N61165.AR.003398
CNC CHARLESTON
5090.3a

CORRECTIVE MEASURES STUDY REPORT AREA OF CONCERN 596 (AOC 596) ZONE E

CNC CHARLESTON SC

5/19/2003

CH2M HILL

CORRECTIVE MEASURES STUDY REPORT

AOC 596, Zone E

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

CH2M-Jones

May 2003

Contract N62467-99-C-0960

CH2M HILL
115 Perimeter Center Place, NE
Suite 700
Atlanta, GA 30346-1278
Tel 770.604.9095
Fax 770.604.9282

CH2MHILL

May 19, 2003

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: CMS Report (Revision 0) – AOC 596, Zone E

Dear Mr. Scaturo:

Enclosed please find four copies of the CMS Report (Revision 0) for AOC 596 in Zone E of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Sam Naik. Please contact him at 770/604-9182, ext. 255, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Dann Spariosu/USEPA, w/att
Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att

CORRECTIVE MEASURES STUDY REPORT

AOC 596, Zone E

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

May 2003

Revision 0
Contract N62467-99-C-0960
158814.ZE.PR.14

Certification Page for Corrective Measures Study Report (Revision 0) — AOC 596, Zone E

I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428

Dean Williamson, P.E.

5/23/2003

Date

Contents

Contents, Continued

Acronyms and Abbreviations

AOC	area of concern
BCT	BRAC Cleanup Team
BEQ	benzo(a)pyrene equivalent
BRAC	Base Realignment and Closure Act
CA	corrective action
CFR	*Code of Federal Regulations*
CMS	Corrective Measures Study
CNC	Charleston Naval Complex
COC	chemical of concern
CSI	Corrective Study Investigation
EnSafe	EnSafe Inc.
EPA	U.S. Environmental Protection Agency
ft^2	square feet
HI	Hazard Index
ILCR	incremental lifetime cancer risk
LUC	land use control
LUCIP	Land Use Control Implementation Plan
LUCMP	Land Use Control Management Plan
µg/kg	micrograms per kilogram
mg/kg	milligram per kilogram
MCL	maximum contaminant level
MCS	media cleanup standard

Acronyms and Abbreviations, Continued

NAVBASE	Naval Base
PPE	personal protective equipment
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDA	Redevelopment Authority
RFI	RCRA Facility Investigation
RGO	remedial goal option
SCDHEC	South Carolina Department of Health and Environmental Control
SVOC	semivolatile organic compound
VOC	volatile organic compound
yd^3	cubic yards

Section 1.0

1.0 Introduction

In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates closure and transition of property to the community. The Charleston Naval Complex (CNC) was formed as a result of the dis-establishment of the Charleston Naval Shipyard and NAVBASE on April 1, 1996.

Corrective Action (CA) activities are being conducted under the Resource Conservation and Recovery Act (RCRA), with the South Carolina Department of Health and Environmental Control (SCDHEC) as the lead agency for CA activities at the CNC. All RCRA CA activities are performed in accordance with the Final Permit (Permit No. SC0 170 022 560). In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at the CNC.

A RCRA Facility Investigation (RFI) Report Addendum and Corrective Measures Study (CMS) Work Plan were prepared for Area of Concern (AOC) 596 in Zone E of the CNC (CH2M-Jones, 2002). The RFI Report Addendum and CMS Work Plan presented the remedial action objectives (RAOs) and media cleanup standards (MCSs) proposed for AOC 596. This CMS report has been prepared by CH2M-Jones to complete the next stage of the CA process for AOC 596.

1.1 Purpose and Scope of Corrective Measures Study Report

This CMS report evaluates corrective measure (remedial) alternatives for preventing unacceptable exposure to arsenic and benzo(a)pyrene equivalent (BEQ) contamination found in the soil at AOC 596. Arsenic and BEQs in surface soil are the chemicals of concern (COCs) identified at AOC 596 under the unrestricted (i.e., residential) use scenario. BEQs were also identified as COCs for non-residential future land use scenario. Figure 1-1 illustrates the original location of AOC 596 within Zone E. Figure 1-2 is an aerial photograph showing the layout of AOC 596.

