Interim Removal Action Report Excavation of Contaminated Soil and Groundwater Monitoring at Site 43

Naval Air Station Pensacola
Pensacola, Florida

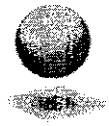
Revision 01

Contract No. N62467-98-D-0995
Contract Task Order No. 0027

Submitted to

Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Prepared by



CH2MHILL
Constructors, Inc.

115 Perimeter Center Place, N.E.
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September 2003

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Prepared/Approved By:

_____ _____
Greg Wilfley, Project Manager Date

Approved By:

_____ _____
Scott Smith, Acting Program Manager Date

Client Acceptance:

_____ _____
U.S. Navy Responsible Authority Date

CH2MHILL
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Certificate of Completion

CH2M HILL Constructors, Inc., attests that, to the best of its knowledge and belief, the Interim Removal Action at Site 43, delivered under Contract No. N62467-98-D-0995, Naval Air Station Pensacola, Pensacola, Florida, CTO 0027, has been completed, inspected, and tested, and complies with the contract.

Ryan Bitely
Project QC Manager

9-2-09
Date

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This Interim Removal Action Report for Excavation of Contaminated Soil and Groundwater Monitoring at Site 43, Naval Air Station Pensacola, Pensacola, Florida, was prepared under the direction of a Florida registered Professional Engineer.

Chris Hood, P.E. No. 53927
Expires February 28, 2005

29 Aug 05

Date

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Acronyms and Abbreviations

bls	below land surface
btoc	below top of casing
°C	degrees Celsius
CCI	CH2M HILL Constructors, Inc.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CompQAP	Comprehensive Quality Assurance Plan
CWO4	Chief Warrant Officer 4
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct-push technology
DQOs	Data Quality Objectives
DTW	depth to water
EISOPQAM	Environmental Investigation Standard Operating Procedures and Quality Assurance Manual
EQIS	Environmental Quality Industrial Services
EPA	U.S. Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FL-PRO	Florida Petroleum Residual Organic
GCTLs	groundwater cleanup target levels
IR	Installation Restoration
IRA	Interim Remedial Action
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mS/cm	micro Siemens per centimeter
NACIP	Naval Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NAVD	North American Vertical Datum
NAVFAC	Naval Facilities Engineering Command
NEESA	Naval Energy and Environmental Support Activity
NTU	nephelometric turbidity unit
PA	Preliminary Assessment
PCBs	polychlorinated biphenyls
PPE	personal protective equipment
QA	Quality Assurance
QC	Quality Control
RCI	reactivity/corrosivity/ignitability
RL	reporting limit
ROICC	Resident Officer in Charge of Construction

SARA	Superfund Amendments and Reauthorization Act of 1986
SCTLs	soil cleanup target levels
SI	Site Inspection
SPLP	synthetic precipitation leaching procedure
SVOC	semivolatile organic compounds
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TOC	top of casing
TtNUS	Tetra Tech NUS
UCL	upper confidence level
UXO	unexploded ordinance
VOC	volatile organic compound

Executive Summary

CH2M HILL Constructors, Inc. (CCI) conducted the following activities at Naval Air Station (NAS) Pensacola, Site 43:

- Sampled, characterized, and removed contaminants of concern (COC).
- Removed metal debris observed during excavation.
- Transported and disposed of metal impacted soil and debris to an approved permitted offsite facility.
- Conducted quality control (QC) activities during construction and quality assurance (QA) reporting to document the Interim Remedial Action (IRA) efforts.

Remedial Goals (RGs) were established for some COCs at the site using the 95 percent upper confidence level (UCL) procedure for surface soil. Once the 95 percent UCL-based RGs were calculated and approved by the regulators, samples were collected to delineate the extent of contamination prior to excavation activities. Forty-one native surface soil samples, 21 subsurface samples, and associated QA/QC samples were collected by CCI in the vicinity of the identified remedial areas for source delineation of the associated metals, including antimony, arsenic, barium, copper, iron, lead, nickel, vanadium, and zinc. Severn Trent Laboratories, located in Pensacola, Florida, analyzed samples collected for the specified COC in each particular area. Based on the laboratory results, areas for excavation were defined.

Of the initial 15 anomalous areas characterized for contamination, six areas exceeded the initial cleanup criteria outlined in the Site 43 Work Plan. These areas were former Pit Numbers 4, 14, 15, 16, 20, and 22. From April 11 though May 3, 2002, a total of 657 cubic yards of soil and debris were removed from these areas at Site 43. Following excavation activities, the cleanup criteria were reevaluated and revised. Many of the RGs established using the 95 percent UCL were not appropriate for the site. Consequently, it was determined that nine other areas, former Pit Numbers 11, 12, 13, 17, 18, 19, 21, 23, and 24, contained samples that exceeded the revised cleanup criteria. Some of these areas were excavated during IRA activities.

Due to limited space onsite, excavated soil was either stockpiled or directly loaded into transport vehicles. The soil was analyzed and determined to be hazardous for lead and was manifested accordingly. Approximately 20 to 25 rusted metal drums and drum parts, and inert ornamental ordnance and munitions were uncovered during the excavation in addition to the 14 drums found during the initial site investigation. The soil, drums, drum parts, and inert ornamental ordnance and munitions were disposed of at Michigan Disposal Waste Treatment Facility in Belleville, Michigan. Decontamination wastewater was analyzed and determined to be non-hazardous waste. The subcontractor disposed of the wastewater and two drums that contained unknown liquids.

Excavated areas were backfilled with a clayey soil for the liner and topsoil for the upper 1 foot, compacted, and tested using a nuclear density gauge for required density and

moisture content. All areas were hydro-seeded with a blend of brown top millet and Bermuda grass, as well as, lawn fertilizer.

Baseline groundwater sampling was conducted prior to excavation activities and a subsequent round of semi-annual groundwater sampling was conducted after excavation activities were complete. Groundwater was only sampled for iron which was the only groundwater COC identified in the SI. Iron concentrations in groundwater were below the established NAS Pensacola background concentration of 1,707 micrograms per liter ($\mu g/L$) for two consecutive sampling events.

Due to the revised (lower) remedial goals established for the site after soil removal activities were completed, CCI recommends a Remedial Investigation/Feasibility Study be conducted to delineate COC contamination and identify a final remedy for this site.

1.0 Introduction

CH2M HILL Constructors, Inc. (CCI) has been contracted by the Department of the Navy, Southern Division, Naval Facilities Engineering Command (NAVFAC), to prepare this Interim Removal Action (IRA) Report to document the work performed at Site 43 by CCI at the Naval Air Station (NAS) Pensacola in Pensacola, Florida. This work was performed under Contract No. N62467-98-D-0995, CTO No. 0027 and in accordance with the following documents:

- Management approach outlined in the CCI Contract Management Plan (July 1998)
- CCI Basewide Work Plan – Revision 00 (June 2000)
- CCI Work Plan Addendum 03 – Excavation of Contaminated Soil and Groundwater Monitoring at Site 43, NAS Pensacola, Revision 00 (April 2001)

This report is organized into the following sections:

Section 1.0 Introduction includes a summary of the scope of the project, site setting, regulatory framework, and the remedial action objectives for the work.

Section 2.0 Significant Events includes a discussion of the chronology of events and lists the Interim Remedial Action (IRA) participants.

Section 3.0 Soil Characterization includes a summary of the soil investigation conducted to define the extent of the excavation.

Section 4.0 Interim Remedial Action Activities provides a summary of the IRA activities undertaken during the performance of the work.

Section 5.0 Groundwater Monitoring presents the results of the baseline and first semi-annual groundwater events.

Section 6.0 Data Quality Evaluation summarizes the results of the soil and groundwater investigations.

Section 7.0 Problems Encountered summarizes the problems encountered during the course of work.

Section 8.0 Final Inspections documents the final inspection performed in completing the work.

Section 9.0 Conclusions and Recommendations provides information on any conclusions and recommendations drawn by CCI during the performance of the work at Site 43.

Section 10.0 Works Cited lists the references used in completing the work at Site 43.

The following support information is presented as appendices to this Project Completion Report:

- Appendix A 95 Percent Upper Confidence Level Guidance and Methodology
- Appendix B Contractor Production Reports and Contractor Quality Control Reports

- Appendix C Project Photographs
- Appendix D Data Validation Report
- Appendix E Utility Excavation Permit
- Appendix F Pre- and Post-Excavation Survey
- Appendix G Offsite Backfill Analytical Results
- Appendix H Geotechnical Test and Results
- Appendix I Waste Disposal Documentation
- Appendix J Field Data Sheets
- Appendix K EPA and FDEP Comments and Navy Response to Comments

1.1 Project Scope

In CCI's Work Plan Addendum 03 – Excavation of Contaminated Soil and Groundwater Monitoring at Site 43, NAS Pensacola, Revision 00 (April 2001), CCI proposed to Southern Division, NAVFAC to perform the following activities:

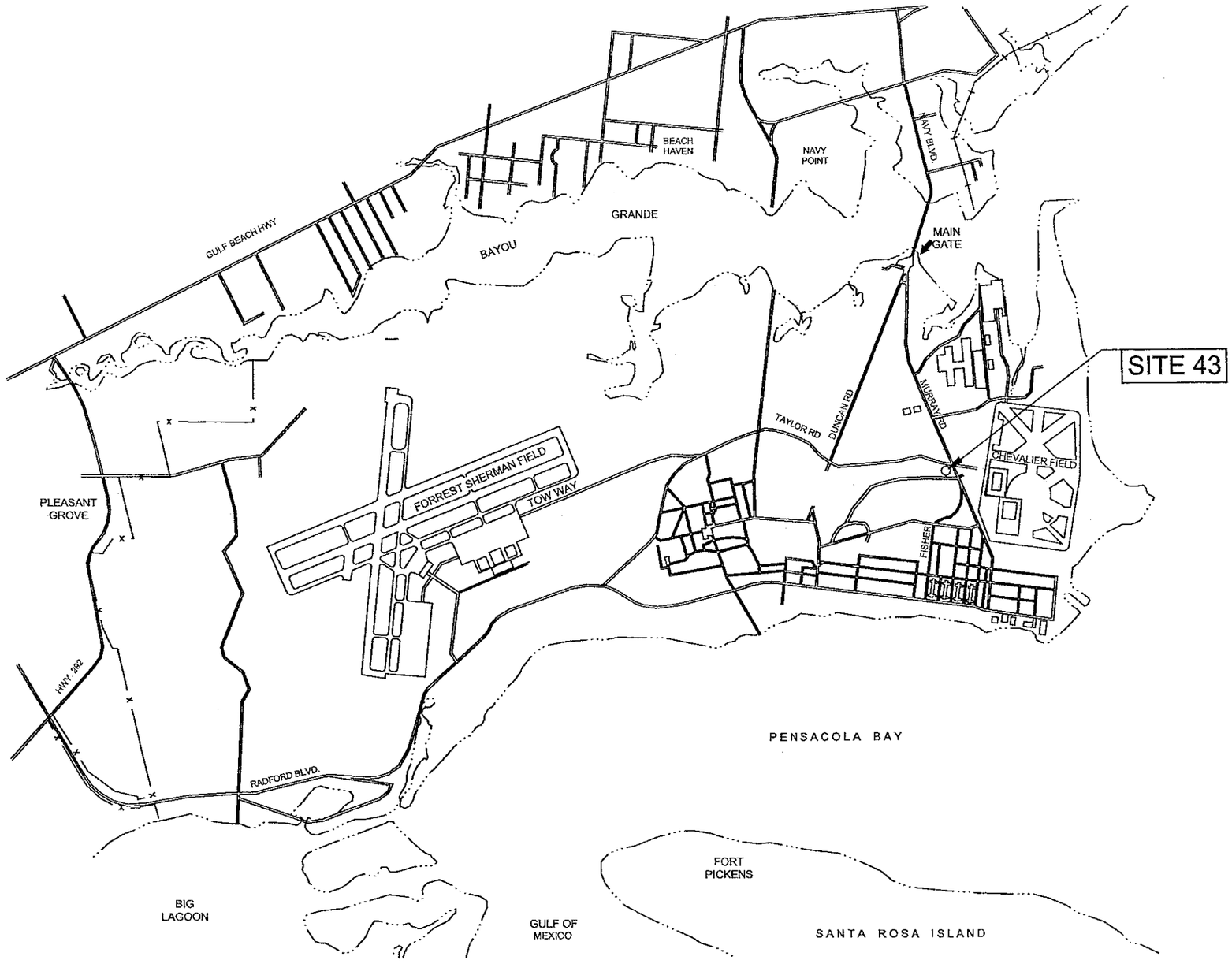
- Mobilization and setup
- Site utility clearance
- Former sample point location survey
- Soil sampling for horizontal and vertical delineation
- Pre-excavation survey
- Excavation of contaminated soil
- Post excavation survey
- Site restoration
- Waste management and disposal
- Decontamination and demobilization
- Semi-annual groundwater monitoring well sampling

This report documents the completion of each of these activities.

1.2 Site Background

1.2.1 Site Setting

Site 43 is located at the southwest corner of Murray and Taylor Roads of the Naval Air Station as shown on Figure 1-1. The site, which includes a tennis court (since abandoned), an old building foundation, and access roads to the officer's quarters, is approximately 40,000 square feet in size (Figure 1-2). The site was historically used to dispose of metallic wastes resembling drums of unknown contents. The discovery of buried drums occurred in December 1992, when a child playing with a metal detector discovered two partially buried drums exposed at the surface, east of the tennis court. No odors, visible soil stains, or other indications of contamination were observed at the time the drums were discovered. Results from a Site Characterization Investigation conducted in April 2000, indicated that surface soil, subsurface soil to a depth of 3.5 feet, and groundwater have been impacted by the historical use of Site 43 as a drum storage area (Tetra Tech NUS [TtNUS], 2000). Figure 1-2



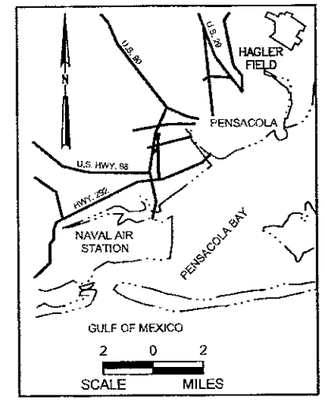


FIGURE 1-1

Site Location Map

Site 43, NAS Pensacola

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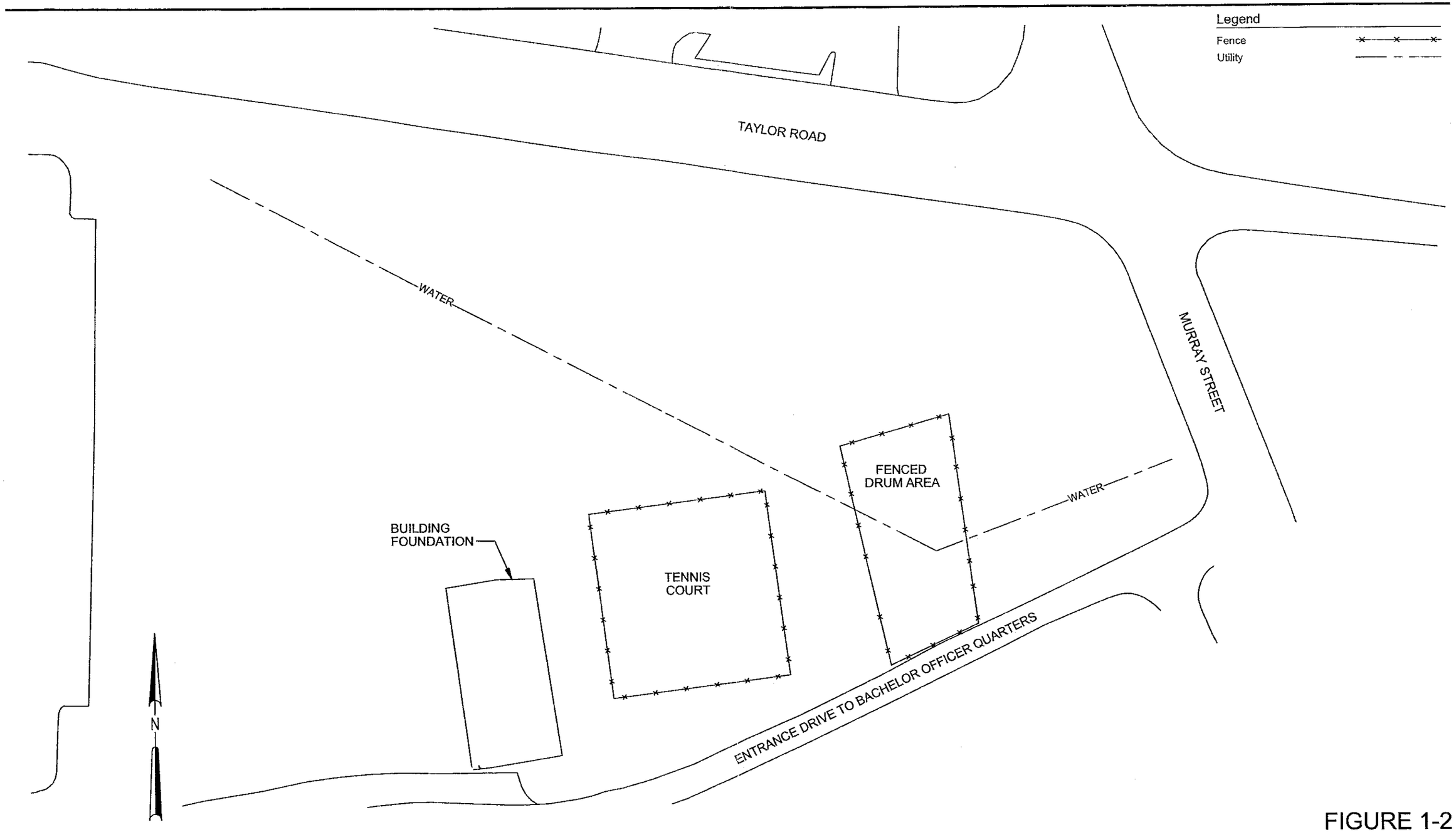

FIGURE 1-2
Site Layout
Site 43, NAS Pensacola

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presents the site layout as it appeared prior to and during IRA activities. The tennis court has since been removed as well as the fencing around the former drum area.

1.2.2 Geology/Hydrogeology

Regional

NAS Pensacola is located in the extreme southeastern portion of Escambia County, Florida, which lies within the Coastal Plain Province of the United States. As described in the *Initial Assessment of NAS Pensacola* (Naval Energy and Environmental Support Activity [NEESA], 1983), NAS Pensacola lies within the coastal lowland that is characterized by a series of broad, nearly level marine terraces that extend several miles from the coast and merge with the narrow terraces along the Escambia and Perdido Rivers. NAS Pensacola is bordered on the south by Big Lagoon, on the east by Pensacola Bay, and on the north by Bayou Grande. Swampy areas exist on or near the western portion of NAS Pensacola, and manmade drainage ways and storm drains feed into the short intermittent streams emptying into the bay and bayou. No perennial streams enter or exit NAS Pensacola, but the marshy areas and three small lakes retain water throughout the year. The general elevation of NAS Pensacola is approximately 40 feet above mean sea level (TtNUS 2000).

