CS006	35.54	CSOF502	3.652
CS007	1.98	CSOF503	0.249
CS008	1.77		

- 1 Samples tested using high resolution analysis (USEPA Method 8290).
- 2 All results are reported in nanograms per kilogram (ng/kg).

REFERENCES

ABB-ES (ABB Environmental Services, Inc.), 1994. Technical Memorandum No. 1, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 1, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. December.

ABB-ES, 1995a. Technical Memorandum No. 2, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 2, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. January.

ABB-ES, 1995b. Technical Memorandum No. 3, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 3, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. April.

ABB-ES, 1995c. Technical Memorandum No. 4, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 4, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

ABB-ES, 1995d. Technical Memorandum No. 5, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 5, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. September.

ABB-ES, 1995e. Letter Report, Interim Removal Action – 28th Street Road Construction, NCBC, Gulfport, Mississippi. Prepared for Southern Division Naval Facilities Engineering Command, North Charleston, South Carolina. September 28.

ABB-ES, 1997a. 28th Street Action Memorandum, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division Naval Facilities Engineering Command, North Charleston, South Carolina. January.

ABB-ES, 1997b. Technical Memorandum No. 6, Site A, Former Herbicide Orange Storage Area, Groundwater Sampling Event No. 6, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

ABB-ES, 1998. Phase I Summary Report for Onsite and Off-site Delineation Activities, Naval Construction Battalion Center Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. January.

ABB-ES, 2000. Agreed Order Dioxin Delineation Studies, NCBC, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina.

AFESC (Air Force Engineering and Service Center), 1998. Herbicide Orange Monitoring Program at the NCBC Gulfport, Mississippi. ESL-TR-83-56.

CCI (CH2MHill Constructors Inc.), 2003. Technical Memorandum, Summary of Dioxin-Contaminated Soil Removal Activities and Results, Site 8, NCBC Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. January 22.

HLA (Harding Lawson Associates), 1998. Swamp Delineation Sampling, Phases III and IV, Naval Construction Battalion Center (NCBC) Gulfport, Mississippi. December 15.

HLA, 1999a. Surface Water and Sediment Dioxin Delineation Report, Naval Construction Battalion Center Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

HLA, 1999b. Groundwater Monitoring Report, Naval Construction Battalion Center Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. December.

HLA, 2000a. Remediation Planning Document, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

HLA, 2000b. Swamp Delineation Sampling, Phases V and VI, Naval Construction Battalion Center (NCBC), Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. November 7.

HLA, 2001. Human Health Risk Assessment and Screening Level Ecological Risk Assessment of Dioxins and Furans Associated with Former Herbicide Orange Storage, Naval Construction Battalion Center,

Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. March.

TtNUS (Tetra Tech NUS, Inc.), 2001. Report for Pilot-Scale Soil/Sediment Treatability Study, Site 8, Herbicide Orange Storage Area at Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. December.

TtNUS, 2002. Excavation and Confirmation Sampling Report for the Edwards Property, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

TtNUS, 2003a. Draft Human Health Risk Assessment of Groundwater Associated with Site 8 Former Herbicide Orange Storage Area, NCBC, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. February.

TtNUS, 2003b. Focused Feasibility Study, Site 8, Herbicide Orange Storage Area at Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. March 24 (Revision 2).

TtNUS, 2003c. Draft Report, Excavation and Sediments Adjacent to Canal Road Culvert, NCBC Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. April.

TtNUS, 2003d. Draft Site Characterization Report, Off-Base Area of Contamination, NCBC Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. April.

TtNUS, 2004. 100% Remedial Design for Site 8 – Herbicide Orange Storage Area and Off-Base Area of Contamination, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. October.

TtNUS, 2005a. Tier 3 Ecological Risk Evaluation, Steps 1 through 3 for Off-Base Area of Contamination Associated with Site 8 - Herbicide Orange Storage Area at NCBC Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. August.

TtNUS, 2005b. Site Investigation Report for Canal Road, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. November.

TtNUS, 2006a. Final Confirmation Report for the Onbase Ditches and Offbase AOC, Naval Construction Battalion Center Gulfport, Gulfport, Mississippi. Prepared for Naval Facilities Engineering Command Southeast, North Charleston, South Carolina.

TtNUS, 2006b. Final Letter Report, Site 8B and 8C Verification Sampling and Associated Drainage Systems, ECC, Naval Construction Battalion Center, Gulfport, Mississippi. Prepared for Naval Facilities Engineering Command Southeast, North Charleston, South Carolina. September.

USEPA, 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Office of Solid Waste and Emergency Response, EPA 540-R-97-006, June.