This CMS report consists of: 1) the identification of a set of corrective measure alternatives that are considered to be technically appropriate for addressing COC-contaminated soil; 2) an evaluation of the alternatives using standard criteria from U.S. Environmental Protection

Agency (EPA) RCRA guidance; and 3) the selection of a recommended (preferred) corrective measure alternative for the site.

This focused CMS evaluates the options for meeting the RAOs, which are described in Section 2.0 of this CMS report. The two remedies considered for achieving the RAOs are: 1) soil excavation and offsite disposal, and 2) land use controls (LUCs). The remedial activities associated with soil removal include excavation, backfilling, replacing pavement, and offsite disposal. The remedial activities that are associated with LUCs include maintaining the existing site use (commercial/industrial) and site controls (pavement/building), a LUC Management Plan (LUCMP) agreement between the Navy and the State of South Carolina, and long-term monitoring and review.

1.2 Background Information

This section of the CMS report presents background information on the facility, site history, and a summary of the nature and extent of the COCs at the site. This information is important to the understanding of the remedial goal options (RGOs), MCSs, and ultimately the evaluation of corrective measure alternatives for AOC 596. Additional information on the site and hydrogeology in the Zone E area of the CNC is provided in the *Zone E RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1997).

1.2.1 Facility Description

AOC 596 consists of Building 101. Building 101 is located at the intersection of Ninth Street and Pierside Street in Zone E of the CNC, as shown on Figure 1-1.

This area of Zone E is zoned M-2 (industrial). The CNC RCRA Permit identified AOC 596 as requiring a Corrective Study Investigation (CSI).

1.2.2 Site History

Building 101 (AOC 596) was built in 1919 and used to store torpedoes until 1943. From 1943 to 1946, the building housed a machine shop. In 1946, the building was converted into a storehouse for diesel parts, and in 1947 it was used as a storehouse for the galvanizing plant. From 1981 to approximately 1995, it was used to store radioactive-contaminated material. However, no evidence of remnant radioactive contamination was found in the building during a survey conducted by the Navy prior to base closure. The building is currently vacant.

A review of the historical engineering drawings for this site shows that in 1922 a railroad line ran into the northeast side of Building 101. A 1952 drawing indicates that between 1939 and 1952 the railroad line was replaced with a new line going into the northeast side of Building 101 to make room for an additional rail line adjacent to Building 101. Between 1952 and 1955, the railroad line was removed and replaced with a paved road. Currently a railroad line runs adjacent to the north side of Building 101. Historical railroad locations are shown on Figure A-1 in Appendix A of the *RFI Report Addendum and CMS Work Plan for AOC 596, Zone E, Revision 0* (CH2M-Jones, 2002).

The materials of concern that were identified based on historical operations at AOC 596 in the *Final Zone E RCRA Facility Investigation (RFI) Work Plan, Revision 1* (EnSafe/Allen & Hoshall, 1995) include solvents, degreasers, explosives, propellants, and petroleum hydrocarbons.

Regulatory review was conducted on the *Zone E RFI Report, Revision 0* (EnSafe, 1997), and a draft response to the comments from SCDHEC were prepared by the Navy/EnSafe team. The RFI Report Addendum, prepared by CH2M-Jones, identified arsenic and BEQs as COCs in surface soil at AOC 596. Detailed information on the analytical results and the screening of those results for the determination of COCs can be found in the *Zone E RFI Report, Revision 0*, and the *RFI Report Addendum and CMS Work Plan for AOC 596, Zone E, Revision 0* (CH2M-Jones, 2002).

1.2.3 Soil COC Summary

Two soil sampling events were conducted at AOC 596 during the RFI at the locations shown on Figure 1-3. Soil samples collected during RFI at AOC 596 were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals.

Arsenic and BEQs in surface soil were identified in the RFI Report Addendum as COCs at AOC 596, under an unrestricted (i.e., residential) land use scenario. This CMS focuses on arsenic and BEQs in surface soil at AOC 596. No COCs were identified in the RFI Report Addendum for subsurface soil or groundwater at AOC 596.