The surficial geology of the area consists of Pleistocene marine deposits made up of light brown to tan fine quartz sand with associated stringers and lenses of gravel and clay. Underlying these deposits, increasing with age, are the Citronelle Formation, the Miocene Coarse Clastics, the Pensacola Clay, the Tampa Formation, the Chickasawhay Limestone, the Bucatunna Clay member of the Byram Formation, the Ocala Group, the Lisbon equivalent, the Tallahatta Formation, and the Hatchetigbee Formation. The Pleistocene deposits and Citronelle formation are often impossible to differentiate, and together range in thickness from approximately 30 to 800 feet across the county (NEESA, 1983).

The groundwater is under artesian conditions where layers of clay, sandy clay, or hardpan are present, and under non-artesian conditions where such clays and hardpans are absent. Water levels in the shallow aquifer range from zero to approximately 30 feet below land surface (bls) across in the NAS Pensacola area. The groundwater flow has historically been toward the Gulf of Mexico and the Escambia and Perdido rivers, although groundwater flow can vary locally due to the effect of topography or surface water bodies. The aquifer recharge is most dominantly from local precipitation. The Floridan aquifer is separated from the Sand and Gravel aquifer by a thick section of clay and is subdivided into two parts, upper and lower, by an extensive clay bed (TtNUS, 2000).

Site-Specific

Based on the lithologic descriptions provided by TtNUS during the Site Characterization Investigation, the subsurface soil generally consists of light to dark brown, fine to medium sand with interspersed white fine sand (TtNUS, 2000). Groundwater was encountered between 13 and 124 feet bls during this investigation.

Legend

Geophysical Anomaly

Fence

Utility

TAYLOR ROAD

MURRAY STREET

WATER

WATER

FENCED DRUM AREA

TENNIS COURT

BUILDING FOUNDATION

ENTRANCE DRIVE TO BACHELOR OFFICER QUARTERS

N

0 60 120 180

Scale: 1" = 60'

FIGURE 1-3

Geophysical Anomaly Locations

Site 43, NAS Pensacola

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2.0 Significant Events

The following sections provide a timeline of the main construction events and list the IRA participants.

2.1 Chronology of Events

The chronology of events for the main construction activities is listed in Table 2-1.

TABLE 2-1
CHRONOLOGY OF EVENTS

Event	Date
CCI Cost Proposal to Southern Division, NAVFAC	May 17, 2001
CCI Basewide Work Plan	June 2000
CCI Work Plan Addendum 03	April 2001
Former sample point location survey	September 10, 2001
Surface soil sampling	August 23, 2001
Surface and subsurface soil sampling	September 10 and 11, 2001
Surface soil sampling	September 24, 2001
Surface soil sampling	November 19, 2001
Groundwater monitoring wells located. Water levels measured. Baseline groundwater sampling was conducted for wells PEN-43-1S and PEN-43-4S.	November 28, 2001
Surface Soil Sampling	December 06, 2001
Redeveloped wells PEN-43-2S, PEN-43-3S and PEN-43-5S to remove the silt.	December 07, 2001
Pre-excavation survey; Monitoring wells PEN-43-2S, PEN-43-3S and PEN-43-5S were sampled as a continuation of the baseline sampling event.	December 12, 2001
In-situ disposal profile sampling	January 28, 2002
A complete round of water levels was collected across the site.	February 01, 2002
Remediation mobilization	April 03, 2002
Utility excavation permit approval	April 10, 2002
Excavation contaminated soil	April 11, 2002
Load-out contaminated soil for offsite disposal	April 12, 2002
Interruption of activities due to potential unexploded ordnance (UXO) threat	April 15, 2002
Resolution of UXO threat and return to excavation/load-out	April 19, 2002
Completion of excavation and load-out	April 23, 2002

3.0 Soil Characterization

Surface and subsurface soil samples were collected for characterization of contaminants of potential concern (COPCs) prior to excavation activities to eliminate leaving the excavation open for prolonged periods and to facilitate accurate quantification of soil.

Of the 15 anomalous areas determined to have surface or subsurface soil exceedances during the site characterization study, only six areas were determined to require further investigation and possible remediation. The contaminated areas that were chosen to be further evaluated were determined by establishing a 95 percent upper confidence level (UCL) based on the results of the 17 surface soil samples that were collected in April 2000 (TtNUS, 2000). The concentrations of the COPCs to which humans receptors will be exposed over time were estimated to determine a 95 percent UCL on the mean of COPC concentrations. Section 2.1.3 of CCI's Work Plan Addendum describes the statistical analyses used to create the established RGs (CCI 2001). The statistical approach and calculations are also included in Appendix A.

Table 3-1 presents the RGs established for the COCs identified at the site using either 62-777, FAC, EPA Region IX Preliminary Remedial Goals (PRGs), or the 95 percent UCL statistical approach. These RGs were presented in various technical memos and the work plan for this site and were used to determine the extent of soil contamination prior to IRA activities. Subsequent to the IRA, errors were noted in the calculation of the remedial goals. The remedial goals were later revised. The revised RGs and the consequences associated with these revisions are discussed in Section 4.10.

TABLE 3-1
Remedial Goals Established Prior to IRA Activities

COC	Surface Soil Remedial Goals (mg/kg)	Subsurface Soil Remedial Goals (mg/kg)
Antimony	5[2]	5[2]
Arsenic	21.93[3]	29[2]
Barium	1533[3]	1,600[2]
Copper	11,226[3]	N/A
Iron	81,900[3]	N/A
Lead	9,390[3]	N/A
Nickel	116.4[3]	130[2]
Vanadium	158.1[3]	N/A
Zinc	23,000[1]	6,000[2]

[1]Chapter 62-777, FAC, Residential Direct Exposure
[2]Chapter 62-777, FAC, Leachability based on Groundwater
[3]Established using three times the 95 percent UCL
mg/kg = milligrams per kilogram
N/A = Not Applicable

3.1 Mobilization

CCI personnel, equipment, subcontractors, and materials mobilized to NAS Pensacola on September 10, 2001, to establish former sample point locations and conduct the initial series of characterization/confirmation samples for the NAS Pensacola Site 43 Remediation Project. Subcontractors utilized for the various tasks are listed in Section 2-1.

3.2 Field Observation

CCI provided oversight of all field operations throughout the course of the project. CCI field oversight staff included a project manager and a site superintendent/health and safety officer, and quality control manager. Detailed records of subcontractor activities were maintained in field logbooks and site field records, including daily Contractor Production Reports and Contractor Quality Control Reports (Appendix B). These reports were completed by CCI. In addition, photographs of all site activities were collected throughout the project. Representative photographs documenting the work are included in Appendix C.

3.3 Site Utility Clearance

During the soil sampling phase of the project, CCI utilized the excavation permit obtained by the Comprehensive Long-term Environmental Action Navy (CLEAN) contractor (TtNUS), as provided by NAS Pensacola Environmental. The permit noted there were no utilities in the area of proposed soil sampling, but underground power and telephone lines were located along the entrance road south of the site. Site utilities were not marked.

3.4 Former Sample Location Point Location Survey

On September 10, 2001, a Florida Registered Land Surveyor from Southern Surveying, Inc. of Navarre, Florida, located the former sample points where elevated concentrations of contaminants were detected. The land surveyor used the State Plane Coordinates provided by the CLEAN contractor to re-establish the former sample point locations. Wooden stakes were used to identify the former sample point locations. Once located, the original sample points were used as benchmarks to establish a baseline grid system for further characterization sampling.

3.5 Soil Sample Collection

Based on the former RGs listed in Table 3-1, soil sampling began with collection of surface samples on the perimeter of each of the six identified hot spot areas (Areas 4, 14, 15, 16, 20, and 22); one surface sample from each side at the proposed excavation limits; and one subsurface sample at the surveyed-in original sample point (more on the larger areas). If the analytical data indicated the former remedial goals listed in Table 3-1 were achieved, no further sampling was conducted. If the former remedial goals listed in Table 3-1 were not achieved then additional sample(s) were collected 5 feet further out from the previous sample(s). Select samples were also analyzed for leachability using EPA Method 1312, SPLP. If the sample results showed no leaching potential, no further sampling was conducted. However, if leaching occurred, the vertical and horizontal extent was further characterized by collecting additional samples at 5-foot intervals until an excavation volume could be assessed. This sampling pattern was proposed to continue until the remediation cleanup goals were reached. If the vertical delineation sample results exceeded the former RGs, additional samples were collected at 5-foot intervals, beginning from 5 to 6 feet bls until clean soil was found or until the groundwater table was reached, whichever occurred first.

From August 23 through September 24, 2001, 41 native surface soil samples, 21 subsurface samples, and associated QA/QC samples were collected by CCI in the vicinity of the identified remedial areas for the source delineation of the associated metals. Figure 3-1 presents the sample locations. The surface soil samples were taken from 0 to 2 feet bls and analyzed for the specified COCs for that area. The determination of whether to continue collecting samples was based on the analytical results of the initial samples.

Since large quantities of metal debris had been encountered, CCI extended the sampling boundary to the edge of the road to the south of the site, the tree line to the east of the site, and to the tennis court west of the drum area and collected perimeter samples. Because some sample results were found to be below the RGs, samples were collected inward toward the contamination from the perimeter until the area had been characterized.

Shallow soil samples were collected using decontaminated stainless steel hand augers. The deeper samples were collected using drill rig equipped for direct-push technology (DPT). Kelly Environmental Drilling of Fort Walton Beach, Florida performed the DPT drilling. Soil was placed into stainless steel bowls, thoroughly mixed using stainless steel spoons, and placed in glass jars. All sampling was conducted in accordance with CCI's Basewide Work Plan for NAS Pensacola (CCI, 1999), FDEP Standard Operating Procedures and the EPA, Region IV Environmental Investigation Standard Operating Procedures and Quality Assurance Manual (EISOPQAM) dated May 1996, revised 1997. All samples were delivered to Severn Trent Laboratories in Pensacola, Florida (a Navy-approved laboratory). Samples were analyzed for select metals by EPA Method 6010B. Select samples were analyzed for leachable metals using EPA Method 1312, SPLP.

3.6 Results

Large areas of metal debris were encountered at the site primarily near the tennis court area to the west, midway through the tree line to the east, to the road to the south, and to the swale to the north (about 10 yards north of fenced area). Groundwater was encountered from 13 to 14 feet bls.

Table 3-2 summarizes the surface soil results. Table 3-3 summarizes the subsurface soil results. The Data Quality Evaluation (DQE) performed for the analytical results is presented in Appendix D.

Metals exceeding the RGs listed in Table 3-1 include antimony, arsenic, barium, copper, iron, lead, nickel, vanadium, and zinc. All were found at concentrations above their respective former and revised RGs. A few of these metals also leached from the soil using the SPLP methodology.

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS18
Subsurface Soil Sample Designation	43SO05

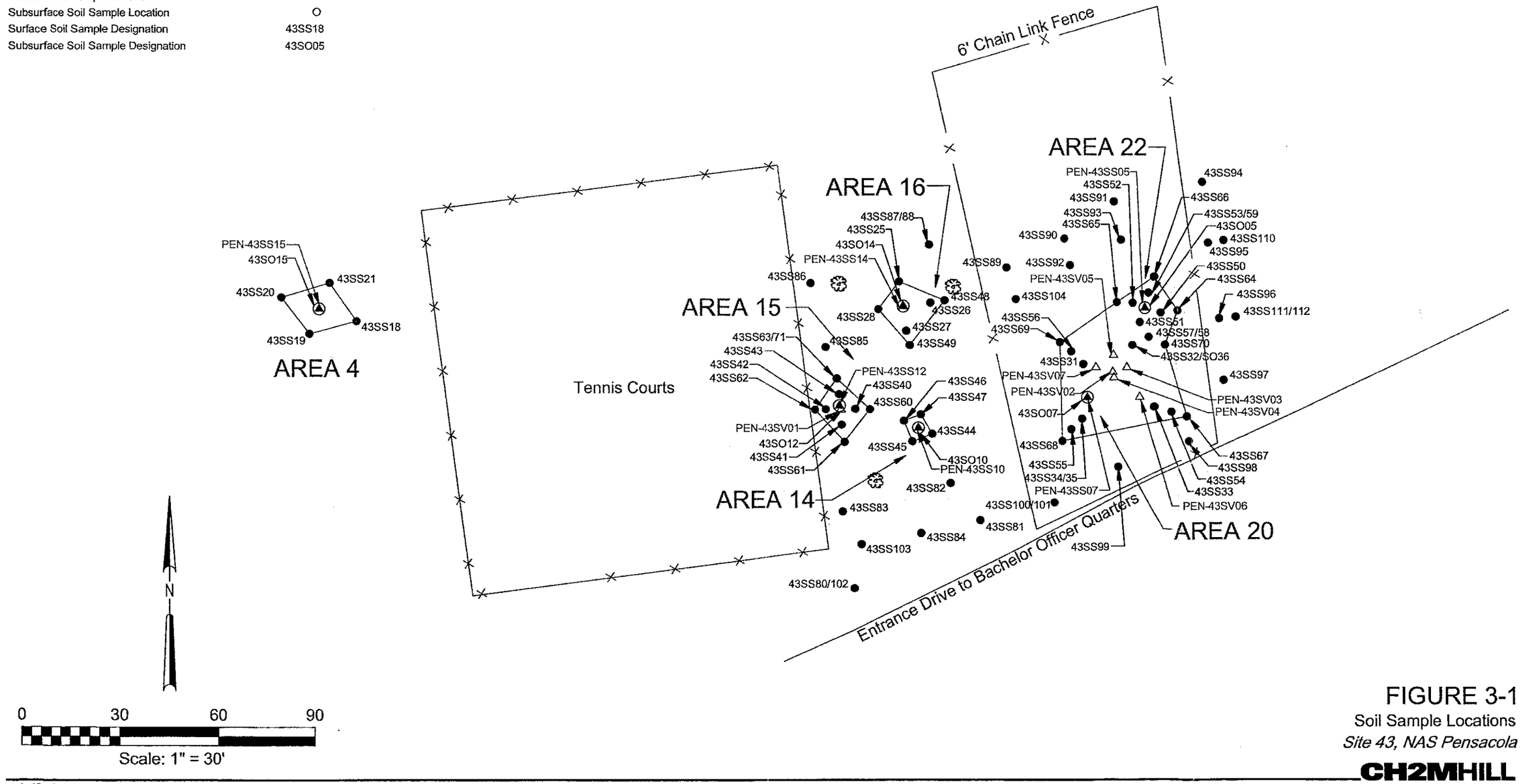

FIGURE 3-1
Soil Sample Locations
Site 43, NAS Pensacola

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS18-S-02 0-2'		43SS19-S-02 0-2'		43SS20-S-02 0-2'		43SS21-S-02 0-2'		43SS25-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	4.9 U	--	0.31 B	--	0.26 B	--	5.3 U	--	4.4 U	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	12	--
Iron	81,900*	--	--	--	--	--	--	--	--	--	--
Lead	9,390*	--	--	--	--	--	--	--	--	48	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

Notes:
* Based on 3x the 95% Upper Confidence Level
** Based on Chapter 62-777 FAC Leachability based on groundwater
***Based on Chapter 62-777 FAC Direct Exposure for Residential
Sample concentrations exceeding regulatory guidelines are **BOLD**.
SPLP = Leachability values may be derived using the SPLP test to calculate site-specific soil cleanup target levels
B = Report Value is less than the RL but greater than or equal to the MDL
E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS26-S-02 0-2'		43SS27-S-02 0-2'		43SS28-S-02 0-2'		43SS31-S-02 0-2'		43SS32-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	25	--	23	--	4.8 U	--	**31**	--	**60**	--
Arsenic	21.93*	--	--	--	--	--	--	**30**	--	18	--
Barium	1533*	--	--	--	--	--	--	**2300**	--	**2200**	--
Copper	11,226*	2300	--	1100	--	6.0	--	2900	--	5800	--
Iron	81,900*	--	--	--	--	--	--	**98000**	--	59000	--
Lead	9,390*	**9800**	--	4000	--	20	--	**9900**	--	**10000**	--
Nickel	116.4*	--	--	--	--	--	--	110	--	**410**	--
Vanadium	158.1*	--	--	--	--	--	--	130	--	**670**	--
Zinc	23,000***	--	--	--	--	--	--	10000	--	9100	--

Notes:
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E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SO36-S-06 Dupe of 43SS32 0-2'		43SS33-S-02 0-2'		43SS34-S-02 0-2'		43SS35-S-02 Dupe of 43SS34 0-2'		43SS40-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	**30**	24 B	**54**	--	**44**	250 U	20	--	16 N	--
Arsenic	21.93*	**35**	25 U	32	--	**52**	25 U	**28**	--	--	--
Barium	1533*	**1900**	**320**	**2000**	--	**2300**	**770**	**2400**	--	--	--
Copper	11,226*	**40,000**	**550**	**54,000**	--	4500	**57**	3500	--	7600 N	--
Iron	81,900*	69,000	**1500**	**120,000**	--	**150,000**	**190 B**	53,000	--	79000 N	--
Lead	9,390*	**16,000**	**1300**	**9800**	--	**12,000**	**630**	**23,000**	--	4000 N	--
Nickel	116.4*	**400**	**310**	60	--	**160**	25 U	62	--	**569 N**	--
Vanadium	158.1*	**870**	**56**	31	--	40	50 U	34	--	--	--
Zinc	23,000***	13,000	**27,000**	**34,000**	--	11,000	**1200**	15000	--	--	--

Notes:
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J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS41-S-02 0-2'		43SS42-S-01 0-2'		43SS43-S-02 0-2'		43SS44-S-02 0-2'		43SS45-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	9.1	--	23	--	17	--	**850**	--	**460**	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	610	--	440	--	4700	--	3400	--	3400	--
Iron	81,900*	13000	--	14000	--	**110,000**	--	--	--	--	--
Lead	9,390*	1800	--	1200	--	4500	--	**60,000**	--	7000	--
Nickel	116.4*	42	--	20	--	130	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

Notes:
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Sample concentrations exceeding regulatory guidelines are **BOLD**.
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E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

TABLE 3-4
Surface Soil Results

Compounds	Regulatory Guidelines	43SS46-S-02 0-2'		43SS47-S-02 0-2'		43SS48-S-02 0-2'		43SS49-S-02 0-2'		43SS50-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	**300**	--	**59**	--	**50**	--	**31**	--	21	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	9.2	--
Barium	1533*	--	--	--	--	--	--	--	--	930	--
Copper	11,226*	7200	--	4200	--	2900	--	1100	--	6400	--
Iron	81,900*	--	--	--	--	--	--	--	--	31,000	--
Lead	9,390*	**29,000**	--	6900	--	6900	--	4400	--	2700	--
Nickel	116.4*	--	--	--	--	--	--	--	--	44	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	41	--
Zinc	23,000***	--	--	--	--	--	--	--	--	3900	--

Notes:
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E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS51-S-02 0-2'		43SS52-S-02 0-2'		43SS53-S-02 0-2'		43SS59-S-03 Dupe of 43SS53-S-02 0-2'		43SS54-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	7.9	--	23	--	11	--	24	--	**49**	--
Arsenic	21.93*	12	--	19	--	9.9	--	--	--	--	--
Barium	1533*	660	--	1100	--	690	--	--	--	--	--
Copper	11,226*	900	--	**69,000**	--	1500	--	3700	--	8000	--
Iron	81,900*	60,000	--	72,000	--	32,000	--	74,000	--	**150,000**	--
Lead	9,390*	2100	--	4200	--	2900	--	3400	--	**26,000**	--
Nickel	116.4*	**140**	--	**370**	--	59	--	--	--	--	--
Vanadium	158.1*	26	--	120	--	34	--	--	--	--	--
Zinc	23,000***	3800	--	19,000	--	3900	--	--	--	--	--