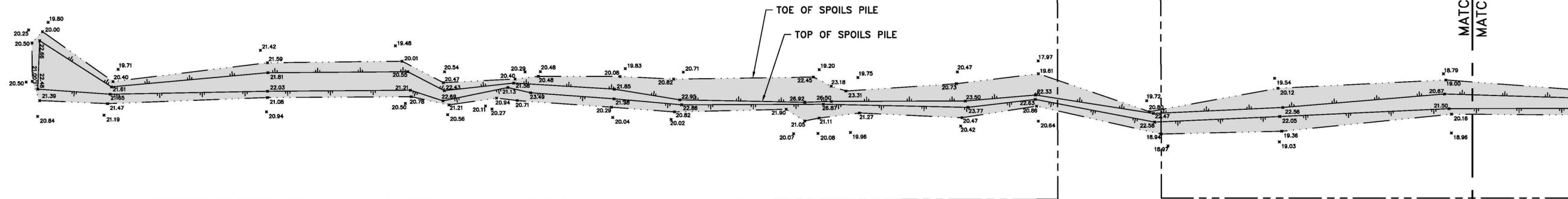
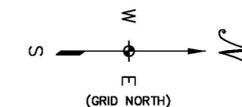
USEPA, 2004. ProUCL Version 3.0 User Guide (EPA/600/R04/079), April.

APPENDIX B

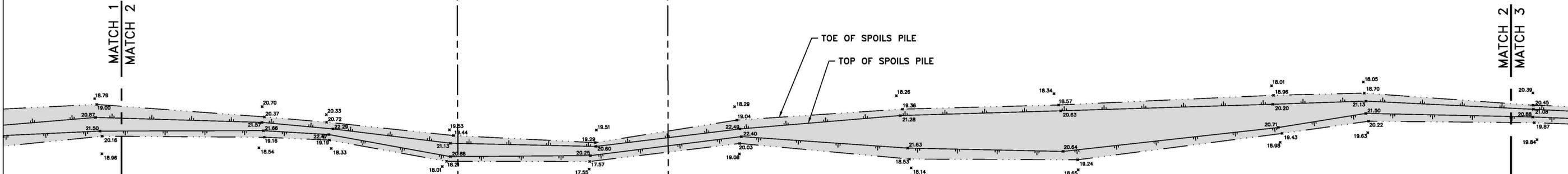
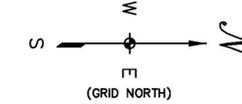
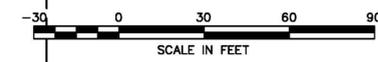
TOPOGRAPHIC SURVEY, CANAL ROAD DREDGE PILES

Prismoidal Volume Results

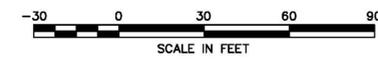
Original Surface Model:	EXISTING SPOILS
Final Surface Model:	EXISTING FLAT
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	6000± cu yd
Compacted Cut Volume:	0.00 cu yd
Total Cut Volume:	6000± cu yd



CANAL ROAD



CANAL ROAD



NOTES:

- Property lines shown are drawn based on the Harrison County Tax Maps: #0610I, #0610P, #0710L, & #0710M.
- All elevations are based on "Gulfport Reset", Elevation=15.96' (NAVD 88).
- Horizontal locations are "State Plane, Mississippi East, Zone-2301 (NAD 83)", based on "Gulfport Reset".
- I hereby certify that I have located the spoils piles shown hereon as requested by Robert Fisher with Tetra Tech NUS, INC., and that all measurements and other data indicated are true and correct to the best of my knowledge, information, and belief.

J. COLTER RATLIFF P.S. #3008
Field Surveyed July 18, 2006.

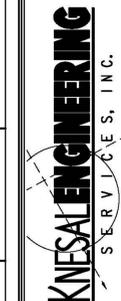
DESIGNED BY:	RLN
DRAWN BY:	RLN
CHECKED BY:	JCC/JCR
DATE:	08-31-06
REVISED:	