Detailed information on the analytical results and the screening of those results for the determination of COCs can be found in the *Zone E RFI Report, Revision 0* and the *RFI Report Addendum and CMS Work Plan for AOC 596, Zone E, Revision 0 (CH2M-Jones, 2002).*

1.3 Report Organization

This CMS report consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of and background information relating to this CMS report.

2.0 Remedial Goal Options and Proposed Media Cleanup Standards— Defines the RGOs and proposed MCSs for AOC 596, in addition to the criteria used in evaluating the corrective measure alternatives for the site.

3.0 Overall Approach for Evaluating Focused Alternatives for AOC 596 — Describes the alternative development process and presents the detailed evaluation criteria.

4.0 Description of Candidate Corrective Measure Alternatives — Describes each of the candidate corrective measure alternatives for addressing arsenic and BEQs in soil.

5.0 Evaluation and Comparison of Corrective Measure Alternatives — Evaluates each alternative relative to standard criteria, then compares the alternatives and the degree to which they meet or achieve the evaluation criteria.

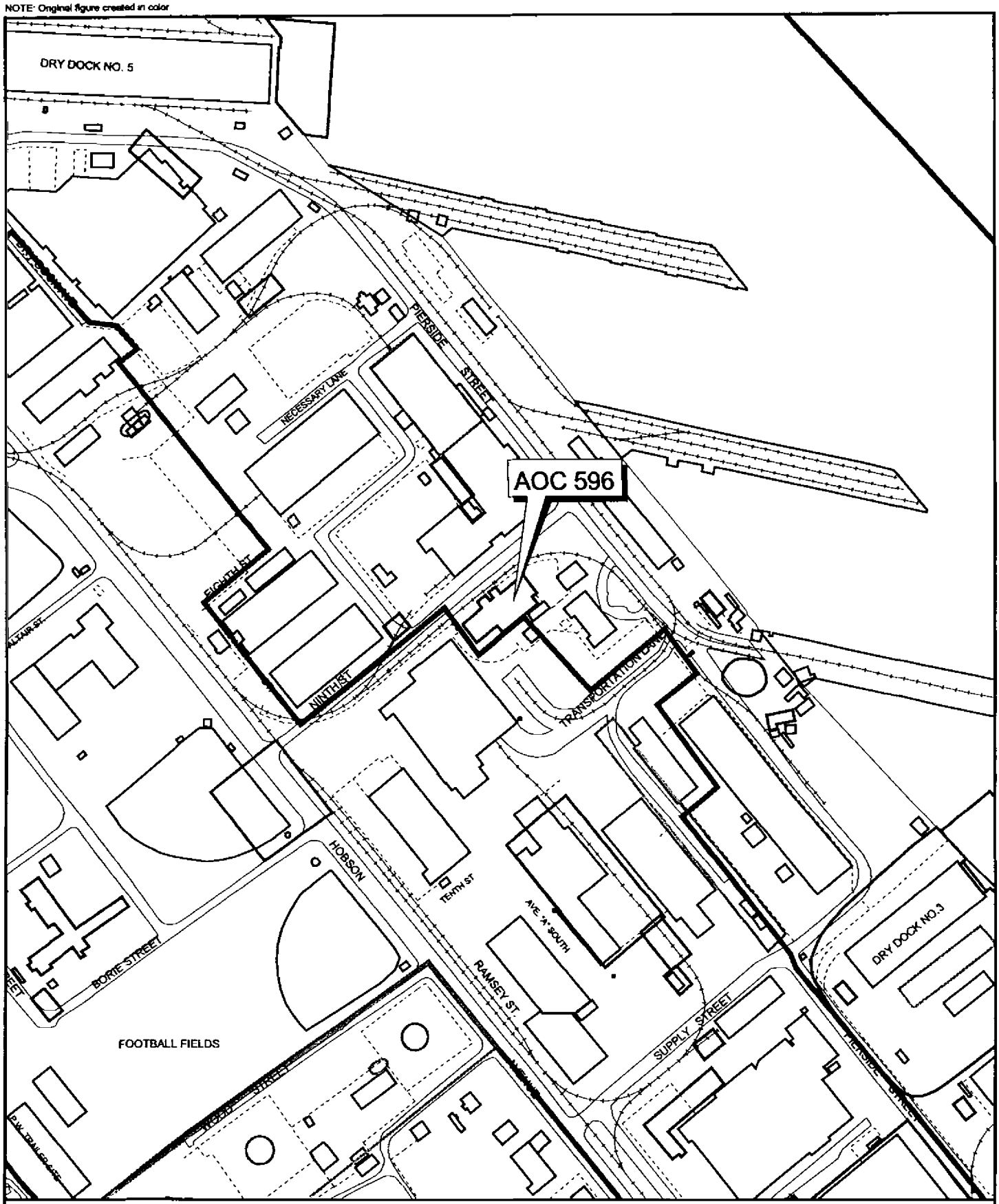
6.0 Recommended Corrective Measure Alternative — Describes the preferred corrective measure alternative to achieve the MCSs and RGOs for arsenic and BEQs in soil based on a comparison of the alternatives.