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J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS55-S-02 0-2'		43SS56-S-02 0-2'		43SS57-S-02 0-2'		43SS58-S-02 Dupe of 43SS57-S-02 0-2'		43SS60-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	26	--	16	--	15	--	23	--	24	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	4800	--	6400	--	1500	--	1700	--	--	--
Iron	81,900*	**180,000**	--	62,000	--	45,000	--	77,000	--	--	--
Lead	9,390*	**13,000**	--	5700	--	4400	--	5300	--	--	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	**210**
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS61-S-02 0-2'		43SS62-S-02 0-2'		43SS63-S-02 0-2'		43SS71-S-02 Dupe of 43SS63 0-2'		43SS64-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	7.8	--	0.41 B	--	20	--	5.8	--	26	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	35,000	--	21,000	--	--	--
Lead	9,390*	--	--	--	--	--	--		--	--	--
Nickel	116.4*	--	--	--	--	70	--	26	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS65-S-02 0-2'		43SS66-S-02 0-2'		43SS67-S-02 0-2'		43SS68-S-02 0-2'		43SS69-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	13	--	**50**	--	**57**	--	**34 NE**	--	**29**	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	51,000	--	**110,000 N**	--	--	--
Lead	9,390*	--	--	--	--	3700 B3	--	9,300 NB3	--	--	--
Nickel	116.4*	80	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS70-S-02 0-2'		43SS80-S-02 0-2'		43SS102-S-02 Dup of 43SS80 0-2'		43SS81-S-02 0-2'		43SS82-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	20	--	0.8 B	--	0.47 B	--	8.3	--	**68 N**	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	--	--	--	--	--	--
Lead	9,390*	--	--	--	--	--	--	--	--	--	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS83-S-02 0-2'		43SS84-S-02 0-2'		43SS85-S-02 0-2'		43SS86-S-02 0-2'		43SS87-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	7.1	--	2.2 B	--	0.91 B	--	0.55 B	--	18	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	--	--	--	--	--	--
Lead	9,390*	--	--	--	--	--	--	--	--	610	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS88-S-02 Dup of 43SS87 0-2'		43SS89-S-02 0-2'		43SS90-S-02 0-2'		43SS91-S-02 0-2'		43SS92-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	3.7 B	--	8.8	--	4.4	--	4.8 U	--	23	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	--	--	--	--	--	--
Lead	9,390*	1200	--	--	--	--	--	--	--	--	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS93-S-02 0-2'		43SS94-S-02 0-2'		43SS95-S-02 0-2'		43SS96-S-02 0-2'		43SS97-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	0.34 B	--	.43 B	--	**31**	--	**53**	--	24	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	--	--	--	--	--	--
Lead	9,390*	--	--	--	--	--	--	--	--	--	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS98-S-02 0-2'		43SS99-S-02 0-2'		43SS100-S-02 0-2'		43SS101-S-02 Dup of 43SS100 0-2'		43SS103-S-02 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	26***	13	--	25	--	3.2 B	--	4.2	--	2.3 B	--
Arsenic	21.93*	--	--	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	56,000 EN	--	12,000	--	--	--
Lead	9,390*	--	--	--	--	--	--	--	--	--	--
Nickel	116.4*	--	--	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--	--	--

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TABLE 3-2
Surface Soil Results

Compounds	Regulatory Guidelines	43SS104-S-02 0-2'		43SS110-S-02 0-2'		43SS111-S-02 0-2'		43SS112-S-02 Dupe of 43SS111 0-2'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals									
Antimony	26***	24	--	7	--	12	--	11	--
Arsenic	21.93*	--	--	--	--	--	--	--	--
Barium	1533*	--	--	--	--	--	--	--	--
Copper	11,226*	--	--	--	--	--	--	--	--
Iron	81,900*	--	--	--	--	--	--	--	--
Lead	9,390*	--	--	--	--	--	--	--	--
Nickel	116.4*	--	--	--	--	--	--	--	--
Vanadium	158.1*	--	--	--	--	--	--	--	--
Zinc	23,000***	--	--	--	--	--	--	--	--

Notes:
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** Based on Chapter 62-777 FAC Leachability based on groundwater
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µg/L = micrograms per liter
-- = Not Analyzed

Table 3-3
Subsurface Soil Results

Compounds	Regulatory Guidelines	43SO05-S-03 2-3'		43SO05-S-8 7-8'		43SO05-S-13 12-13'		43SO07-S-06 5-6'		43SO07-S-8 7-8'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	5**	**58**	**17 B**	0.48	--	0.59 B	--	0.85 B	**14 B**	0.35 B	--
Arsenic	29**	--	--	--	--	--	--	1.0	25 U	0.46 B	--
Barium	1600**	--	--	--	--	--	--	56	**520**	2.6	--
Copper	SPLP	6900	**59**	1.0	50 U	0.84 U	24 B	120 N	**8900 N**	0.85 B	**58**
Iron	SPLP	66000	**560**	1400	**660**	200	**1100**	3200 N	**1000**	1500	**310 B**
Lead	SPLP	5200	**560**	2.3	25 U	0.46	**16**	450 N	**4800**	1.4	25 U
Nickel	130**	--	--	--	--	--	--	3.2	**71**	0.7	--
Vanadium	980**	--	--	--	--	--	--	32	**42 B**	9.2	--
Zinc	6,000***	--	--	--	--	--	--	290 N	**13000**	4.0	--

Notes:
* Based on 3x the 95% Upper Confidence Level
** Based on Chapter 62-777 FAC Leachability based on groundwater
***Based on Chapter 62-777 FAC Direct Exposure for Residential
Sample concentrations exceeding regulatory guidelines are **BOLD.**
the SPLP test to calculate site-specific soil cleanup target levels
B = Report Value is less than the RL but greater than or equal to the MDL
E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

Table 3-3
Subsurface Soil Results

Compounds	Regulatory Guidelines	43SO07-S-100 Dupe Of 43SS007-S-8 7-8'		43SO07-S-13 12-13'		43SO10-S-03 2-3'		43SO10-S-8 7-8'		43SO10-S-13 12-13'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	5**	0.32 B	--	0.46 B	--	**30**	250 U	0.68 B	--	1.0 B	--
Arsenic	29**	0.34 B	--	0.46 U	--	--	--	--	--	--	--
Barium	1600**	2.7	--	0.50 B	--	--	--	--	--	--	--
Copper	SPLP	0.79 B	--	0.91 U	**44 B**	**6500**	**19 B**	1.8	**21 B**	0.37 B	**32**
Iron	SPLP	1500	--	97	**900**	--	--	--	--	--	--
Lead	SPLP	1.3	--	0.63	**38**	**8200**	**47**	2.3	--	1.1	**22**
Nickel	130**	0.69	--	0.46 U	--	--	--	--	--	--	--
Vanadium	980**	9.2	--	0.18 B	--	--	--	--	--	--	--
Zinc	6,000***	4.3	--	1.0 B	--	--	--	--	--	--	--

Notes:
* Based on 3x the 95% Upper Confidence Level
** Based on Chapter 62-777 FAC Leachability based on groundwater
***Based on Chapter 62-777 FAC Direct Exposure for Residential
Sample concentrations exceeding regulatory guidelines are **BOLD.**
the SPLP test to calculate site-specific soil cleanup target levels
B = Report Value is less than the RL but greater than or equal to the MDL
E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

Table 3-3
Subsurface Soil Results

Compounds	Regulatory Guidelines	43SO12-S-06 5-6'		43SO12-S-11 10-11'		43SO12-S-100 Dupe of 43SO12-S-11 10-11'		43SO12-S-14 13-14'		43SO14-S-03 2-3'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	5**	4.7 U	250 U	0.53 B	--	0.47 B	--	0.66 B	--	8.8	11 B
Arsenic	29**	--	--	--	--	--	--	--	--	--	--
Barium	1600**	--	--	--	--	--	--	--	--	--	--
Copper	SPLP	7.1	310	0.82 B	50 U	0.70 B	--	1.3	84	1700	45 B
Iron	SPLP	1500	12000	290	1100	270	--	160	1800	--	--
Lead	SPLP	35	760	1.3	25 U	1.2	--	1.6	70	3300	160
Nickel	130**	0.65	17 B	0.27 B	--	0.48 U	--	0.23 B	--	--	--
Vanadium	980**	--	--	--	--	--	--	--	--	--	--
Zinc	6,000***	--	--	--	--	--	--	--	--	--	--

Notes:
* Based on 3x the 95% Upper Confidence Level
** Based on Chapter 62-777 FAC Leachability based on groundwater
***Based on Chapter 62-777 FAC Direct Exposure for Residential
Sample concentrations exceeding regulatory guidelines are **BOLD.**
the SPLP test to calculate site-specific soil cleanup target levels
B = Report Value is less than the RL but greater than or equal to the MDL
E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

Table 3-3
Subsurface Soil Results

Compounds	Regulatory Guidelines	43SO14-S-8 7-8'		43SO14-S-13 12-13'		43SO15-S-03 2-3'		43SO30-S-06 5-6'		43SO31-S-06 5-6'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals											
Antimony	5**	0.30 B	--	0.68 B	--	4.0 U	250 U		--	0.79 B	--
Arsenic	29**	--	--	--	--	--	--		--	0.48 U	--
Barium	1600**	--	--	--	--	--	--		--	14	--
Copper	SPLP	1.6	50 U	0.51 B	--	--	--		--	2.5	--
Iron	SPLP	--	--	--	--	--	--		--	1600	--
Lead	SPLP	1.2	--	5.0	--	--	--		--	11	--
Nickel	130**	--	--	--	--	--	--		--	0.68	--
Vanadium	980**	--	--	--	--	--	--		--	3.3	--
Zinc	6,000***	--	--	--	--	--	--		--	13	--

Notes:
* Based on 3x the 95% Upper Confidence Level
** Based on Chapter 62-777 FAC Leachability based on groundwater
***Based on Chapter 62-777 FAC Direct Exposure for Residential
Sample concentrations exceeding regulatory guidelines are **BOLD**.
the SPLP test to calculate site-specific soil cleanup target levels
B = Report Value is less than the RL but greater than or equal to the MDL
E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

Table 3-3
Subsurface Soil Results

Compounds	Regulatory Guidelines	43SO32-S-06 5-6'		43SO33-S-06 5-6'		43SO34-S-06 5-6'	
		mg/kg	SPLP µg/L	mg/kg	SPLP µg/L	mg/kg	SPLP µg/L
Metals							
Antimony	5**	0.36 B	--	0.29 B	--	0.50 B	250 U
Arsenic	29**	0.38 B	--	0.37 B	--	0.47 B	25 U
Barium	1600**	2.5	--	5.8	--	11	**310**
Copper	SPLP	1.1	--	1.4	--	0.75 B	**35 B**
Iron	SPLP	1300	--	1500	--	1600	**1100**
Lead	SPLP	3.1	--	7.5	--	1.7	**38**
Nickel	130**	0.64	--	0.66	--	0.59	25 U
Vanadium	980**	2.9	--	3.2	--	3.3	**110**
Zinc	6,000***	6.9	--	10	--	4	**5**

Notes:
* Based on 3x the 95% Upper Confidence Level
** Based on Chapter 62-777 FAC Leachability based on groundwater
***Based on Chapter 62-777 FAC Direct Exposure for Residential
Sample concentrations exceeding regulatory guidelines are **BOLD.**
the SPLP test to calculate site-specific soil cleanup target levels
B = Report Value is less than the RL but greater than or equal to the MDL
E = The reported value is estimated due to the presence of interference
J = estimated value
N = The spiked sample recovery is not within the control limits
U = undetected
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
-- = Not Analyzed

3.6.1 Antimony

The cleanup goal for antimony was originally set at the FDEP leachability SCTL of 5 mg/kg under Chapter 62-777, FAC, (CCI, 2001). Antimony was detected at most locations both in surface and subsurface soil concentrations above this RG and was often the driver for additional sampling. Therefore the RG was reevaluated during soil delineation sampling activities. It was determined that at the very least, antimony results would only be required to meet the background soil concentration at NAS Pensacola of 9.48 mg/kg (2 x the mean).

Antimony was also detected using the synthetic precipitation leaching procedure (SPLP) method in soil to a depth of at least 6 feet bls, however the results were below the associated groundwater RG. Additionally, antimony was not present in groundwater samples collected during the SI. Therefore, under Florida guidance, samples exceeding the leachability criteria but not failing the actual direct leachability testing, are not considered contaminated unless they exceed the direct exposure criteria. Due to this reasoning, the RG was changed to be protective of residential direct exposure (26 mg/kg), rather than leachability to groundwater. Upon reviewing draft technical memoranda summarizing the findings at the site, both EPA and FDEP representatives accepted 26 mg/kg as the new RG for antimony in surface soil at Site 43.

Antimony results ranged from 0.34U (undetected) to 850 mg/kg in surface soil. All perimeter samples collected to determine the extent of antimony contamination in surface soil were below 26 mg/kg. However, one surface soil sample collected from outside of the defined "perimeter" area did exceed the RG of 26 mg/kg but was located beneath a large oak tree and could not be excavated without damaging the tree root system. In subsurface soils, antimony results ranged from 0.53J (estimated) to 58 mg/kg.

As mentioned above, SPLP analyses were also conducted on eight soil samples collected at Site 43. Detectable SPLP sample results ranged from 11J μg/L to 24 μg/L, all below the NAS Pensacola background reference concentration for groundwater of 30.2 μg/L. It should be noted that the detection limit for the non-detect values was 250 μg/L. Due to this limitation, it is not possible to accurately evaluate whether antimony is present in leachable quantities. However, since the highest total antimony samples (58 and 60 mg/kg) had correlating SPLP samples below the RG, it can be inferred that the non-detect SPLP samples with the higher detection limits, all less than 30 mg/kg total antimony, likely were below the SPLP RG. Refer to Figure 3-2 for antimony in soil results and the area of excavation.

3.6.2 Arsenic

Arsenic results ranged from 9.2 to 52 mg/kg in surface soil. Of the 10 surface soil samples collected, five had concentrations greater than the original RG of 21.93 mg/kg. Arsenic in the surface soil was delineated to the original RG of 21.93 mg/kg.

In subsurface soil, arsenic results ranged 0.34J mg/kg to 1.0 mg/kg, all below the background concentration of 1.56 mg/kg (2 x mean).

In addition, two surface soil and two subsurface soil SPLP samples were collected. All four results were reported as non-detect (< 25 μg/L). The GCTL for arsenic is 50 μg/L. Based on this analytical data, arsenic is not present in surface or subsurface soil at leachable quantities above the groundwater RG.

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS18
Subsurface Soil Sample Designation	43SO05
Excavation Area (0-2')	
Monitoring Well	
Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.

Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Antimony	26	5	9.48	26	26

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Antimony	6	30.2

0 30 60 90

Scale: 1" = 30'

N

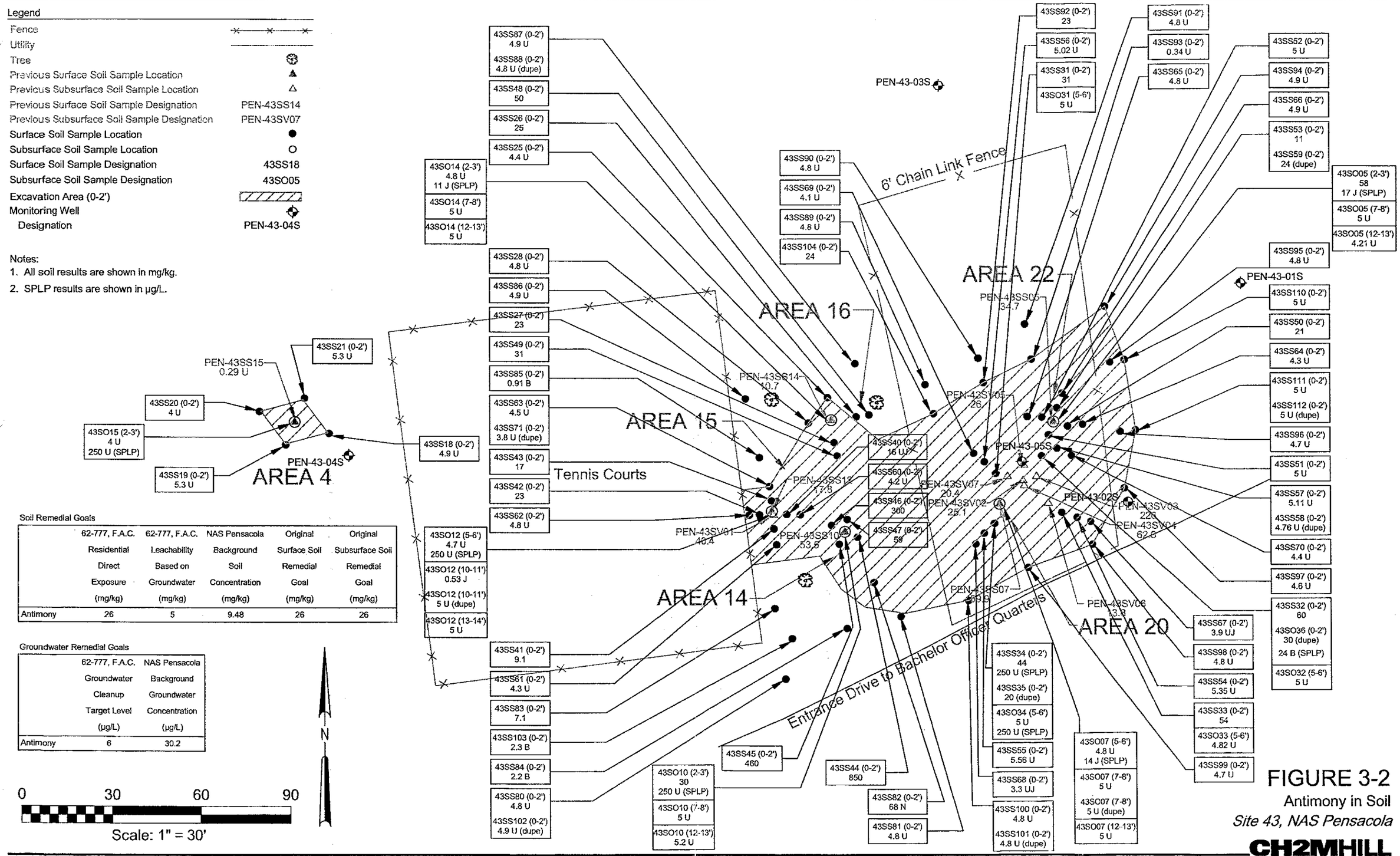

FIGURE 3-2
Antimony in Soil
Site 43, NAS Pensacola

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Refer to Figure 3-3 for arsenic in soil results and the area of excavation.

3.6.3 Barium

Barium results ranged from 660 to 2,400 mg/kg in surface soil. Of the 10 samples collected, six samples exceeded the original RG of 1,533 mg/kg. In subsurface soil, barium results ranged from 0.50J to 56 mg/kg. Of the four subsurface soil samples collected, no samples exceeded the original RG of 1,533 mg/kg or the leachability criterion of 1,600 mg/kg. Barium was delineated to the original RG of 1,533 mg/kg.

In addition, two surface soil and one subsurface soil SPLP sample was collected. The SPLP results of ranged from 310 µg/L to 770 µg/L. All SPLP sample results were below the groundwater GCTL of 2,000 µg/L. Based on this analytical data, barium is not present in surface or subsurface soil at leachable quantities.