DRAWING ISSUE	DATE	BY
	DATE	BY
FOR APPROVAL	DATE	BY
	DATE	BY
APPROVED FOR BID	DATE	BY
APPROVED FOR CONST.	DATE	BY

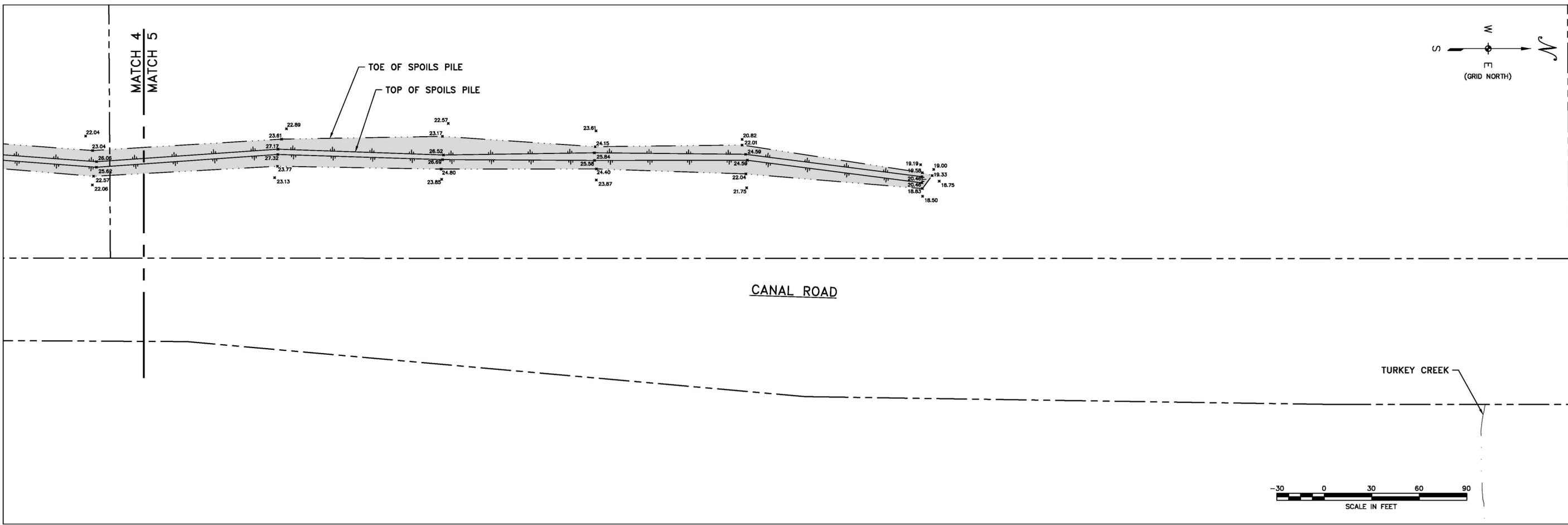
SHEET TITLE
TOPOGRAPHIC SURVEY

PROJECT NAME
**SPOIL PILE CALCULATIONS FOR
TETRA TECH NUS, INC.
HARRISON COUNTY, MISSISSIPPI**

PROJECT ADDRESS
14321 CREOSOTE ROAD
GULFPORT, MS 39503
PHONE (228) 865-7030
FAX (228) 865-0043
email: knc@knesalengineering.com
www.knesalengineering.com



DRAWING NO.	2367
TOPO-1	
REV.	△
SHEET	1
OF	3
PROJECT NO.	2367



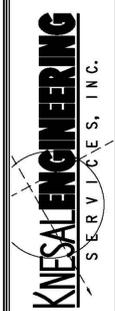
DESIGNED BY:
RLN
DRAWN BY:
RLN
CHECKED BY:
JCC/JCR 8-31-06
DATE:
08-31-06
REVISED:

KNECAL ENG. DATE	DRAWING ISSUE	
	BY	DATE
	PRELIMINARY	
	FOR APPROVAL	
	APPROVED FOR BID	
	APPROVED FOR CONST.	

SHEET TITLE
TOPOGRAPHIC SURVEY

PROJECT NAME
**SPOIL PILE CALCULATIONS FOR
TETRA TECH NUS, INC.
HARRISON COUNTY, MISSISSIPPI**

14321 CREOSOTE ROAD
GULFPORT, MS 39503
PHONE (228) 865-7000
FAX (228) 865-0043
email: knc@kncsalingeering.com
www.kncsalingeering.com



DRAWING NO. 2367
TOPO-3
REV.
SHEET 3 OF 3
PROJECT NO. 2367

NOTES:

1. Property lines shown are drawn based on the Harrison County Tax Maps: #0610I, #0610P, #0710L, & #0710M.
2. All elevations are based on "Gulfport Reset", Elevation=15.96' (NAVD 88).
3. Horizontal locations are "State Plane, Mississippi East, Zone-2301 (NAD 83)", based on "Gulfport Reset".
4. I hereby certify that I have located the spoils piles shown hereon as requested by Robert Fisher with Tetra Tech NUS, INC., and that all measurements and other data indicated are true and correct to the best of my knowledge, information, and belief.

J. COLTER RATLIFF P.S. #3008
Field Surveyed July 18, 2006.

APPENDIX C

COST ESTIMATES

NAVAL CONSTRUCTION BATTALION CENTER
 Gulfport, Mississippi
 Canal Road Dredge Piles EE/CA
 Alternative 1: Excavation & Off-Site Disposal
 Capital Cost