7.0 References— Lists the references used in this document.

Appendix A contains cost estimates developed for the proposed corrective measure alternatives.

All tables and figures appear at the end of their respective sections.

NOTE: Original figure created in color



Fence
Railroads
Roads - Lines
Shoreline
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 200 400 Feet

1 inch = 325 feet

Figure 1-1
Location of AOC 596 in Zone E
Charleston Naval Complex

File Path: C:\18gis\CNC\cnc-egis.apr, Date: 28 Mar 2002 13:53, User: MKARAFA, EGIS

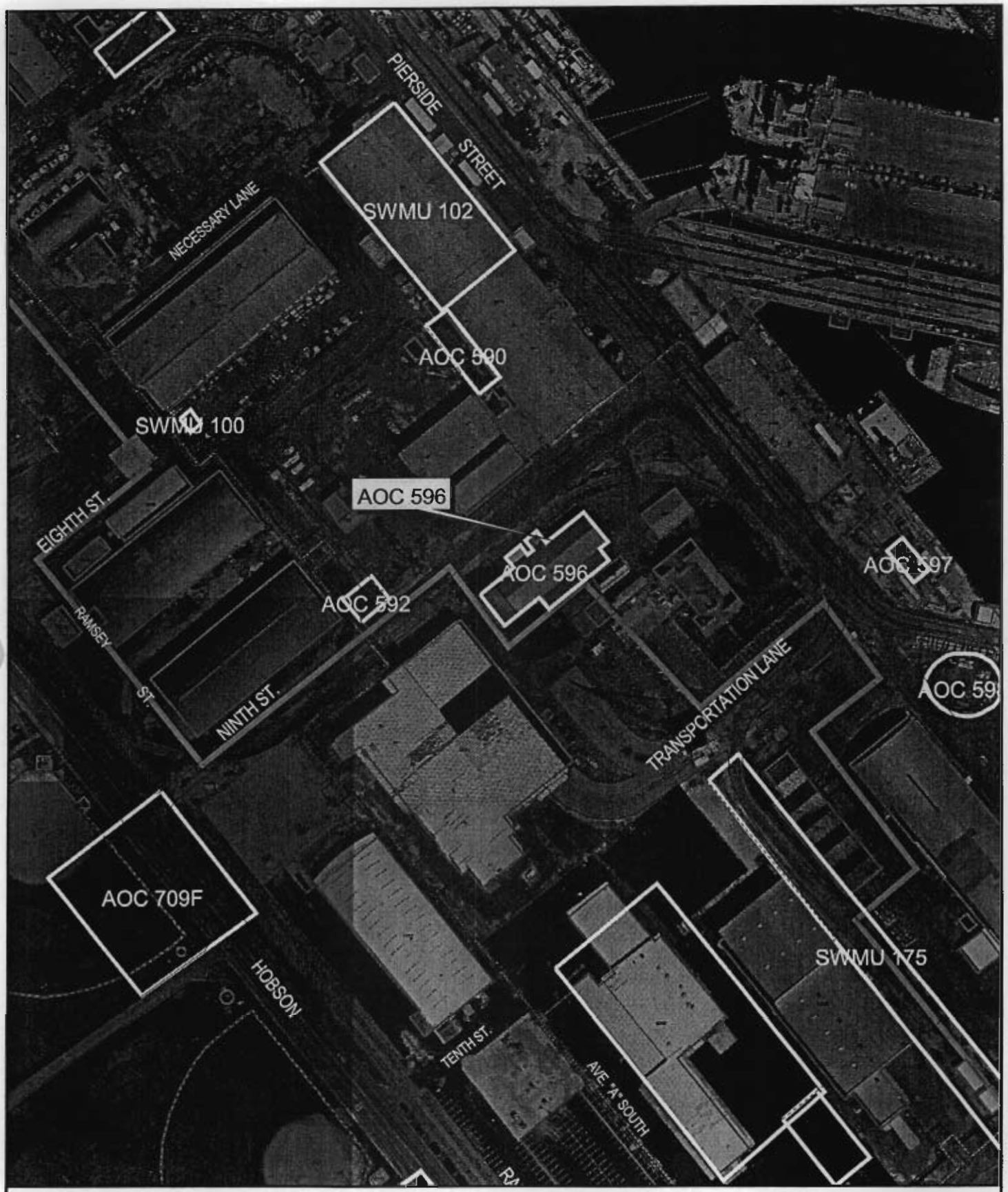


Figure 1-2
Site Map
AOC 596, Zone E
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\cnc\statbasis.apr, Date: 22 Oct 2002 14:22, User: SNAIK1