Refer to Figure 3-4 for barium in soil results and the area of excavation.

3.6.4 Copper

Detectable copper results ranged from 6.0 to 69,000 mg/kg in surface soil. Of the 30 surface soil samples collected, three sample results had concentrations greater than the original RG of 11,226 mg/kg. In subsurface soil, copper results ranged from 0.37J to 6,900 mg/kg. Based on the original RG of 11,226 mg/kg, none of the 21 subsurface soil samples analyzed exceeded the RG. Copper was delineated to the original RG of 11,226 mg/kg.

In addition, two surface soil and 14 subsurface soil SPLP samples were collected. Surface soil SPLP results ranged from 57 to 550 µg/L, with no exceedances above the groundwater GCTL of 1,000 µg/L. Subsurface soil SPLP results ranged from 18J to 8,900J µg/L, with exceedances in one sample, 43SO07-S-06. This sample was collected at a depth of 5 to 6 feet bls. Another sample collected from 7 to 8 feet bls at the same location and yielded results of 58 µg/L, which is below the GCTL.

Refer to Figure 3-5 for copper in soil results and the area of excavation.

3.6.5 Iron

Iron results ranged from 12,000 to 180,000 mg/kg in surface soil. Of the 26 surface soil samples collected, seven sample results had concentrations greater than the original RG of 81,900 mg/kg. In subsurface soil, iron results ranged from 97 to 66,000 mg/kg. Based on the original RG of 81,900 mg/kg, none of the 15 soil subsurface samples analyzed exceeded the RG. Iron was delineated to the original RG of 81,900 mg/kg.

In addition, two surface soil and 10 subsurface soil SPLP samples were collected. Surface soil SPLP results ranged from 190J to 1,500 µg/L, with no exceedances above the groundwater background concentration of 1,707 µg/L. Subsurface soil SPLP results ranged from 310J to 12,000 µg/L, with exceedances of the groundwater RG in one samples.

Refer to Figure 3-6 for iron in soil results and the area of excavation.

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS31
Subsurface Soil Sample Designation	43SO07
Excavation Area (0-2')	
Monitoring Well	
Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.

Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Arsenic	0.8	29	1.56	21.93 [1]	29

[1] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Arsenic	50	2.8

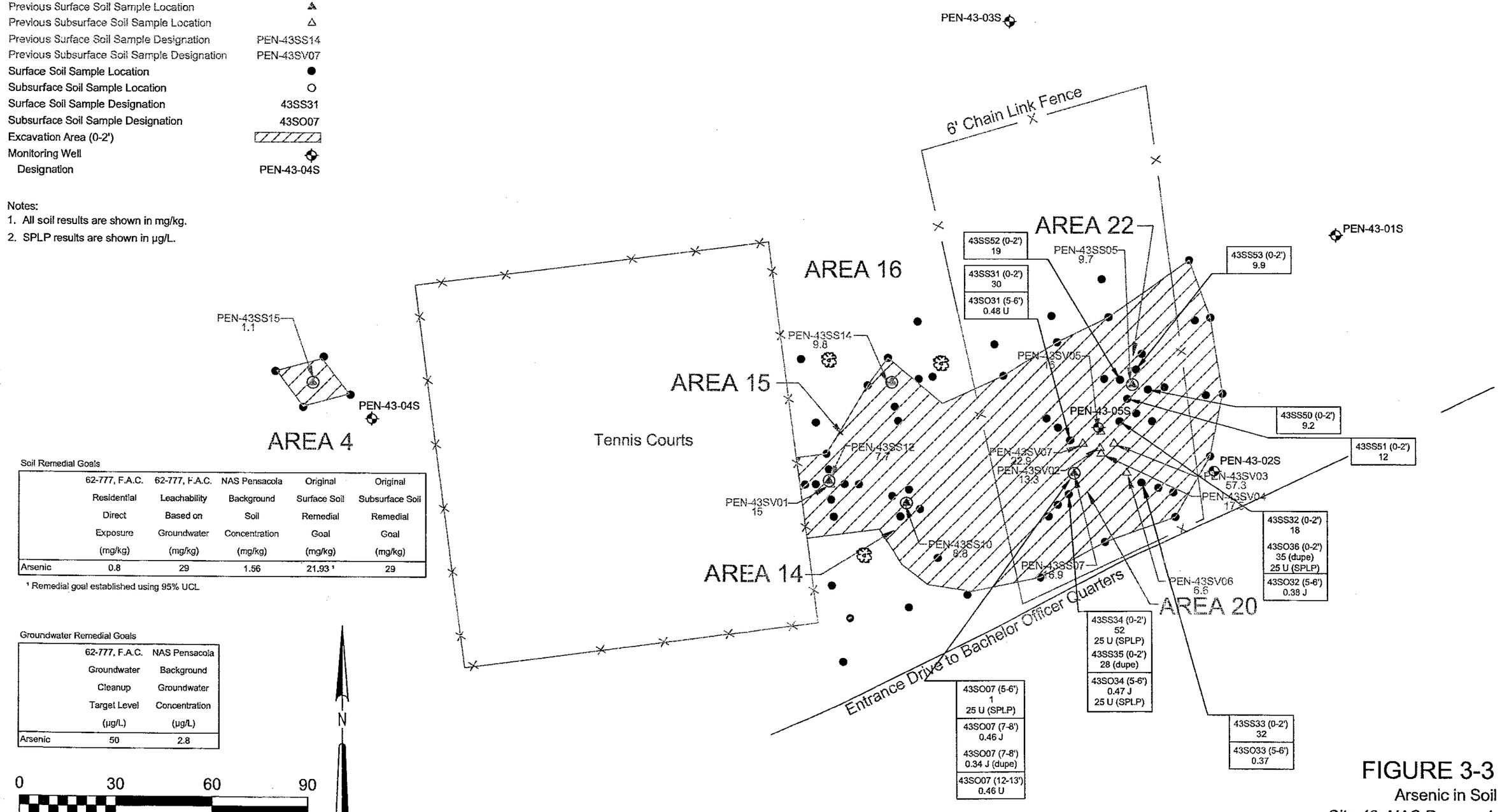

FIGURE 3-3
Arsenic in Soil
Site 43, NAS Pensacola

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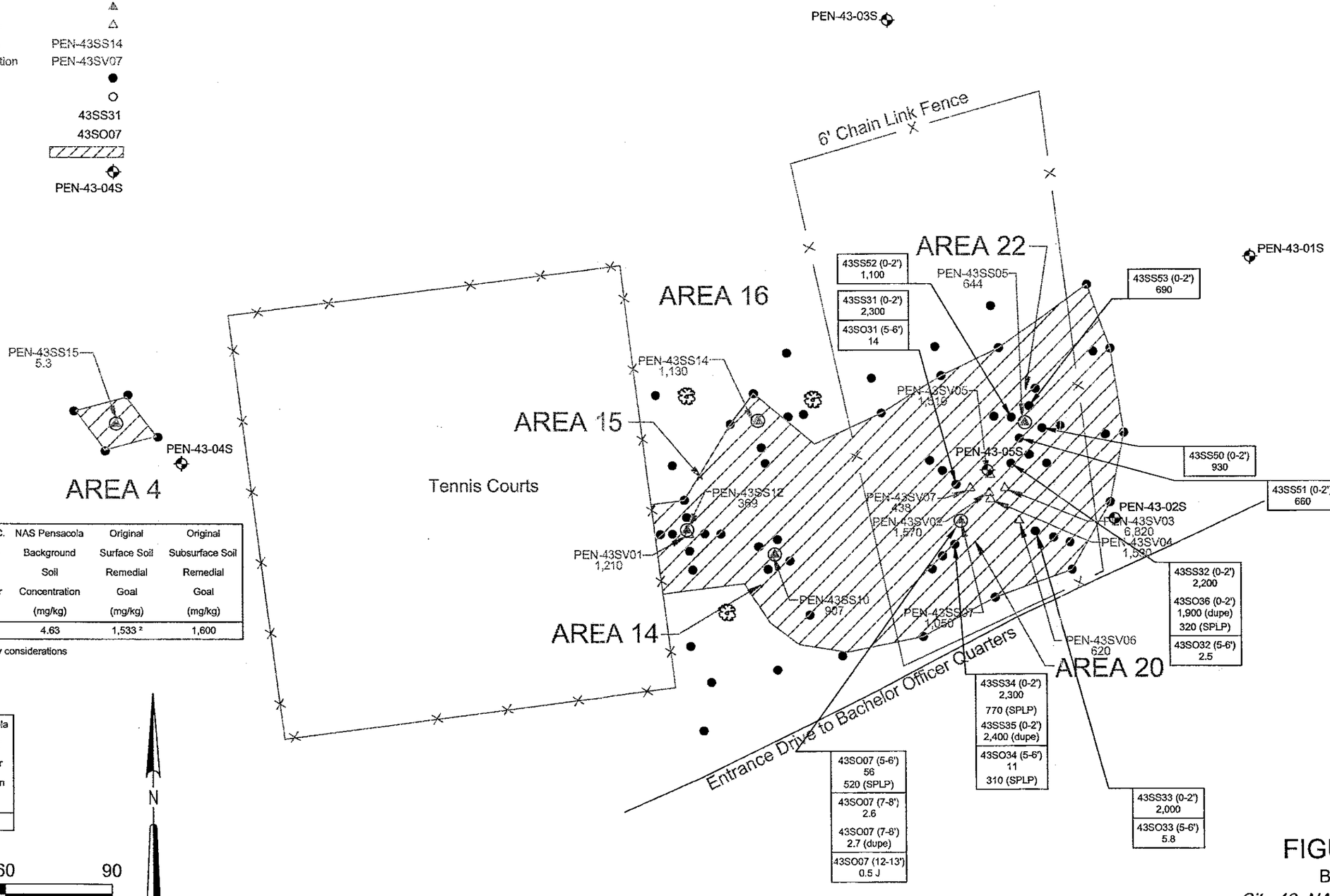
20-Aug-2003

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS31
Subsurface Soil Sample Designation	43SO07
Excavation Area (0-2')	
Monitoring Well	
Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.



Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Barium	110 [1]	1,600	4.63	1,533 [2]	1,600

[1] Direct exposure value based on acute toxicity considerations
[2] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Barium	2,000	13.22

FIGURE 3-4
Barium in Soil
Site 43, NAS Pensacola

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20-Aug-2003

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS25
Subsurface Soil Sample Designation	43SO05
Excavation Area (0-2')	
Monitoring Well	
Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.

Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Copper	110 [1]	— [2]	5.72	11,226 [3]	NA

[1] Direct exposure value based on acute toxicity considerations
[2] Leachability value may be derived using SPLP test to calculate site-specific SCTL
[3] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Copper	1,000	16.2

0 30 60 90
Scale: 1" = 30'

N

AREA 4
AREA 14
AREA 15
AREA 16
AREA 20
AREA 22
Tennis Courts
6' Chain Link Fence
Entrance Drive to Bachelor Officer Quarters

PEN-43-04S
PEN-43-01S
PEN-43-02S
PEN-43-03S
PEN-43-05S
PEN-43SS15 3
PEN-43SS14 753
PEN-43SS12 840
PEN-43SS10 1,270
PEN-43SS07 29,000
PEN-43SS05 2,660
PEN-43SV01 4,810
PEN-43SV02 1,400
PEN-43SV03 3,470
PEN-43SV04 15,900
PEN-43SV05 1,720
PEN-43SV06 1,310
PEN-43SV07 529

43SS48 (0-2') 2,900
43SS26 (0-2') 2,300
43SS25 (0-2') 1 U
43SO14 (2-3') 1,700 45 J (SPLP)
43SO14 (7-8') 1.6 50 U (SPLP)
43SO14 (12-13') 0.51 J 18 J (SPLP)
43SS28 (0-2') 6
43SS27 (0-2') 1,100
43SS49 (0-2') 1,100
43SS43 (0-2') 4,700
43SS42 (0-2') 440
43SO12 (5-6') 0.93 UJ 310 (SPLP)
43SO12 (10-11') 0.82 J 50 U (SPLP)
43SO12 (10-11') 0.7 J (dupe)
43SO12 (13-14') 1.3 84 (SPLP)
43SS41 (0-2') 610
43SS40 (0-2') 7,600 J
43SS46 (0-2') 7,200
43SS47 (0-2') 4,200
43SS56 (0-2') 6,400 J
43SS31 (0-2') 2,900
43SO31 (5-6') 2.5
43SS52 (0-2') 69,000
43SS53 (0-2') 1,500
43SS59 (0-2') 3,700 (dupe)
43SO05 (2-3') 6,900 59 (SPLP)
43SO05 (7-8') 1 50 U (SPLP)
43SO05 (12-13') 0.84 U 24 J (SPLP)
43SS50 (0-2') 6,400
43SS51 (0-2') 900
43SS57 (0-2') 1,500
43SS58 (0-2') 1,700 (dupe)
43SS32 (0-2') 5,800
43SO36 (0-2') 40,000 (dupe) 550 (SPLP)
43SO32 (5-6') 1.1
43SS34 (0-2') 4,500 57 (SPLP)
43SS35 (0-2') 3,500 (dupe)
43SO34 (5-6') 0.75 B 35 B (SPLP)
43SS55 (0-2') 4,800
43SS54 (0-2') 8,000
43SS33 (0-2') 54,000
43SO33 (5-6') 1.4
43SO07 (5-6') 120 J 8,900 J (SPLP)
43SO07 (7-8') 0.85 B 58 (SPLP)
43SO07 (7-8') 0.79 B (dupe)
43SO07 (12-13') 0.91 U 44 J (SPLP)
43SS45 (0-2') 3,400
43SS44 (0-2') 3,400
43SO10 (2-3') 6,500 19 J (SPLP)
43SO10 (7-8') 1.8 21 B (SPLP)
43SO10 (12-13') 0.37 J 27 J (SPLP)

FIGURE 3-5
Copper in Soil
Site 43, NAS Pensacola
CH2MHILL

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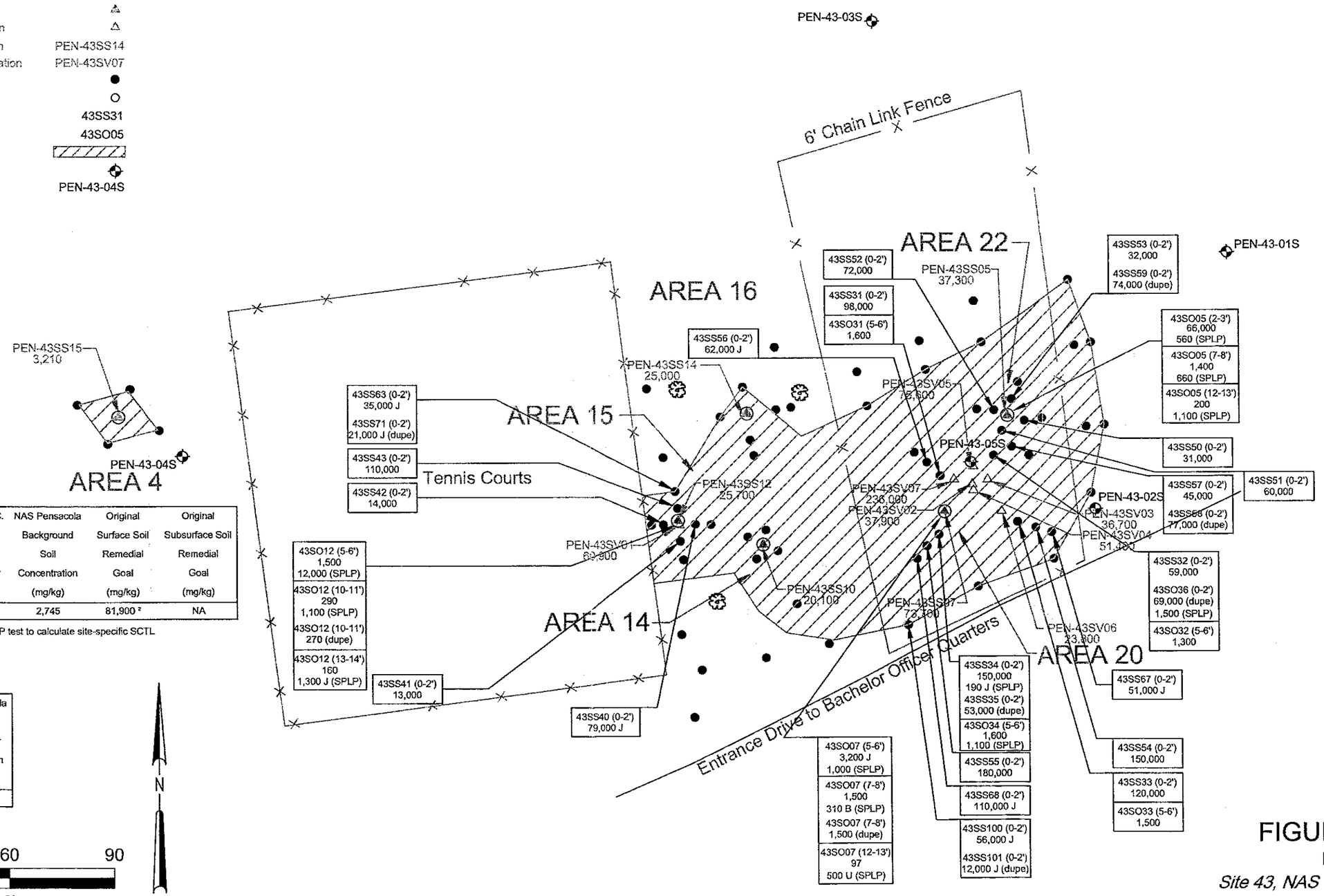
20-Aug-2003

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS31
Subsurface Soil Sample Designation	43SO05
Excavation Area (0-2')	
Monitoring Well	
Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.



Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Iron	23,000	--- [1]	2,745	81,900 [2]	NA

[1] Leachability value may be derived using SPLP test to calculate site-specific SCTL
[2] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Iron	300	1,707

N

0 30 60 90

Scale: 1" = 30'

FIGURE 3-6
Iron in Soil
Site 43, NAS Pensacola

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3.6.6 Lead

Lead results ranged from 20 to 60,000 mg/kg in surface soil. Of the 34 surface soil samples collected, 11 sample results had concentrations greater than the original RG of 9,390 mg/kg. In subsurface soil, lead results ranged from 0.46 to 8,200 mg/kg. Based on the original RG of 9,390 mg/kg, none of the 21 soil subsurface samples analyzed exceeded the RG. Lead was delineated to the original RG of 9,390 mg/kg.

In addition, two surface soil and 13 subsurface soil samples were collected for SPLP analysis. Surface soil SPLP results ranged from 630 to 1,300 µg/L, which are above the groundwater GCTL of 15 µg/L. Subsurface soil SPLP results ranged from 14J to 4,800 µg/L, with exceedances in at least 8 samples.

Refer to Figure 3-7 for lead in soil results and the area of excavation.

3.6.7 Nickel

Nickel results ranged from 20 to 569J mg/kg in surface soil. Of the 17 surface soil samples collected, seven sample results had concentrations greater than the original RG of 116.4 mg/kg. In subsurface soil, nickel results ranged from 0.23J to 3.2 mg/kg. Based on the original RG of 116.4 mg/kg, none of the 12 subsurface soil samples analyzed exceeded the RG. Nickel was delineated to the original RG of 116.4 mg/kg.