5/25/2007 3:50 PM

Item	Quantity	Unit	Subcontract	Unit Cost			Extended Cost			Subtotal	
				Material	Labor	Equipment	Subcontract	Material	Labor		Equipment
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans including Permits	300	hr			\$35.00		\$0	\$0	\$10,500	\$0	\$10,500
2 MOBILIZATION/DEMobilIZATION & SITE SUPPORT											
2.1 Office Trailer	5	mo				\$410.00	\$0	\$0	\$0	\$2,050	\$2,050
2.2 Field Office Support	5	mo		\$165.00			\$0	\$825	\$0	\$0	\$825
2.3 Storage Trailer (1)	5	mo				\$111.00	\$0	\$0	\$0	\$555	\$555
2.4 Utility Connection/Disconnection (phone/electric)	1	ls	\$1,500.00				\$1,500	\$0	\$0	\$0	\$1,500
2.5 Construction Survey	7.7	ac	\$1,300.00				\$10,010	\$0	\$0	\$0	\$10,010
2.6 Equipment Mobilization/Demobilization	8	ea			\$158.00	\$384.00	\$0	\$0	\$1,264	\$3,072	\$4,336
2.7 Site Utilities	5	mo	\$160.00				\$800	\$0	\$0	\$0	\$800
2.8 Field Construction Mgt. (4p * 5 days/week)	19	mwk			\$5,000.00		\$0	\$0	\$95,000	\$0	\$95,000
3 DECONTAMINATION											
3.1 Decontamination Services	4	mo		\$1,232.00	\$1,900.00	\$1,381.00	\$0	\$4,928	\$7,600	\$5,524	\$18,052
3.2 Temporary Equipment Decon Pad	2	ls		\$1,540.00	\$2,050.00	\$310.00	\$0	\$1,500	\$2,000	\$200	\$3,700
3.3 Decon Water	5,000	gal		\$0.20			\$0	\$1,000	\$0	\$0	\$1,000
3.4 Decon Water Storage Tank, 6,000 gallon	4	mo				\$702.50	\$0	\$0	\$0	\$2,810	\$2,810
3.5 Clean Water Storage Tank, 4,000 gallon	4	mo				\$630.60	\$0	\$0	\$0	\$2,522	\$2,522
3.6 Disposal of Decon Waste (liquid & solid)	4	mo	\$950.00				\$3,800	\$0	\$0	\$0	\$3,800
4 OFF-BASE SOIL REMOVAL											
4.1 Cut & Chip Trees	7.7	ac			\$2,100.00	\$1,550.00	\$0	\$0	\$16,170	\$11,935	\$28,105
4.2 Remove Chipped Trees	22	day			\$236.40	\$1,014.00	\$0	\$0	\$5,201	\$22,308	\$27,509
4.3 Chip Stumps	22	day			\$307.20	\$106.30	\$0	\$0	\$6,758	\$2,339	\$9,097
4.4 Fence Removal & Reset	4,072	lf	\$20.50				\$83,476	\$0	\$0	\$0	\$83,476
4.5 Excavator, 2 cy bucket	48	day			\$318.40	\$994.60	\$0	\$0	\$15,283	\$47,741	\$63,024
4.6 Backhoe-loader	48	day			\$307.20	\$243.40	\$0	\$0	\$14,746	\$11,683	\$26,429
4.7 Waste characterization	15	ea	\$850.00				\$12,750	\$0	\$0	\$0	\$12,750
4.8 Off-site transport, haz waste	13,233	tons	\$50.00				\$661,650	\$0	\$0	\$0	\$661,650
4.9 Off-site disposal, haz waste	13,233	tons	\$200.00				\$2,646,600	\$0	\$0	\$0	\$2,646,600
4.10 TSDF fees	1	LS	\$200.00				\$200	\$0	\$0	\$0	\$200
4.11 Concrete Pipe, 96" dia., Class 3	100	lf		\$385.00			\$0	\$38,500	\$0	\$0	\$38,500
4.12 Gravel for Pipe	100	cy		\$36.00			\$0	\$3,600	\$0	\$0	\$3,600
4.13 Geotextile for Pipe	250	sy		\$1.45	\$0.29		\$0	\$363	\$73	\$0	\$435
4.14 Labor, crew of 3	48	day			\$690.00		\$0	\$0	\$33,120	\$0	\$33,120
4.15 Temporary SRT, includes disposal cost	9	ea	\$65.00	\$670.00	\$420.00		\$585	\$6,030	\$3,780	\$0	\$10,395
4.16 Silt Fence	4,232	lf		\$0.34	\$0.48		\$0	\$1,439	\$2,031	\$0	\$3,470
4.17 Backfill, soil	500	cy		\$9.75			\$0	\$4,875	\$0	\$0	\$4,875
4.18 Topsoil, loam, 6" thick	2,446	cy		\$22.00			\$0	\$53,812	\$0	\$0	\$53,812
4.19 Excavator, 2 cy bucket	10	day			\$318.40	\$994.60	\$0	\$0	\$3,184	\$9,946	\$13,130
4.20 Labor, crew of 3	10	day			\$690.00		\$0	\$0	\$6,900	\$0	\$6,900
4.21 Hydro Seed, with mulch & fertilizer	369	msf	\$78.10				\$28,819	\$0	\$0	\$0	\$28,819
4.22 Verification Sampling	80	ea	\$850.00	\$20.00	\$55.00	\$20.00	\$68,000	\$1,600	\$4,400	\$1,600	\$75,600
5 OTHER											
5.1 Fence, chain-link, barbed wire topped, 8'	3,700	ft	\$44.00				\$162,800	\$0	\$0	\$0	\$162,800
5.2 Gate, double-swing	2	ea	\$2,350.00				\$4,700	\$0	\$0	\$0	\$4,700
Subtotal							\$3,685,690	\$118,471	\$228,010	\$124,285	\$4,156,456

NAVAL CONSTRUCTION BATTALION CENTER
Gulfport, Mississippi
Canal Road Dredge Piles EE/CA
Alternative 1: Excavation & Off-Site Disposal
Capital Cost