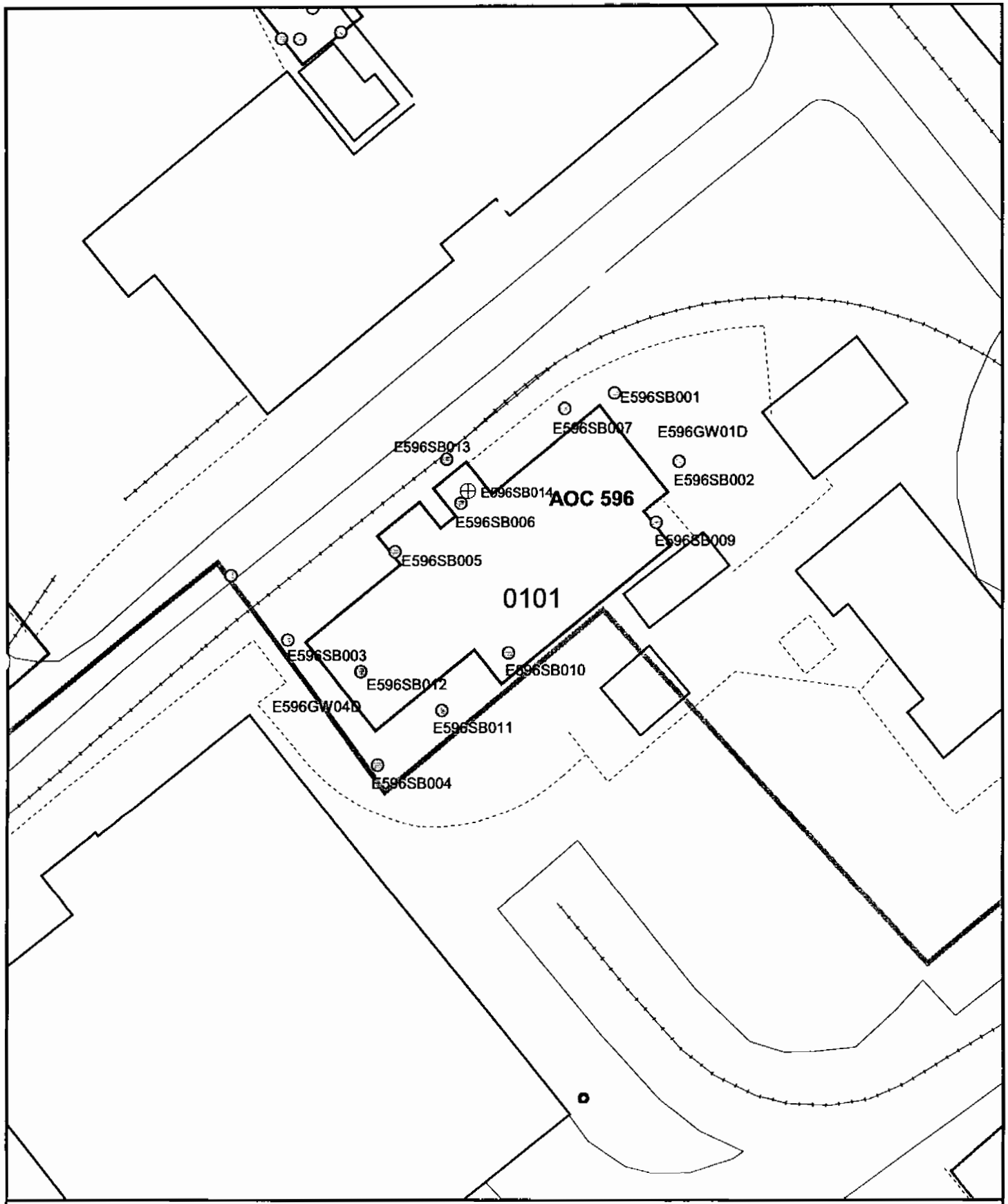


Figure 1-3
RFI and September 2002 Sample Location
AOC 596, Zone E
Charleston Naval Complex

File Path: c:\documents\cnc sites\aoc 596\proj2-1.apr, Date: 06 Jun 2002 14:22, User: MKARAFA, EGIS

Section 2.0

2.0 Remedial Goal Options and Proposed Media Cleanup Standards

RGOs and MCSs are typically developed at the end of the risk assessment in the RFI. RGOs can be based on a variety of criteria, such as drinking water maximum contaminant levels (MCLs), specific incremental lifetime cancer risk (ILCR) target levels (e.g., 1E-04, 1E-05, or 1E-06), target Hazard Index (HI) levels (e.g., 0.1, 1.0, 3.0), or site background concentrations. When area background concentrations are higher than the health protection-based concentrations, the background levels are the target MCSs. Achieving these goals should protect human health and the environment, while achieving compliance with applicable state and federal standards.

2.1 Remedial Action Objectives

RAOs are medium-specific goals that protect human health and the environment by preventing or reducing exposures under current and future land use conditions. In the *RFI Report Addendum and CMS Work Plan for AOC 596, Zone E, Revision 0* (CH2M-Jones, 2002), the RAOs identified for surface soil are to prevent ingestion and direct/dermal contact with soil containing COCs at unacceptable levels.

2.2 Media Cleanup Standards