In addition, three surface soil and three subsurface soil samples were collected for SPLP analysis. Detectable surface soil SPLP results ranged from 210 to 310 µg/L, with two of the three samples exceeding the groundwater GCTL of 100 µg/L. The only detectable subsurface soil SPLP result (71 µg/L) was below the GCTL.

Refer to Figure 3-8 for nickel in soil results and the area of excavation.

3.6.8 Vanadium

Vanadium results ranged from 26 to 870 mg/kg in surface soil. Of the 10 surface soil samples collected, two sample results had concentrations greater than the original RG of 158.1 mg/kg. In subsurface soil, detectable vanadium results ranged from 2.9 to 32 mg/kg. Based on the original RG of 158.1 mg/kg, none of the eight subsurface soil samples analyzed exceeded the RG. Vanadium was delineated to the original RG of 158.1 mg/kg.

In addition, two surface soil and two subsurface soil samples were collected for SPLP analysis. Surface soil SPLP results ranged from non-detect (50U) to 56 µg/L, with one exceedance over the groundwater GCTL of 49 µg/L. Subsurface soil SPLP results ranged from 42J to 110 µg/L, with one sample above the GCTL.

Refer to Figure 3-9 for vanadium in soil results and the area of excavation.

3.6.9 Zinc

Zinc results ranged from 3,800 to 34,000 mg/kg in surface soil. Of the 10 surface soil samples collected, one sample exhibited a concentration greater than the original RG of 23,000 mg/kg. Zinc was delineated to the original RG of 23,000 mg/kg in surface soil.

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS25
Subsurface Soil Sample Designation	43SO05
Excavation Area (0-2')	
Monitoring Well Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.

Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Lead	400	—[1]	7.35	9,390[2]	NA

[1] Leachability value may be derived using SPLP test to calculate site-specific SCTL
[2] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Lead	15	1.6

0 30 60 90
Scale: 1" = 30'

N

AREA 4
PEN-43-04S
PEN-43SS15 18.9

AREA 16
AREA 15
AREA 14
AREA 22
AREA 20
Tennis Courts
6' Chain Link Fence
Entrance Drive to Bachelor Officer Quarters

PEN-43-03S
PEN-43-01S
PEN-43-02S
PEN-43-05S
PEN-43SS14 4,050
PEN-43SS12 1,910
PEN-43SV01 4,820
PEN-43SS10 3,370
PEN-43SS05 8,130
PEN-43SV05 29,700
PEN-43SV07 2,080
PEN-43SV02 8,160
PEN-43SV03 16,400
PEN-43SV04 4,880
PEN-43SS07 10,600
PEN-43SV06 2,500

43SS87 (0-2') 610
43SS88 (0-2') 1,200 (dupe)
43SS48 (0-2') 6,900
43SS26 (0-2') 9,800
43SS25 (0-2') 48
43SO14 (2-3') 3,300 160 (SPLP)
43SO14 (7-8') 1.2
43SO14 (12-13') 5 14 J (SPLP)
43SS28 (0-2') 20
43SS27 (0-2') 4,000
43SS49 (0-2') 4,400
43SS43 (0-2') 4,500
43SS42 (0-2') 1,200
43SO12 (5-6') 35 760 (SPLP)
43SO12 (10-11') 1.3 25 U (SPLP)
43SO12 (10-11') 1.2 (dupe)
43SO12 (13-14') 1.6 70 (SPLP)
43SS41 (0-2') 1,800
43SS56 (0-2') 5,700 J
43SS31 (0-2') 9,900
43SO31 (5-6') 11
43SS52 (0-2') 4,200
43SS53 (0-2') 2,900
43SS59 (0-2') 3,400 (dupe)
43SO05 (2-3') 5,200 560 (SPLP)
43SO05 (7-8') 2.3 25 U (SPLP)
43SO05 (12-13') 0.46 25 U (SPLP)
43SS50 (0-2') 2,700
43SS40 (0-2') 4,800 J
43SS46 (0-2') 29,000
43SS47 (0-2') 6,900
43SS51 (0-2') 2,100
43SS57 (0-2') 4,400
43SS58 (0-2') 5,300 (dupe)
43SS32 (0-2') 10,000
43SO36 (0-2') 16,000 (dupe) 1,300 (SPLP)
43SO32 (5-6') 3.1
43SS67 (0-2') 3,700 J
43SS34 (0-2') 12,000 630 (SPLP)
43SS35 (0-2') 23,000 (dupe)
43SO34 (5-6') 1.7 38 (SPLP)
43SS55 (0-2') 13,000
43SS68 (0-2') 9,300 J
43SS54 (0-2') 26,000
43SS33 (0-2') 9,800
43SO33 (5-6') 7.5
43SO07 (5-6') 450 J 4,800 (SPLP)
43SO07 (7-8') 1.4 25 U (SPLP)
43SO07 (7-8') 1.3 (dupe)
43SO07 (12-13') 0.63 38 (SPLP)
43SS45 (0-2') 7,000
43SS44 (0-2') 60,000
43SO10 (2-3') 8,200 47 (SPLP)
43SO10 (7-8') 2.3
43SO10 (12-13') 1.1 25 U (SPLP)

FIGURE 3-7
Lead in Soil
Site 43, NAS Pensacola

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20-Aug-2003

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS31
Subsurface Soil Sample Designation	43SO07
Excavation Area (0-2')	
Monitoring Well Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.

Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Nickel	110 [1]	130	6.38	116.4 [2]	130

[1] Direct exposure value based on acute toxicity considerations
[2] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Nickel	100	39.9

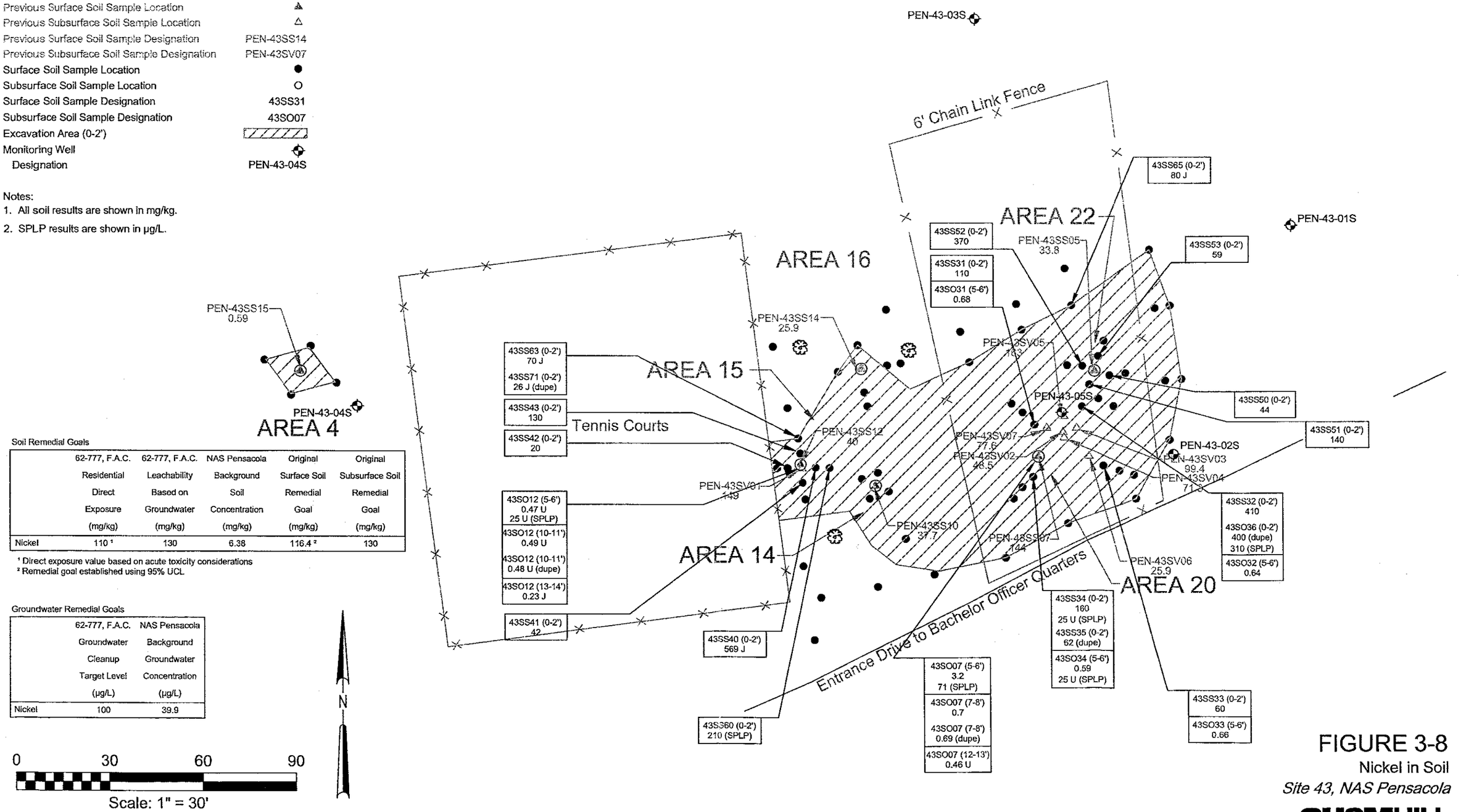

FIGURE 3-8
Nickel in Soil
Site 43, NAS Pensacola

CH2MHILL

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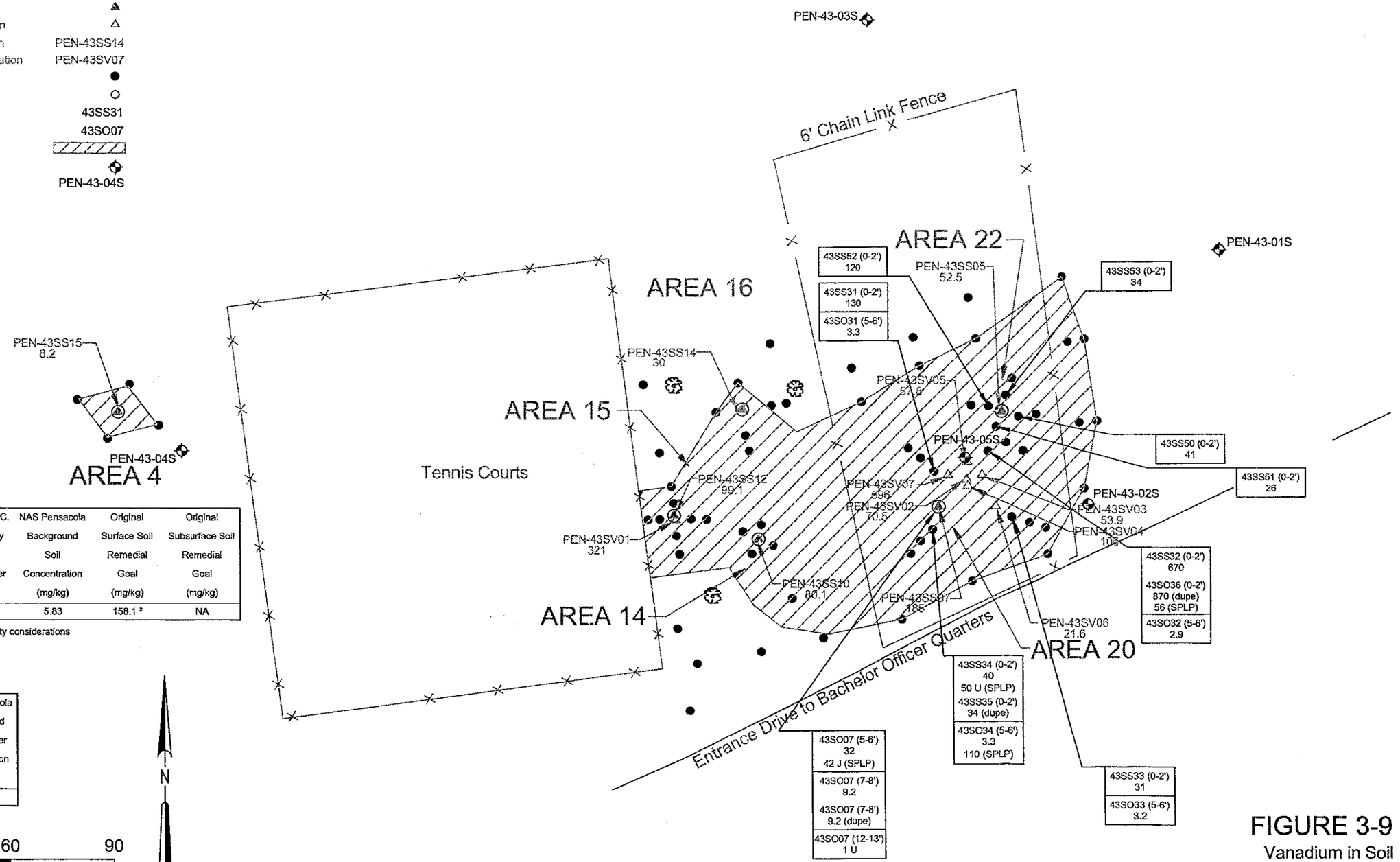
20-Aug-2003

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS31
Subsurface Soil Sample Designation	43SO07
Excavation Area (0-2')	
Monitoring Well	
Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.



Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Vanadium	15 [1]	980	5.83	158.1 [2]	NA

[1] Direct exposure value based on acute toxicity considerations
[2] Remedial goal established using 95% UCL

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Vanadium	49	9.575

FIGURE 3-9
Vanadium in Soil
Site 43, NAS Pensacola

CH2MHILL

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In subsurface soil, zinc results ranged from 1.0J to 290J mg/kg. None of the eight subsurface samples analyzed exceeded either the original RG of 23,000 or the leachability SCTL of 6,000 mg/kg. Therefore, subsurface soil was delineated to the leachability criteria of 6,000 mg/kg.

In addition, two surface soil and two subsurface soil samples were collected for SPLP analysis. Surface soil SPLP results ranged from 1,200 to 27,000 μg/L with one sample above the groundwater GCTL of 5,000 μg/L. Subsurface soil SPLP results ranged from 5 to 13,000 μg/L, with one sample above the GCTL.

Refer to Figure 3-10 for zinc in soil results and the area of excavation.

3.7 Summary Discussion

Metals exceeding the original RGs listed in Table 3-1 include antimony, arsenic, barium, copper, iron, lead, nickel, vanadium and zinc. All were found at concentrations above their respective RG. Additionally, copper, iron, lead, nickel, vanadium, and zinc also leached from the soil above their associated groundwater RGs using the SPLP methodology. The surface and subsurface soil was delineated to the original RGs.

During the SI, only iron and aluminum were detected in groundwater at concentrations exceeding the FDEP GCTLs. Only iron exceeded the NAS Pensacola background concentration. Due to naturally occurring iron in the Sand and Gravel aquifer (Geraghty & Miller 1984 and 1986), NAS Pensacola drinking water is supplied from an off-base source. The closest surface water body is approximately 3,500 feet east of the site; therefore, migration to surface water is unlikely. Figure 3-6 presents the iron SPLP results in subsurface soil.

No other metals detected in soil have migrated to the water table at concentrations above the groundwater criteria. The closest surface water body is approximately 3,500 feet east of the site; therefore, migration to surface water is unlikely.

Based on the metals concentrations found above the original RGs established in the work plan for Site 43 in surface soil, there were two proposed excavation areas, a small one west of the tennis court (Area 4) and a larger one east of the tennis court (encompassing Areas 14, 15, 16, 20, and 22). Figure 3-11 presents the proposed excavation area. The following table presents the proposed volumes of soil associated with these excavations.

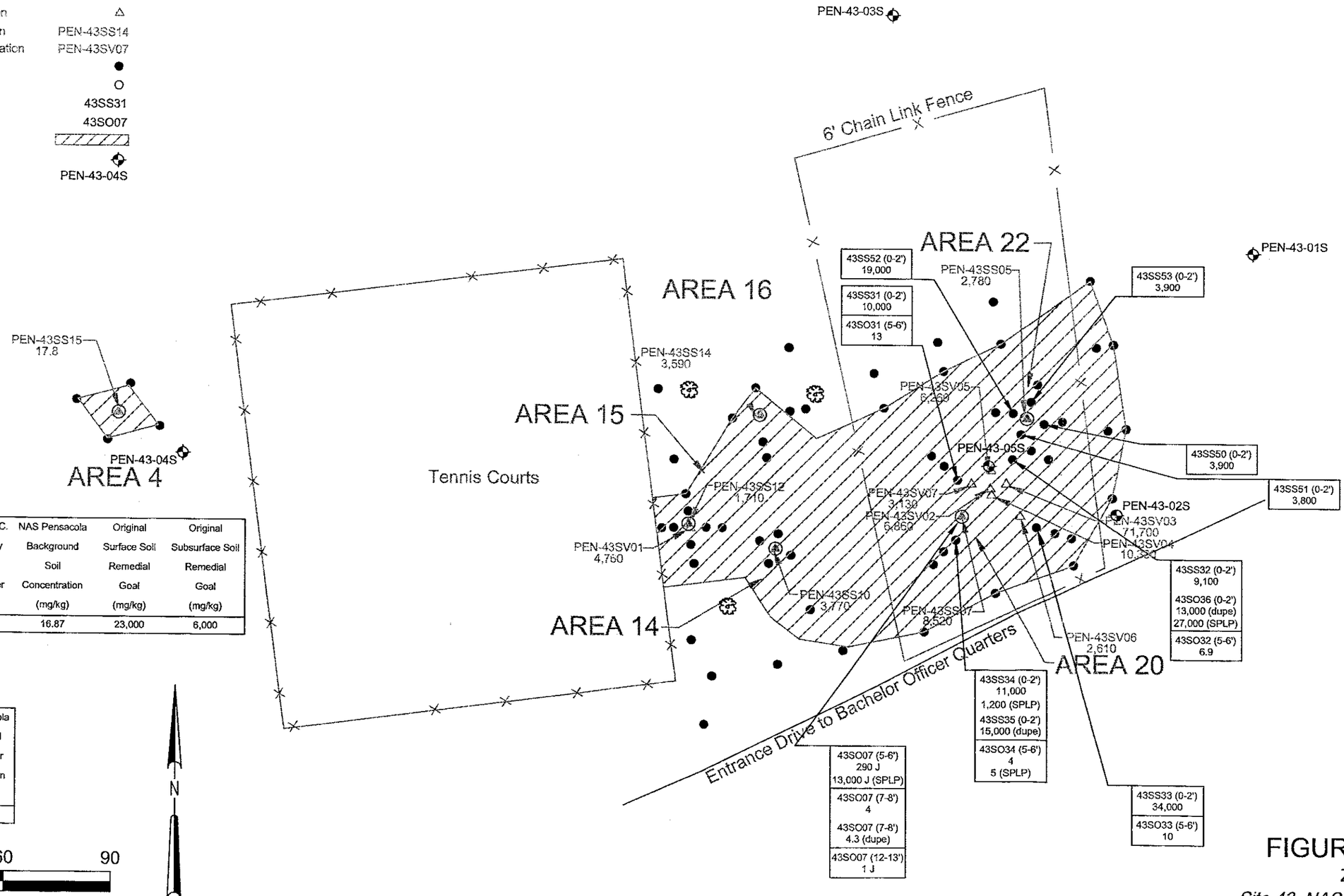
TABLE 3-4
Excavation Volumes

Excavation Area	Depth	Volume (cubic yards)
4	0-2	16
14, 15, 16, 20 and 22	0-2	641
TOTAL CUBIC YARDS		657

Legend

Fence	
Utility	
Tree	
Previous Surface Soil Sample Location	
Previous Subsurface Soil Sample Location	
Previous Surface Soil Sample Designation	PEN-43SS14
Previous Subsurface Soil Sample Designation	PEN-43SV07
Surface Soil Sample Location	
Subsurface Soil Sample Location	
Surface Soil Sample Designation	43SS31
Subsurface Soil Sample Designation	43SO07
Excavation Area (0-2')	
Monitoring Well Designation	PEN-43-04S

Notes:
1. All soil results are shown in mg/kg.
2. SPLP results are shown in µg/L.