5/25/2007 3:50 PM

Item	Quantity	Unit	Subcontract	Unit Cost			Extended Cost				Subtotal
				Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	
Local Area and Year To Date Adjustments							100.0%	100.9%	86.3%	86.3%	
							\$3,685,690	\$119,538	\$196,773	\$107,258	\$4,109,258
									\$59,032		\$59,032
									\$19,677		\$19,677
								\$11,954			\$11,954
										\$10,726	\$10,726
							\$368,569				\$368,569
Total Direct Cost							\$4,054,259	\$131,491	\$275,482	\$117,984	\$4,579,216
											\$1,144,804
											\$457,922
Subtotal											\$6,181,941
											\$123,639
Total Field Cost											\$6,305,580
											\$1,576,395
											\$157,639
TOTAL COST											\$8,039,614

NAVAL CONSTRUCTION BATTALION CENTER
Gulfport, Mississippi
Canal Road Dredge Piles EE/CA
Alternative 1: Excavation & Off-Site Disposal
Annual Cost

5/25/2007 3:50 PM

Item	Item Cost per round	Item Cost every x years	Notes
Sampling ⁽¹⁾	\$0	\$0	Labor, Field Supplies
Report ⁽¹⁾	\$0	\$0	Document sampling events and results
Site Review ⁽¹⁾	\$0	\$0	Five Year Site Reviews
TOTALS	\$0	\$0	

(1) Long-term monitoring reporting and site reviews are currently being performed. A cost of \$0.00 is therefore reflected

NAVAL CONSTRUCTION BATTALION CENTER
Gulfport, Mississippi
Canal Road Dredge Piles EE/CA
Alternative 1: Excavation & Off-Site Disposal
Present Worth Analysis

5/25/2007 3:50 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	\$8,039,614		\$8,039,614	1.000	\$8,039,614
1			\$0	0.935	\$0
2			\$0	0.873	\$0
3			\$0	0.816	\$0
4			\$0	0.763	\$0
5			\$0	0.713	\$0
6			\$0	0.666	\$0
7			\$0	0.623	\$0
8			\$0	0.582	\$0
9			\$0	0.544	\$0
10			\$0	0.508	\$0
11			\$0	0.475	\$0
12			\$0	0.444	\$0
13			\$0	0.415	\$0
14			\$0	0.388	\$0
15			\$0	0.362	\$0
16			\$0	0.339	\$0
17			\$0	0.317	\$0
18			\$0	0.296	\$0
19			\$0	0.277	\$0
20			\$0	0.258	\$0
21			\$0	0.242	\$0
22			\$0	0.226	\$0
23			\$0	0.211	\$0
24			\$0	0.197	\$0
25			\$0	0.184	\$0
26			\$0	0.172	\$0
27			\$0	0.161	\$0
28			\$0	0.150	\$0
29			\$0	0.141	\$0
30			\$0	0.131	\$0
TOTAL PRESENT WORTH					\$8,039,614

NAVAL CONSTRUCTION BATTALION CENTER
 Gulfport, Mississippi
 Canal Road Dredge Piles EE/CA
 Alternative 2: Excavation, Consolidation, and Stabilization
 Capital Cost