Soil Remedial Goals

	62-777, F.A.C. Residential Direct Exposure (mg/kg)	62-777, F.A.C. Leachability Based on Groundwater (mg/kg)	NAS Pensacola Background Soil Concentration (mg/kg)	Original Surface Soil Remedial Goal (mg/kg)	Original Subsurface Soil Remedial Goal (mg/kg)
Zinc	23,000	6,000	16.87	23,000	6,000

Groundwater Remedial Goals

	62-777, F.A.C. Groundwater Cleanup Target Level (µg/L)	NAS Pensacola Background Groundwater Concentration (µg/L)
Zinc	5,000	153.2

0 30 60 90

Scale: 1" = 30'

N

FIGURE 3-10
Zinc in Soil
Site 43, NAS Pensacola

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20-Aug-2003

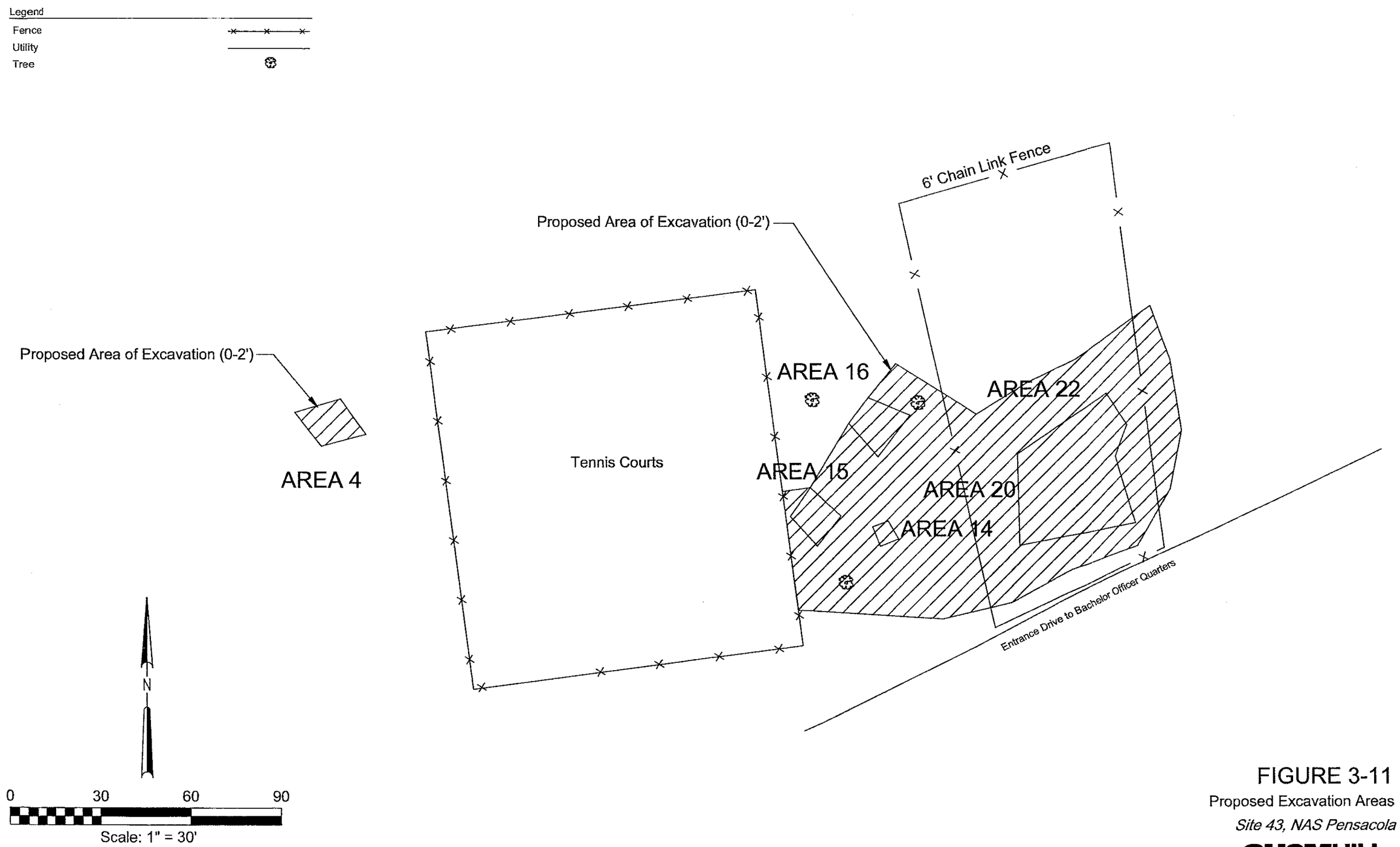

FIGURE 3-11

Proposed Excavation Areas

Site 43, NAS Pensacola

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4.0 Interim Remedial Action

4.1 Mobilization

CCI personnel, equipment, subcontractors, and materials mobilized to NAS Pensacola on April 3, 2002, to perform IRA activities at Site 43. Subcontractors utilized for the various tasks are listed in Section 2-2.

4.2 Site Utility Clearance

During the initial sampling phases of the project CCI utilized the excavation permit obtained by the CLEAN contractor, as provided by NAS Pensacola Environmental. However, prior to start-up of excavation a new permit was obtained to ensure that all utilities were clearly identified for the activities. The second permit was obtained on April 10, 2002. Several utilities, including multi-pair telephone line and water lines, were identified either at the periphery of the excavation area or in the excavation area. A copy of the excavation permit is included in Appendix E.

4.3 Pre-excavation Survey

During the course of soil characterization through pre-excavation sampling, the individual sample points were surveyed to State Plane Coordinates and elevations. On December 12, 2002, a Registered Florida Land Surveyor from Southern Surveying, Inc. surveyed the limits of proposed excavation. The survey drawing is provided in Appendix F.

4.4 Excavation of Contaminated Soil

As stated in the Section 3.7, two areas were recommended for excavation at Site 43. One small area measuring approximately 10 by 10 feet was in an area formerly known as Pit No. 4, west of the tennis court. The larger area encompassed former Pit Nos. 14, 15, 16, 20, and 22. Figure 3-11 presents the proposed excavation area. The upper 2 feet of surface soil was to be removed in each location to protect human health and the environment. In addition, while the excavation was open, areas in which significant metal debris was observed would be excavated. Appendix C presents excavation photographs.

In preparation for excavation, the 6-foot-high chain-linked fence was removed from the excavation area. Additionally, in order to preserve the 11 existing live oak and laurel oak trees at the site, (as specified by the NAS Pensacola Natural Resources Manager) the limits of the excavations adjacent to the trees were trenched to a minimum depth of 2 feet bls. The trenching was intended to minimize damage to the root system of the trees, but it also provided clear delineation of the excavation limits. Two trees (a palm and a poplar) were removed from the excavation area.

Excavation began on April 11, 2002, by CCI subcontractor Environmental Quality Industrial Services (EQIS) using a trackhoe. Due to limited space onsite, a combination of temporarily stockpiling soil and direct loading of soil into transport vehicles was employed. As expected, significant debris was encountered slightly below the surface to approximately 2 feet bls. In two distinct areas, significant metal debris was removed to depths of 3 to 4 feet bls. Approximately 20 to 25 rusted metal drums and drum parts were uncovered during the excavation. Two of the recovered drums contained liquid (less than 1 gallon each). Each drum was over-packed, labeled, and staged in a remote area designated by NAS Pensacola personnel pending analysis of the liquids. The empty drums were crushed and disposed with the soil. Additionally, the 14 drums unearthed during the preliminary investigation conducted by the CLEAN contractor in November 2000 were disposed of with the remaining waste.

Distinct dark discoloration of the soil was observed in and around the debris layer. To the extent possible the discolored soil was removed during the excavation. However, due to the structural and ecological limitations (tennis court and trees) to the excavation, all of discolored soil was not removed.

On Friday, April 12, 2002, during the course of excavating the contaminated soil at Site 43, three 24-inch-long by 10-inch-diameter projectile shaped objects were unearthed that resembled unexploded ordinance (UXO). The objects were found in the southeastern corner of the former fenced-in area and appeared to be made of concrete with metallic nose cones. As a precautionary measure, CCI halted activities in the area and notified Mr. Ron Joyner of the NAS Pensacola Environmental office. Mr. Joyner informed CCI that similar objects had previously been unearthed at another project site on base and were determined to be inert practice bombs and not UXO. Mr. Joyner notified the NAS Pensacola UXO First Response Team. In addition, the CCI field team notified the CCI Project Manager, CCI Navy RAC Program Safety Manager, and CH2M HILL UXO Manager. Based on the historical information provided by Mr. Joyner, CCI resumed operations.

On Monday, April 15, 2002, the NAS Pensacola UXO First Response Team visited the site and removed the projectile-like objects. Chief Warrant Officer 4 (CWO4) James Clarke informed CCI that excavation operations could continue since he believed the objects were ornamental and posed no threat.

During the course of excavation at western side of the site, an 18-inch round, steel object was unearthed. Upon visual inspection, it appeared that the object had a copper plug in the center. Once again, excavation operations were halted; however, soil load-out operations continued. The CCI field team made the appropriate notifications and both Mr. Joyner and CWO4 Clarke returned to the site. CWO4 Clarke informed CCI that the object appeared to be a Civil War era cannon ball and that it appeared to be the type that did carry an explosive charge. CWO4 Clarke retrieved the cannon ball and informed CCI that the excavation could resume. Shortly after CWO4 Clarke departed the site, Mr. Joyner and CCI personnel examined the excavation area and found other suspicious debris. CWO4 Clarke again was called to the site to examine the articles. CWO4 Clarke removed the articles and informed CCI that a preliminary test of the fuse area of the cannon ball confirmed it was ignitable. CWO4 Clarke notified the team that the UXO Response Team from Eglin Air Force Base was en route to NAS Pensacola to remove the cannon ball and planned to detonate it at a bombing range at Eglin. CCI's plan of action was determined and included the following:

1) Stop all intrusive activities at the site.

2) Stop all offsite transportation of previously loaded out soil and debris.

3) Stop all treatment operations of the soil and debris previously shipped to the disposal facility in Belleville, Michigan.

4) Have all transport trucks en route to the disposal facility return to NAS Pensacola immediately.

On April 16, 2002, CCI's Project Manager and UXO Manager arrived onsite. The 18-inch cannon ball was tentatively identified as a Cohern Mortar. The UXO Manager noted that this particular type of munitions had been discovered at NAS Pensacola in the recent past and determined to be UXO. During the next 2 days, several meetings were conducted, as well as telephone calls, resulting in the decision to off-load five tractor-trailer loads of soil and debris previously excavated from Site 43 elsewhere on the facility. A remote location near Sherman Field was selected for the off-loading and staging of the contaminated soil and debris.

On April 18, 2002, CCI was informed that the Cohern Mortar removed from NAS Pensacola had been take to Eglin Air Force Base and split open by shape charges at the range. The mortar was determined to be inert, having no explosive charge. In addition, the other suspicious articles removed from the site were tested and also found to be non-explosive. Based on this information an action plan was formulated as follows:

Screen the soil staged east of Sherman Field for UXO

If no UXO is found:	If UXO is found:
1. Notify EQs Michigan Facility to begin treating the previously received Site 43 soil	1. CCI to temporarily secure Site 43
2. Load out the soil staged east of Sherman Field for transit to EQ's Michigan facility	2. CCI to begin UXO plan development for NAS Pensacola and EQ's Michigan Facility
3. Resume excavation activities at Site 43	3. CCI to provide UXO response to NAS Pensacola and EQ's Michigan Facility

On April 19, 2002, a CCI UXO Technician/UXO Safety Officer mobilized to NAS Pensacola to supervise the soil screening activities. The five tractor-trailer loads of soil and debris taken to Sherman Field were transferred to an adjoining lined staging area in 1-foot lifts. The soil and debris was visually inspected for UXO and UXO-related material. During the screening, objects that appeared to be UXO in nature were closely examined by CCI and set aside. The screening resulted in the recovery of a 6-inch solid steel cannon ball and a concrete projectile. CWO4 Clarke and Mark Shull from the Resident Office in Charge of Construction (ROICC) were informed of the discovery and apprised of the situation. CWO4

Clarke inspected the items, notified CCI that they were inert, and removed them from the area.

Unfortunately, the excavation permit process does not include UXO or potential UXO. Therefore, CCI could not predict potential complications related to the discovery of potential UXO. Changing operations and plans during this period resulted in schedule and financial impacts to the project.

At the end of the IRA, 31 truckloads with an accumulative total of 747.62 tons of soil and debris had been removed from the site. The soil was transported to the Michigan Disposal Waste Treatment Facility in Belleville, Michigan. Photographs of the field activities are included in Appendix C.

4.5 Post Excavation Surveying

After excavation activities were complete, Southern Surveying, Inc. conducted the post excavation survey to ensure that the limits established during the pre-excavation survey were maintained. A copy of the survey is included in Appendix F.

4.6 Backfill and Site Restoration

Prior to completing the excavation activities at the site, EQIS collected representative soil samples from the selected offsite backfill source from Sand and Dirt, Inc. The soil was analyzed to ensure its suitability for use at the project site. Both physical and chemical analyses were conducted. Two types of backfill were selected, a clayey soil for a 1-foot-thick, semi-permeable liner and a topsoil for the upper 1 foot. A sample from both soil types was composited and analyzed for chemical parameters. The clay liner was also tested for physical parameters.

4.6.1 Chemical Analysis of Backfill

One sample was collected from the proposed backfill barrow pit and analyzed for target compound list (TCL) volatile organic compounds (VOCs) (Method 8260B), TCL SVOCs (8270C), TCL pesticides (8081A), TCL herbicides (8151A), target analyte list (TAL) metals (Methods 3050B/6010B/7471A, polychlorinated biphenyls (PCBs) (Method 8082), (Florida Petroleum Residual Organic [FL-PRO] method) total recoverable petroleum hydrocarbons, and pH. The analytical results indicated the soil was non-detect for all parameters tested except metals. The arsenic concentration of 1.06 mg/kg was above the FDEP SCTL residential maximum concentration for arsenic of 0.8 mg/kg. However, arsenic is naturally occurring in the area and the site-specific cleanup goal for arsenic in surface soil is 21.93 mg/kg, therefore the backfill was accepted as clean fill. The results of the backfill analyses are presented in Appendix G.

4.6.2 Physical Properties Testing of Backfill

Pensacola Testing Labs, a certified materials testing firm, analyzed representative samples of the backfill material to be used as the semi-permeable lay liner for soil classification, moisture content, dry density, and compactability. The analysis revealed the soil was a high clay content, low permeability soil that met the classification standards established for

optimum field parameters for compaction. Geotechnical results are presented in Appendix H.

4.6.3 Backfilling

Once the survey was complete, a 1-foot layer of fine silty, sandy clay backfill was placed into the excavation to act as a semi-permeable layer. This clay layer was compacted to 98 percent modified proctor to ensure that it would provide a substantial barrier from surface water infiltration. The top 1 foot of backfill was clean and capable of sustaining vegetative growth. The topsoil was compacted with three passes of heavy equipment.

4.6.4 Compaction Testing

Upon completion of the critical subsurface lift of backfill compaction using the clayey backfill, Pensacola Testing Labs, performed compaction testing via a nuclear density gauge. During the initial testing, the backfilled soil failed to meet the required density and optimum moisture content. Several additional passes over the soil were completed and the backfill soil was retested and met the required density and moisture content. Geotechnical results are presented in Appendix H.

4.6.5 Site Restoration

The entire area was hydro-seeded with a blend of brown top millet and Bermuda grass, as well as lawn fertilizer. The seeded area was watered approximately 2 hours per day for the first 7 days to ensure growth. Photographs of the restored site are included in Appendix C.

4.7 Equipment Decontamination

All equipment was decontaminated with a low-volume, high-pressure washer prior to demobilizing the project site. Plastic sheeting was placed in one corner of the excavation area and, using the existing sides and constructed earthen berms, the rinsate from the pressure washing activities was contained. All rinsate generated by the activities was contained in metal drums pending analysis. Decontamination of personnel and personal protective equipment (PPE) was performed in accordance with the health and safety plan and applicable provisions of 29 Code of Federal Regulation (CFR) 1910.120 and loaded in the trucks with the soil and other solid debris.

4.8 Waste Management and Disposal

4.8.1 Solid Wastes

During the initial soil sampling phase in January, CCI collected *in-situ* waste characterization soil samples within the established limits of the areas to be excavated. These sample were analyzed for toxicity characteristic leaching procedure (TCLP) VOCs (Methods 1311/8260B), TCLP SVOCs (Methods 1311/8270C), TCLP pesticides (Methods 1311/8081A), TCLP herbicides (Methods 1311/8151A), TCLP metals (Methods 1311/3010A/6010B/7470A), PCBs (Method 8082), reactivity, corrosivity, Ignitability (RCI), TCL VOCs (Method 8260B), TAL metals (Methods 3050B/6010B/7471A), and pH.

The TCLP results for lead ranged from 24.4 to 27.2 milligrams per liter (mg/L). This concentration exceeds the maximum concentration for toxicity pursuant to 40 CFR, Part 261.24 (Table 1), which states that if the lead concentration exceeds 5 mg/L, the source is deemed toxic and must be treated as a hazardous waste. Therefore, the contaminated soil was determined to be hazardous for lead (D008) and would require offsite treatment prior to final disposition. Analytical results of the disposal profile are included in Appendix I.

CCI provided NAS Pensacola Hazardous Waste Management with a waste approval package for the waste stream. This package included the following:

- Hazardous waste profile
- Analytical results
- Transporter/disposal facility permit and insurance information
- Completed sample waste manifest

Mr. James Bartee with NAS Pensacola Hazardous Waste Management signed the disposal profiles. Mr. James Bartee and his designee, Mr. Edward Dolihite, signed the manifests for the shipment of waste each day. During the course of shipment at the conclusion of each day, Mr. Bartee and/or Mr. Dolihite were provided the generator copies of the open manifests. The remainder of the copies was provided to the transporter to accompany the load in transit. Copies of the waste manifests, certificates of disposal and weigh tickets are included in Appendix I.

On April 12, 2002, soil and debris began being loaded into 20 cubic yard dump trailers for transportation to the disposal facility. The dump trailers were lined with plastic liners, with each load manifested as hazardous for lead (D008) and placarded accordingly. A total of 31 loads with an accumulative total of 747.62 tons of soil and debris were removed from the site. All of the soil was transported to Michigan Disposal Waste Treatment Facility in Belleville, Michigan.

The 20 to 25 metal drums and drum parts unearthed during the IRA and the 14 drums recovered during the initial assessment in November 2000 by TtNUS were also loaded with the soil and other debris from the site. The drums, soil, and debris were transported and disposed at the waste facility in Michigan.