Item	Quantity	Unit	Subcontract	Unit Cost			Subcontract	Extended Cost			Subtotal
				Material	Labor	Equipment		Material	Labor	Equipment	
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans including Permits	300	hr			\$35.00		\$0	\$0	\$10,500	\$0	\$10,500
2 MOBILIZATION/DEMobilIZATION & SITE SUPPORT											
2.1 Office Trailer	5	mo				\$410.00	\$0	\$0	\$0	\$2,050	\$2,050
2.2 Field Office Support	5	mo		\$165.00			\$0	\$825	\$0	\$0	\$825
2.3 Storage Trailer (1)	5	mo				\$111.00	\$0	\$0	\$0	\$555	\$555
2.4 Utility Connection/Disconnection (phone/electric)	1	ls	\$1,500.00				\$1,500	\$0	\$0	\$0	\$1,500
2.5 Construction Survey	23	ac	\$1,300.00				\$29,900	\$0	\$0	\$0	\$29,900
2.6 Equipment Mobilization/Demobilization	8	ea			\$158.00	\$384.00	\$0	\$0	\$1,264	\$3,072	\$4,336
2.7 Site Utilities	5	mo	\$160.00				\$800	\$0	\$0	\$0	\$800
2.8 Field Construction Mgt. (4p * 5 days/week)	18	mwk			\$5,000.00		\$0	\$0	\$90,000	\$0	\$90,000
3 DECONTAMINATION											
3.1 Decontamination Services	4	mo		\$1,232.00	\$1,900.00	\$1,381.00	\$0	\$4,928	\$7,600	\$5,524	\$18,052
3.2 Temporary Equipment Decon Pad	2	ls		\$1,540.00	\$2,050.00	\$310.00	\$0	\$1,500	\$2,000	\$200	\$3,700
3.3 Decon Water	5,000	gal		\$0.20			\$0	\$1,000	\$0	\$0	\$1,000
3.4 Decon Water Storage Tank, 6,000 gallon	4	mo				\$702.50	\$0	\$0	\$0	\$2,810	\$2,810
3.5 Clean Water Storage Tank, 4,000 gallon	4	mo				\$630.60	\$0	\$0	\$0	\$2,522	\$2,522
3.6 Disposal of Decon Waste (liquid & solid)	4	mo	\$950.00				\$3,800	\$0	\$0	\$0	\$3,800
4 OFF-BASE SOIL REMOVAL											
4.1 Cut & Chip Trees	7.7	ac			\$2,100.00	\$1,550.00	\$0	\$0	\$16,170	\$11,935	\$28,105
4.2 Remove Chipped Trees	22	day			\$236.40	\$1,014.00	\$0	\$0	\$5,201	\$22,308	\$27,509
4.3 Chip Stumps	22	day			\$307.20	\$106.30	\$0	\$0	\$6,758	\$2,339	\$9,097
4.4 Fence Removal & Reset	4,072	lf	\$20.50				\$83,476	\$0	\$0	\$0	\$83,476
4.5 Excavator, 2 cy bucket	22	day			\$318.40	\$994.60	\$0	\$0	\$7,005	\$21,881	\$28,886
4.6 Backhoe-loader	22	day			\$307.20	\$243.40	\$0	\$0	\$6,758	\$5,355	\$12,113
4.7 Dump Truck, 2 each, 22 cy each	38	day			\$236.40	\$1,014.00	\$0	\$0	\$8,983	\$38,532	\$47,515
4.8 Concrete Pipe, 96" dia., Class 3	100	lf		\$385.00			\$0	\$38,500	\$0	\$0	\$38,500
4.8 Gravel for Pipe	100	cy		\$36.00			\$0	\$3,600	\$0	\$0	\$3,600
4.9 Geotextile for Pipe	250	sy		\$1.45	\$0.29		\$0	\$363	\$73	\$0	\$435
4.10 Labor, crew of 3	22	day			\$690.00		\$0	\$0	\$15,180	\$0	\$15,180
4.11 Temporary SRT, includes disposal cost	9	ea	\$65.00	\$670.00	\$420.00		\$585	\$6,030	\$3,780	\$0	\$10,395
4.12 Silt Fence	4,232	lf		\$0.34	\$0.48		\$0	\$1,439	\$2,031	\$0	\$3,470
4.13 Backfill, soil	500	cy		\$9.75			\$0	\$4,875	\$0	\$0	\$4,875
4.14 Topsoil, loam, 6" thick	2,446	cy		\$22.00			\$0	\$53,812	\$0	\$0	\$53,812
4.15 Excavator, 2 cy bucket	10	day			\$318.40	\$994.60	\$0	\$0	\$3,184	\$9,946	\$13,130
4.16 Labor, crew of 3	10	day			\$690.00		\$0	\$0	\$6,900	\$0	\$6,900
4.17 Hydro Seed, with mulch & fertilizer	369	msf	\$78.10				\$28,819	\$0	\$0	\$0	\$28,819
4.18 Verification Sampling	80	ea	\$850.00	\$20.00	\$55.00	\$20.00	\$68,000	\$1,600	\$4,400	\$1,600	\$75,600
5 SITE 8B AND SITE 8C PREPARATION											
5.1 Regrade Area, Dozer, 140 hp	10	day			\$307.20	\$611.40	\$0	\$0	\$3,072	\$6,114	\$9,186
5.2 Brush/demo Disposal	1	ls	\$970.00				\$970	\$0	\$0	\$0	\$970
5.3 Reclaim/mixer	10	day			\$307.20	\$1,265.00	\$0	\$0	\$3,072	\$12,650	\$15,722
5.4 Compact, Vibratory Roller (2 rollers)	0	day			\$307.20	\$448.40	\$0	\$0	\$0	\$0	\$0
5.5 Labor, crew of 2	10	day			\$460.00		\$0	\$0	\$4,600	\$0	\$4,600
5.6 Channel Crossing, 24" RCP, rock, backfill, seed	8	ea		\$780.00			\$0	\$6,240	\$0	\$0	\$6,240

NAVAL CONSTRUCTION BATTALION CENTER
Gulfport, Mississippi
Canal Road Dredge Piles EE/CA
Alternative 2: Excavation, Consolidation, and Stabilization
Capital Cost

Item	Quantity	Unit	Subcontract	Unit Cost			Extended Cost				Subtotal
				Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	
6 STABILIZATION, 500 psi											
6.1 Bench-scale Testing	1	ls	\$25,000.00				\$25,000	\$0	\$0	\$0	\$25,000
6.2 Place & Grade Materials, Dozer, 140 hp	8	day			\$307.20	\$611.40	\$0	\$0	\$2,458	\$4,891	\$7,349
6.3 Portland Cement, 14%	146,342	cwt		\$5.85			\$0	\$856,101	\$0	\$0	\$856,101
6.4 Spread Cement	13	day			\$307.20	\$818.80	\$0	\$0	\$3,994	\$10,644	\$14,638
6.5 Mix Cement with Material	13	day			\$307.20	\$1,265.00	\$0	\$0	\$3,994	\$16,445	\$20,439
6.6 Compact, Vibratory Roller (2 rollers)	26	day			\$307.20	\$448.40	\$0	\$0	\$7,987	\$11,658	\$19,646
6.7 Labor, crew of 3	13	day			\$690.00		\$0	\$0	\$8,970	\$0	\$8,970
6.8 Channel Restoration, topsoil, seed, etc.	1	ls		\$5,000.00			\$0	\$5,000	\$0	\$0	\$5,000
7 OTHER											
7.1 Permanent SRT installation	3	ea	\$8,600.00				\$25,800	\$0	\$0	\$0	\$25,800
Subtotal							\$268,650	\$985,812	\$235,933	\$193,032	\$1,683,427
Local Area and Year To Date Adjustments							100.0%	100.9%	86.3%	86.3%	
							\$268,650	\$994,684	\$203,611	\$166,587	\$1,633,531
Overhead on Labor Cost @ 30%									\$61,083		\$61,083
G & A on Labor Cost @ 10%									\$20,361		\$20,361
G & A on Material Cost @ 10%								\$99,468			\$99,468
G & A on Equipment Cost @ 10%										\$16,659	\$16,659
G & A on Subcontract Cost @ 10%							\$26,865				\$26,865
Total Direct Cost							\$295,515	\$1,094,153	\$285,055	\$183,245	\$1,857,968
Indirects on Total Direct Cost @ 25%											\$464,492
Profit on Total Direct Cost @ 10%											\$185,797
Subtotal											\$2,508,257
Health & Safety Monitoring @ 2%											\$50,165
Total Field Cost											\$2,558,422
Contingency on Total Field Costs @ 25%											\$639,605
Engineering on Total Field Cost @ 5.5%											\$140,713
TOTAL COST											\$3,338,740

NAVAL CONSTRUCTION BATTALION CENTER
Gulfport, Mississippi
Canal Road Dredge Piles EE/CA
Alternative 2: Excavation, Consolidation, and Stabilization
Annual Cost

5/25/2007 3:51 PM

Item	Item Cost per round	Item Cost every x years	Notes
Sampling ⁽¹⁾	\$10,000	\$0	Labor, Field Supplies. Baseline, semiannual for yrs 1 and 2, annually thereafter.
Report ⁽¹⁾	\$0	\$0	Document sampling events and results
Site Review ⁽¹⁾	\$0	\$0	Five Year Site Reviews
TOTALS	\$10,000	\$0	

(1) Long-term monitoring reporting and site reviews are currently being performed. Costs reflected above are only for sediment sampling associated with Site 8B and Site 8C permanent SRTs.

NAVAL CONSTRUCTION BATTALION CENTER
Gulfport, Mississippi
Canal Road Dredge Piles EE/CA
Alternative 2: Excavation, Consolidation, and Stabilization
Present Worth Analysis

5/25/2007 3:52 PM

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	\$3,338,740	\$10,000	\$3,338,740	1.000	\$3,338,740
1		\$20,000	\$20,000	0.935	\$18,700
2		\$20,000	\$20,000	0.873	\$17,460
3		\$10,000	\$10,000	0.816	\$8,160
4		\$10,000	\$10,000	0.763	\$7,630
5		\$10,000	\$10,000	0.713	\$7,130
6		\$10,000	\$10,000	0.666	\$6,660
7		\$10,000	\$10,000	0.623	\$6,230
8		\$10,000	\$10,000	0.582	\$5,820
9		\$10,000	\$10,000	0.544	\$5,440
10		\$10,000	\$10,000	0.508	\$5,080
11		\$10,000	\$10,000	0.475	\$4,750
12		\$10,000	\$10,000	0.444	\$4,440
13		\$10,000	\$10,000	0.415	\$4,150
14		\$10,000	\$10,000	0.388	\$3,880
15		\$10,000	\$10,000	0.362	\$3,620
16		\$10,000	\$10,000	0.339	\$3,390
17		\$10,000	\$10,000	0.317	\$3,170
18		\$10,000	\$10,000	0.296	\$2,960
19		\$10,000	\$10,000	0.277	\$2,770
20		\$10,000	\$10,000	0.258	\$2,580
21		\$10,000	\$10,000	0.242	\$2,420
22		\$10,000	\$10,000	0.226	\$2,260
23		\$10,000	\$10,000	0.211	\$2,110
24		\$10,000	\$10,000	0.197	\$1,970
25		\$10,000	\$10,000	0.184	\$1,840
26		\$10,000	\$10,000	0.172	\$1,720
27		\$10,000	\$10,000	0.161	\$1,610
28		\$10,000	\$10,000	0.150	\$1,500
29		\$10,000	\$10,000	0.141	\$1,410
30		\$10,000	\$10,000	0.131	\$1,310
TOTAL PRESENT WORTH					\$3,480,910