4.8.2 Liquid Wastes

As a result of the IRA activities, decontamination wastewater and well purge-water were generated. Approximately 200 gallons of water was accumulated into metal drums. All of the drums were labeled and samples collected for disposal analysis. The waste water was analyzed for TCL VOCs (Method 8260B), TCL SVOCs (8270C), TCL pesticides (8081A), TCL herbicides (8151A), TAL metals (Methods 3050B/6010B/7471A, PCBs (Method 8082), RCI, and pH. The analytical results indicated the water was non-hazardous.

Two of the drums removed from the excavation during the IRA contained small amounts of liquid (less than 1 gallon each). One drum contained a clear, odorless liquid that could merely be water, while the other drum contained a dark, viscous, liquid that could be some type of oil. The drums were temporarily set aside pending sampling. However, during the drum sampling event, the drum containing the clear liquid was dry. The other drum containing oily liquid was sampled; however, only half of the required sample volume

remained. As a consequence, insufficient sample was available to properly characterize the waste, which resulted in a RCRA empty drum.

Analytical results of the liquid waste streams are included in Appendix I. The subcontractor disposed of the decontamination water and the two empty drums on August 21, 2002.

4.9 Demobilization

On May 6, 2002, CCI and subcontractors demobilized from the remediation portion of the project.

4.10 Remedial Goal Revisions and IRA Summary

During the review of the draft IRA report, various limitations associated with performing a 95 percent UCL were determined which resulted in incorrect RGs for the identified COCs at this site. Per University of Florida guidance, the 95 percent UCL cannot be used for barium, copper, nickel, or vanadium for current or potential residential land use. This limitation is due to the acute toxic effects children experience as a result to direct exposure to these metals. Additionally, further discussions with EPA resulted in the determination that the 95 percent UCL should not be used for lead. For these COCs, the lower of the respective residential or leachability soil cleanup target level (SCTL) should be the RG. After the discovery of the error, it was determined the additional nine areas investigated during SI activities (11, 12, 13, 17, 18, 19, 21, 23, and 24) also required further investigation and possible remediation. These areas should be investigated during future recommended Remedial Investigation(RI)/Feasibility Study (FS) activities conducted at the site.

For the four remaining COCs at the site, antimony, arsenic, iron, and zinc, it was determined the 95 percent UCL could potentially be used to calculate the RG. The statistical method selected for calculating the 95 percent UCL was the bootstrap method rather than the lognormal method. This decision was based primarily on the small sample size in conjunction with a 1997 EPA technical paper which recommends at least 30 samples be available for lognormality to be considered. Using the bootstrap method to calculate the 95 percent UCL corrects some of the failing points of using the lognormal method. The guidance and methodology used to calculate the 95 percent UCL is presented in Appendix A. If the 95 percent UCL is less than the SCTL, the RG would be determined by calculating three times the SCTL. Since the 95 percent UCL calculation results for antimony, arsenic, and iron were above the associated SCTLs, the 95 percent UCL method could not be applied. Therefore, the residential direct exposure SCTL should be the RG for antimony, arsenic, and iron. If background concentrations for these constituents are found to be present in higher concentrations than the respective SCTL, the background concentration will be the RG. Conversely, since the 95 percent UCL calculated for zinc was below the associated SCTL, three times the SCTL will be used as the RG for zinc

Table 4-1 presents the original RGs established for the COCs identified at the as outlined in the work plan/or and various technical memos previously submitted. Table 4-1 also presents the revised RGs based on additional guidance on the usage of the 95 percent UCL. Unless a background concentration for NAS Pensacola or 95 percent UCL was determined

for the listed constituent, the RGs reflect Florida's existing guidance on using the lower of either the residential SCTLs or leachability SCTLs values.

TABLE 4-1
Revised Remedial Goals

COC	Original Surface Soil Remedial Goals (mg/kg)	Original Subsurface Soil Remedial Goals (mg/kg)	Revised Soil Remedial Goals (mg/kg)[1]	Groundwater Remedial Goals (µg/L)
Antimony	26[2]	26[2]	26[2]	30.2[6]
Arsenic	21.93[4]	29[3]	1.56[6]	50[5]
Barium	1533[4]	1,600[3]	110[2]	2,000[5]
Copper	11,226[4]	N/A	110[2]	1,000[5]
Iron	81,900[4]	N/A	23,000[2]	1,707[6]
Lead	9,390[4]	N/A	400[2]	15[5]
Nickel	116.4[4]	130[3]	110[2]	100[5]
Vanadium	158.1[4]	N/A	15[2]	53[5]
Zinc	23,000[2]	6,000[3]	69,000[7]/6,000[3]	5,000[5]

[1]Revised Soil Remedial Goals reflect the lower of either the residential SCTL, leachability SCTL or background
[2]Chapter 62-777, FAC, Residential Direct Exposure
[3]Chapter 62-777, FAC, Leachability based on Groundwater
[4]Established using three times the 95 percent UCL
[5]Chapter 62-777, FAC, Groundwater Criteria
[6]Established using background concentrations for NAS Pensacola (2 x mean)
[7]Established using the 95 percent UCL, three times the SCTL
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
N/A = Not Applicable

Proposed changes to the SCTLs listed in Chapter 62-777, FAC, are expected to be made in Fall 2003. If these changes occur, the RGs listed in Table 4-1 should be revisited to ensure the current RGs are applied to this site.

Based the revised RGs, the laboratory data were reevaluated to determine the extent of contamination at the site and to determine where data gaps may exist. As shown on Figure 3-11, the excavation consisted of the removal of surface soil to 2 feet bls. Antimony, arsenic, barium, copper, iron, lead, nickel vanadium and zinc were detected in soil at concentrations exceeding the newly established RGs. Due to the change of RGs following excavation activities, certain constituents presently exceed their respective soil or groundwater RGs in the six areas (4, 14, 15, 16, 20, and 22) investigated during IRA activities and in an additional nine areas (11, 12, 13, 17, 18, 19, 21, 23, and 24) investigated during SI activities. Many of these contaminated areas, although not fully delineated, were excavated and removed from the site. The COCs left in place are discussed below.

4.10.1 Antimony

With the exception of one surface sample that could not be excavated without damaging a large oak tree, no surface soil samples remaining at the site exceed the RG of 26 mg/kg. However, three subsurface soil samples collected during the SI and two subsurface samples collected during the IRA from 2 to 3 feet bls contain antimony above the direct exposure RG of 26 mg/kg. Based on SPLP sampling, antimony is not leaching from the soil in concentrations above the groundwater background concentration of 30.2 µg/L and was not present in the groundwater collected during the SI.

Based on the revised RGs, the horizontal and vertical extent of the antimony contamination has not been determined with respect to direct exposure criteria in subsurface soil. It is recommended additional samples be taken to determine the horizontal and vertical extent of the antimony contamination or that land use controls (LUCs) be placed on the subsurface soil at the site.

4.10.2 Arsenic

All arsenic samples analyzed that exceeded the revised RG of 1.56 mg/kg in surface soil have been excavated. However, the soil was not delineated to its revised RG. Seven subsurface soil samples collected during the SI are above the direct exposure RG. All but one of these subsurface samples are below the leachability SCTL; one subsurface sample exceeds both the direct exposure and leachability SCTLs.

Based on SPLP sampling, arsenic is not present in subsurface soil above the groundwater GCTL of 50 μg/L and was not present in the groundwater during the SI, therefore arsenic is not a leachability concern at the site. Based on the revised soil RGs, however, the horizontal and vertical extent of the arsenic contamination with respect to direct exposure has not been determined. It is recommended additional samples be taken to determine the horizontal and vertical extent of the arsenic contamination.

4.10.3 Barium

All barium samples that exceeded the revised RG of 110 mg/kg in surface soils during the IRA soil sampling have been excavated. However, in three areas not further investigated as part of the IRA (Areas 11, 12 and 23), barium concentrations above the revised RG in surface soil were left in place.

Seven subsurface soil samples collected during the SI exceeded the direct exposure RG, and one also exceeded the leachability criteria of 1,600 mg/kg. These subsurface samples were not excavated.

Based on SPLP sampling, barium is not present in subsurface soil above the groundwater GCTL of 2,000 μg/L and was not present in the groundwater during the SI, therefore barium is not a leachability concern at the site. Based on the revised RGs, however, the vertical and horizontal extent of barium contamination has not been delineated with respect to direct exposure. It is recommended additional samples be taken to determine the horizontal and vertical extent of the barium contamination.

4.10.4 Copper

In addition to the two surface samples that could not be excavated without damaging a large oak tree, four surface soil samples collected in areas not excavated as part of the IRA exceed the RG of 110 mg/kg. Samples collected in areas 11, 12, 17 and 24 during the SI contained copper concentrations ranging from 160 to 876 mg/kg.

Copper concentrations remaining in the subsurface soil range from 120 to 15,900 mg/kg in 11 locations. These samples were not excavated and remain in place. Based on SPLP sampling, copper is present in one subsurface soil sample above the groundwater GCTL of 1,000 μg/L, but was not present in the groundwater during the SI.

Based on the revised RGs, the vertical and horizontal extent of copper contamination has not been delineated. It is recommended additional samples be taken to determine the horizontal and vertical extent of the copper contamination.

4.10.5 Iron

All iron samples that exceeded the RG of 23,000 mg/kg in surface soils have been excavated but were not delineated to the new RG. Iron concentrations remaining in the subsurface soil range from 23,800 to 263,000 mg/kg in eight locations. These samples were not excavated and remain in place.

Based on SPLP sampling, iron is present in two subsurface soil samples above the groundwater RG of 1,707 µg/L, but was not present in the groundwater above the RG of 1,707 µg/L.

Based on the revised RGs, the vertical and horizontal extent of iron contamination has not been delineated. It is recommended additional samples be taken to determine the horizontal and vertical extent of the iron contamination and groundwater continued to be monitored.

4.10.6 Lead

In addition to the three surface samples that could not be excavated without damaging a large oak tree, four surface soil samples collected in areas not excavated as part of the IRA exceed the RG of 400 mg/kg. Surface soil samples collected in areas 11, 12, 23 and 24 during the SI contained lead concentrations ranging from 817 to 3,860 mg/kg.

Lead concentrations remaining in the subsurface soil range from 450J to 20,700 mg/kg in 11 locations. These samples were not excavated and remain in place.

Based on SPLP sampling, lead is present in all 10 subsurface soil samples analyzed above the groundwater GCTL of 15 µg/L, but was not present in the groundwater during the SI.

Based on the revised RGs, the vertical and horizontal extent of lead contamination has not been delineated. It is recommended additional samples be taken to determine the horizontal and vertical extent of the lead contamination.

4.10.7 Nickel

All nickel samples that exceeded the RG of 110 mg/kg in surface soils have been excavated but were not delineated to the revised RG. Two subsurface samples remain above the RG.

Based on SPLP sampling, nickel leached from one subsurface soil sample above the groundwater GCTL of 100 µg/L, but was not present in the groundwater samples collected during the SI.

Based on the revised RGs the vertical and horizontal extent of nickel contamination has not been delineated. It is recommended additional samples be taken to determine the horizontal and vertical extent of the nickel contamination.

4.10.8 Vanadium

All vanadium samples that exceeded the RG of 15 mg/kg in surface soils have been excavated except in two areas not further investigated during the IRA. In Areas 12 and 23, surface soil samples contained vanadium at 19.2 and 26.6 mg/kg, respectively. It should be noted that the Florida surface soil residential SCTL for vanadium is expected to increase to 67 mg/kg later this year.

Subsurface vanadium left in place in eight areas ranges from 21.6 to 321 mg/kg, each above the current RG of 15 mg/kg.

Based on SPLP sampling, vanadium is present in two subsurface soil sample above the groundwater GCTL of 49 μg/L, but was not present in the groundwater in samples collected during the SI.

Based on the revised RGs, the vertical and horizontal extent of vanadium contamination has not been delineated. It is recommended additional samples be taken to determine the horizontal and vertical extent of the vanadium contamination.

4.10.9 Zinc

All zinc samples that exceeded the revised residential direct exposure RG of 69,000 mg/kg in surface soils have been excavated. Subsurface concentrations of zinc in excess of the leachability criteria of 6,000 mg/kg left on site ranges from 6,260 to 71,700 mg/kg in three locations.

Based on SPLP sampling, zinc was present in two subsurface soil sample above the groundwater SCTL of 5,000 μg/L, but was not present in the groundwater during the SI.

Based on the revised RGs, the vertical and horizontal extent of zinc contamination has not been delineated. It is recommended additional samples be taken to determine the horizontal and vertical extent of the zinc contamination.

4.10.10 SVOCs

Benzo(a)pyrene was detected in surface soil in seven locations during the SI above the residential SCTL of 0.1 mg/kg. All but three of these areas were excavated during the IRA. The three remaining sample concentrations range from 0.110J to 0.360 mg/kg. Two of the three samples were located along the perimeter of the excavation and may have been removed.

In subsurface soil, benzo(a)pyrene was detected above the residential SCTL of 0.1 mg/kg in one sample. Additionally, dibenz(a,h)anthracene was detected above the residential SCTL of 0.1 mg/kg in one sample.

5.0 Groundwater Monitoring

CCI conducted baseline groundwater monitoring events on November 28, 2001, and December 12, 2001. The first semi-annual sampling was conducted on June 13 and June 27, 2002. Five wells (PEN-43-01S through PEN-43-05S) were included in the monitoring program. During the baseline sampling event, each of the proposed wells was located and inspected. The monitoring well locations are shown on Figure 5-1.

During the baseline event, three of the proposed monitoring wells located were noted to be dry and apparently had silted in over time. The wells contained between 3 and 4 feet of silt. These wells were redeveloped to clear out the silt and subsequently sampled. During the semi-annual sampling event in June, one of the wells had silted in and was redeveloped a second time. A summary of site activities for Site 43 is presented in Table 2-1.

5.1 Groundwater Elevations

Complete rounds of water levels were measured in each of the monitoring wells at Site 43 on February 1 and July 10, 2002. These groundwater elevations are listed in Table 5-1.

During the February event, groundwater appeared to be flowing radially inward toward the drum storage area. This is consistent with historical flow. However, after the interim removal action was complete, the water levels were measured and the flow appeared to be to the east, towards Pensacola Bay. This flow direction is what would be expected from a site in this area without subsurface interferences. Figures 5-2 and 5-3 depict the groundwater flow direction for the February and July 2002 water level events, respectively.

TABLE 5-1
Groundwater Elevation Data

Monitoring Well	TOC Elevation (feet NAVD)	Screened Interval (feet bls)	Well Depth (feet bls)	DTW (feet btoc)	GWE (feet NAVD)	Well Depth (feet bls)	DTW (feet btoc)	GWE (feet NAVD)
			02/01/2002			07/10/2002		
PEN-43-01S	19.95	9.5 to 19.5	19.19	15.10	4.85	19.19	15.68	4.27
PEN-43-02S	21.07	9.4 to 19.4	18.70	16.10	4.97	18.40	16.68	4.39
PEN-43-03S	21.50	9.5 to 19.5	19.00	16.32	5.18	18.99	16.88	4.62
PEN-43-04S	14.46	5 to 15	15.05	8.73	5.73	15.05	9.25	5.20
PEN-43-05S	20.57/20.40*	9 to 19	19.15	16.54	4.03	18.90	15.89	4.51

bls below land surface
GWE groundwater elevation
btoc below top of casing
NAVD North American Vertical Datum
DTW depth to water
TOC top of casing
*The TOC was changed by 0.17 feet during construction activities for this well.