CLIENT: NCBC Gulfport, Gulfport, MI		JOB NUMBER: 112G00521.11.130	
SUBJECT: Canal Road Dredge Piles EE/CA			
BASED ON:		DRAWING NUMBER:	
BY: RCM	CHECKED BY: TJR	APPROVED BY:	DATE:
Date: 2/12/07	Date: 2/23/07		

CALCULATIONS and ASSUMPTIONS:

Site 8B, area =	722,712 sq ft 80,301 sq yd 16.59 acres (26,767 cy)	(planimetry using AutoCAD, Figure 2-8) (volume assuming 1.0 ft avg. depth over entire area) (perimeter, Figure 2-8)
Site 8C, area =	148,715 sq ft 16,524 sq yd 3.41 acres (5,508 cy)	(planimetry using AutoCAD, Figure 2-8) (volume assuming 1.0 ft avg. depth over entire area) (perimeter, Figure 2-8)
Site 8B + Site 8C, area =	871,427 sq ft 96,825 sq yd 20.0 acres (32,275 cy)	(volume assuming 1.0 ft avg. depth over entire area)
Canal Road dredge piles, area =	132,084 sq ft 3.03 acres	(footprint including existing grade pts; planimetry using AutoCAD, Appendix A figures)
Canal Road dredge piles, shaded area (<u>Not Used</u>) =	73,750 sq ft 1.69 acres	(footprint excluding existing grade pts; planimetry using AutoCAD, shaded area on Appendix A figures)
Canal Road dredge piles, length =	4,072 ft	(length using AutoCAD, Appendix A figures)
Canal Road dredge piles, volume =	174,555 cu ft 6,465 cy 9,601 tons	(interpolation between existing grade pts serves as pile base; average end area using AutoCAD, Appendix A figures) (assuming density of 110 pcf ... 1.485)
Canal Road dredge piles	240,597 cu ft 8,911 cy 13,233 tons	(dredge pile volume plus 6" additional excavation beneath pile footprint) (assuming density of 110 pcf ... 1.485)

Volumes are in-place cubic yards unless otherwise noted.

CLIENT: NCBC Gulfport, Gulfport, MI		JOB NUMBER: 112G00521.11.130	
SUBJECT: Canal Road Dredge Piles EE/CA			
BASED ON:		DRAWING NUMBER:	
BY: RCM	CHECKED BY: TJR	APPROVED BY:	DATE:
Date: 2/12/07	Date: 2/23/07		

Assumptions

Assume mobilization of eight pieces of equipment.

Canal Road Dredge Piles

Install canal crossing by placing 96-inch diameter reinforced concrete pipe (RCP) on bed of geotextile and gravel. Backfill sides and top of pipe with gravel. Assume pipe and gravel are left in place after completion of work. Assume 100 lf of 96-inch diameter RCP, 100 cy of gravel and 250 sy of geotextile needed to complete.

Area to clear of vegetation = 7.71 acres (dredge pile footprint plus length x 50 ft)
 time to clear 0.35 acres per day
 7.71 acres / 0.35 acres/day = 22 days

No grubbing will take place at excavation area with trees chipped and hauled to center for mulch. Stumps to be chipped in place and removed with soil. Existing fence to be removed and reset.

Assume the limiting factor affecting the duration of excavation is hauling the soil from the Canal Road dredge pile area to the off-site TSDF. Therefore, the total excavation time is as follows:

Haul volume = 8,911 cy
 No. of Truck Loads = 637 truck loads (assume dump trailers w/25 cy & 22 ton capacity, weight of 1.485 tons/cy controls or 14.81 cy/load, further assume slightly underloaded so use 14.0 cy/load)
 No. of Days (Alternative 1) = 40 days (assume haz waste TSDF approx. 200 miles / 3 hrs 39 minutes 1-way; assume average 16 loads/day)
 No. of Days (Alternative 2) = 19 days (assume 2.5 miles one-way haul, 2 loads/hour/truck, 10 hr workday w/8.5 productive hrs/day, 2 trucks)

No. of SRTs = 9 SRTs (spaced 1/500 ft over dredge pile length, rounded up)

Silt fence 4,232 ft (dredge pile length plus breadth of pile incl access at N & S ends)

Backfill 500 cy (assumed 5% excavation volume, rounded up)

Topsoil 2,446 cy (dredge pile area x 6")

Hydro seed 369 msf (cleared area +10%)

CLIENT: NCBC Gulfport, Gulfport, MI		JOB NUMBER: 112G00521.11.130	
SUBJECT: Canal Road Dredge Piles EE/CA			
BASED ON:		DRAWING NUMBER:	
BY: RCM	CHECKED BY: TJR	APPROVED BY:	DATE:
Date: 2/12/07	Date: 2/23/07		

Time to compete project

	Alternative		
	1	2	
Mobilization (Site 8B & 8C)	0	10	
Canal Road Activities	88	62	
Site 8B & 8C Stabilization	0	13	
Demobilization	5	5	
	93	90	work days
	18.6	18.0	work weeks
	4.4	4.3	work months