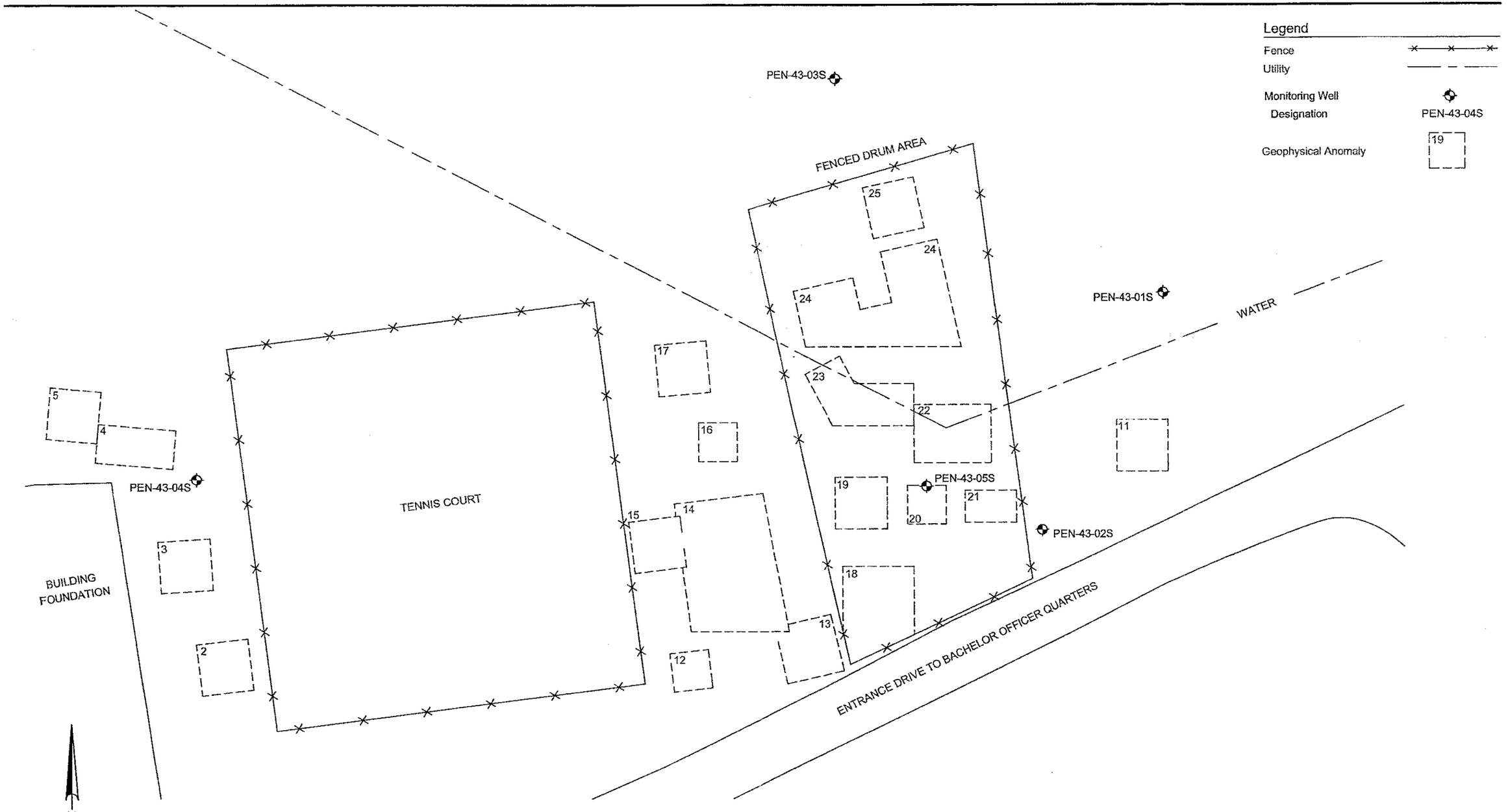

FIGURE 5-1

Monitoring Well Location Map

Site 43, NAS Pensacola

CH2MHILL

rp4_43_f5-1.dwg
31-Jul-2002

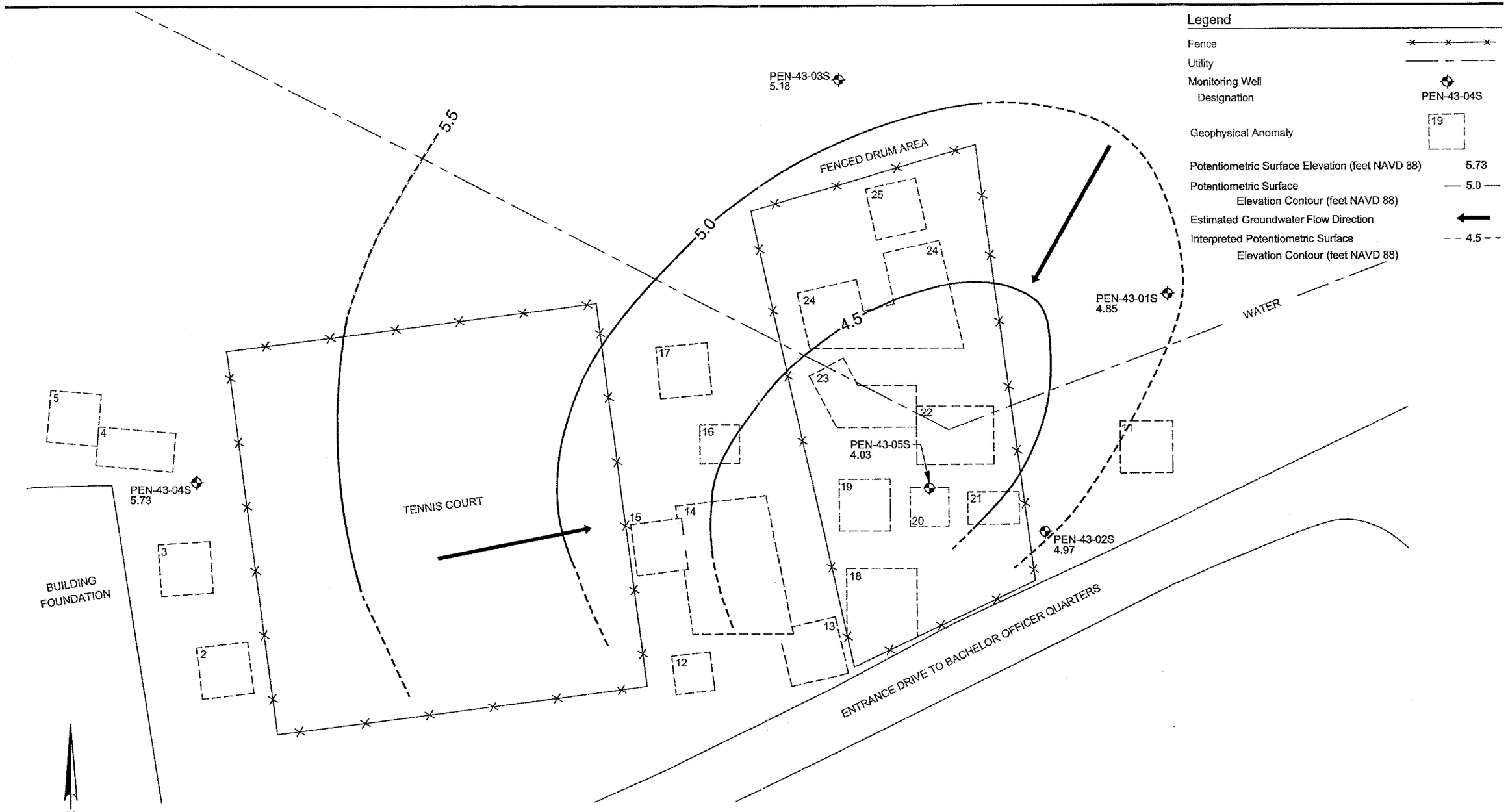

FIGURE 5-2

Groundwater Elevation Map
(February 2002)
Site 43, NAS Pensacola

CH2MHILL

rp4_43_f5-2.dwg
31-Jul-2002

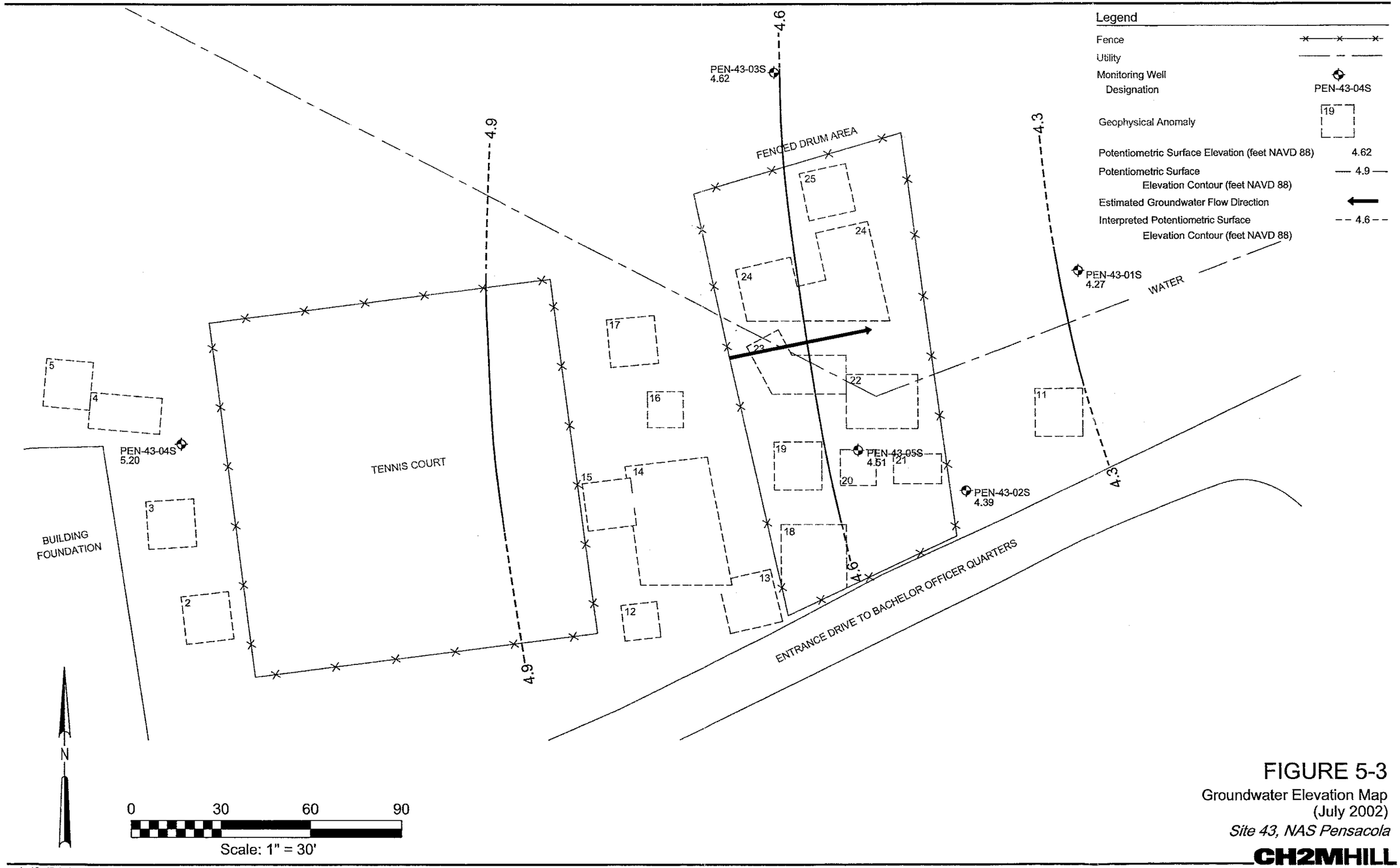

FIGURE 5-3

Groundwater Elevation Map
(July 2002)
Site 43, NAS Pensacola

CH2MHILL

rp4_43_f5-3.dwg
31-Jul-2002

5.2 Groundwater Sampling and Laboratory Analyses

Groundwater sampling was performed in accordance with FDEP Standard Operating Procedures, Department of Environmental Regulation QA-001/92. Prior to sampling, the field parameters (temperature, pH, conductivity, turbidity, and dissolved oxygen [DO]) were measured at each monitoring well. The field parameter data are summarized in Table 5-2. The field data sheets are presented in Appendix J. Samples were collected using a peristaltic pump and Teflon tubing.

TABLE 5-2
Groundwater Field Parameter Data

Monitoring Well	Measurement Date	Water Temperature (°C)	pH	Specific Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)
PEN-43-01S	11/28/2001	23.4	5.98	0.65	10	8.22
	06/13/2002	22.25	5.21	0.88	202	6.45
PEN-43-02S	12/12/2001	23.3	6.1	0.19	0	3.00
	06/27/2002	25.05	5.57	0.137	30.6	4.99
PEN-43-03S	12/12/2001	24.9	6.1	0.13	0	0.52
	06/13/2002	23.37	5.41	0.176	5	4.98
PEN-43-04S	11/28/2001	24.3	6.29	0.138	< 1	7.14
	06/13/2002	24.07	5.49	0.158	6	5.50
PEN-43-05S	12/12/2001	24.8	5.9	0.10	11	0.00
	06/13/2002	23.97	5.17	0.083	98	6.44

°C degrees Celsius
mg/L milligrams per liter
mS/cm micro Siemens per centimeter
NTU nephelometric turbidity unit

Laboratory analyses for the groundwater sampling were provided by Severn Trent Laboratories, Inc., Pensacola, Florida, in accordance with their FDEP-approved Comprehensive Quality Assurance Plan (CompQAP). Groundwater samples were analyzed for iron by SW-846 method 6010B. All purge water was containerized in metal drums and was subsequently disposed by the subcontractor at the EQIS facility in Atlanta, Georgia.

5.3 Groundwater Analytical Results

Iron concentrations detected during the baseline event in December 2001 ranged from less than 64 to 140 µg/L. None of the samples exceeded the background concentration of 1,707 µg/L for iron at NAS Pensacola. Concentrations were also below the FDEP groundwater cleanup target level (GCTL) for iron of 300 µg/L (Chapter 62-777 FAC).

Iron concentrations detected during the semi-annual sampling event in June 2002 ranged from 190 to 820 µg/L. The iron concentrations were higher in each well than during the

baseline event. Since the interim removal activities disturbed the shallow soils, a slight increase in groundwater concentrations could be expected due to the initial releases; however, the remedial actions removed the source of groundwater contamination and concentrations are expected to decrease. Additionally, none of the samples exhibited iron concentrations above the background concentration for iron at NAS Pensacola (1,707 µg/L). Concentrations in three monitoring wells were above the FDEP GCTL for iron of 300 µg/L.

Analytical results from the baseline and semi-annual groundwater sampling events are summarized in Table 5-3 and the data evaluation is provided in Appendix D. Iron concentrations detected in each monitoring well sampled are shown on Figure 5-4.

TABLE 5-3
Groundwater Analyses Summary

Monitoring Well	Date Sampled	Iron (µg/L)
PEN-43-01S	11/28/2001	240
	06/13/2002	510
Duplicate of PEN-43-1S	06/13/2002	610
PEN-43-02S	12/12/2001	140
Duplicate of PEN-43-2S	12/12/2001	130
	06/27/2002	820
PEN-43-03S	12/12/2001	64 U
	06/13/2002	190
PEN-43-04S	11/28/2001	91 J
Duplicate of PEN-43-4S	11/28/2001	110
	06/13/2002	210
PEN-43-05S	12/12/2001	130
	06/13/2002	470
Cleanup value (NAS Pensacola background concentration)		**1,707**

µg/ L micrograms per liter
J = estimated value
U = undetected

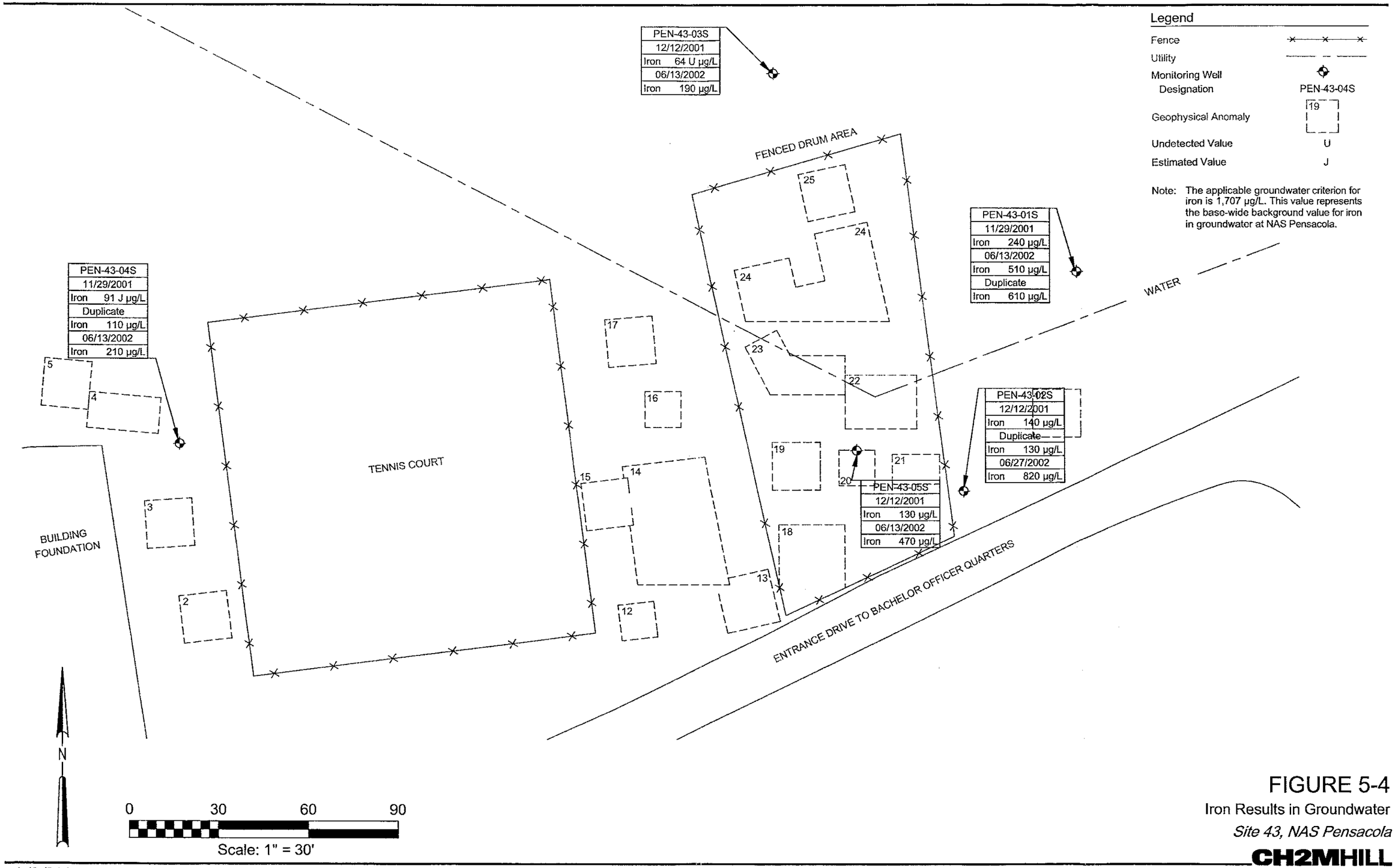

FIGURE 5-4

Iron Results in Groundwater

Site 43, NAS Pensacola

CH2MHILL

rp4_43_f5-4.dwg
31-Jul-2002

6.0 Data Quality Evaluation

The complete Data Validation Report is included in Appendix D.

7.0 Problems Encountered

7.1 Potential UXO

As detailed in Section 4.4, potential UXO was unearthed at the site. Unfortunately, the excavation permit process does not include UXO or potential UXO clearance. Therefore, CCI could not predict potential complications related to the discovery of potential UXO. The landfill cell at the Michigan facility containing the waste that had already been disposed was closed down, and trucks that were en route to the facility were called back. The soil was temporarily stockpiled and screened at a remote location on the Base and had to be reloaded after inspection. Various UXO personnel were called onto the site, and time was lost. Changing operations and plans during this period resulted in schedule and financial impacts to the project.

7.2 Monitoring Wells

As detailed in Section 5, three of the proposed monitoring wells at the site were noted to be dry during the baseline event and apparently had silted in over time. The wells contained between 3 and 4 feet of silt. These wells were redeveloped to clear out the silt and subsequently sampled. During the semi-annual sampling event in June, one of the wells had silted in again and was redeveloped a second time. There were slight schedule and financial impacts to the project due to the numerous remobilizations to the site.

8.0 Final Inspection

On May 6, 2002, base personnel performed an inspection of the work for compliance with the scope of work and acceptance. Mr. Mark Shull and Mr. Jerry Flemming, NAS Pensacola ROICC, conducted the inspection. No deficiencies were noted and Mr. Shull stated the site was very acceptable.

9.0 Conclusions and Recommendations

9.1 Conclusions

- An IRA was completed to remove visible debris and the upper 2 feet of contaminated soil.
- Thirty-one truck loads with an accumulative total of 747.62 tons of soil and debris were transported to Michigan Disposal Waste Treatment Facility in Belleville, Michigan.
- Fourteen drums from the initial site investigation, 20 to 25 drums, and drum parts were loaded and disposed of in the Michigan landfill.
- Ornamental ordnance and munitions were found in the excavation area and were determined to be inert and disposed of in the Michigan landfill.
- Following the IRA, RGs were revisited and it was determined that the initial RGs were not appropriate for the site. Based upon this information, the laboratory data were reevaluated to characterize the extent of contamination at the site.
- Due to the change in RGs following IRA activities, several inorganics and two SVOCs remain in surface and subsurface soil at concentrations above their respective RG.
- Iron concentrations detected in groundwater during the IRA sampling activities were all below the background concentration for iron at NAS Pensacola.

9.2 Recommendations

- An RI/FS should be completed to determine the horizontal and vertical extent of the contamination at this site and whether adverse risk to human health or the environment exist.
- Applicable or Relevant and Appropriate Requirements should be established for each COC at the site.
- As requested by FDEP and EPA, permanent monitoring wells should be installed at agreed upon locations and the temporary wells should be properly abandoned.

10.0 Works Cited

CH2M HILL Constructors, Inc. *Contract Management Plan*, Contract No. N62467-98-D-0995. July 1998.

CH2M HILL Constructors, Inc. *Basewide Work Plan Naval Air Station Pensacola, Pensacola, Florida*. June 2000.

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Naval Energy and Environmental Support Activity. *Initial Assessment Study of Naval Air Station Pensacola*. June 1983.

Tetra Tech NUS, Inc. *Site Characterization Report for Site 43, NAS Pensacola, Pensacola, Florida*. April 2000.

Appendix A

95 Percent Upper Confidence Level Guidance and Methodology

Appendix B

Contractor Production Reports and Contractor Quality Control Reports

Appendix C

Project Photographs

Appendix D

Data Validation Report

Available on CD only

Appendix E

Utility Excavation Permit

Appendix F

Pre- and Post-Excavation Survey

Available on CD only

Appendix G

Offsite Backfill Analytical Results

Appendix H

Geotechnical Test and Results

Appendix I

Waste Disposal Documentation

Transportation and Disposal Log
Manifests

Appendix J

Field Data Sheets

Appendix K

EPA and FDEP Comments and Navy Response to Comments