MCSs for AOC 596 were presented in the *RFI Report Addendum and CMS Work Plan for AOC 596, Zone E, Revision 1* (CH2M-Jones, 2003). For sites where background arsenic levels exceed risk-based concentrations (RBCs), EPA Region IV typically considers arsenic concentrations in surface soil up to 20 milligrams per kilogram (mg/kg) and 270 mg/kg as acceptable for unrestricted and industrial land use, respectively (EPA, 2001). For arsenic within Zone E, the above criteria will be adopted as MCSs. For BEQs, the CNC BEQ sitewide reference concentration of 1,304 micrograms per kilogram (µg/kg) developed by the BCT was recommended in the CMS Work Plan for AOC 596 as the MCS for BEQs in surface soil.

The MCSs will be met if the site statistical estimates of concentrations are similar to background statistical estimates. For point comparisons between site and background, ranges of site concentrations may be compared with the ranges of background

concentrations. The EPA Region IV residential land use value for arsenic in soil of 20 mg/kg, or a zonewide average similar to that in Zone E, are potential practical MCSs for this area. Other potential RGOs, such as the 1E-06 ILCR level, were considered but regarded as not applicable because the site background concentrations of arsenic and BEQs are significantly greater than this level.

The pattern of distribution of arsenic in soil at this site indicates one area of exceedance above the unrestricted land use criterion of 20 mg/kg at the RFI soil boring E596SB006, where the surface soil arsenic concentration was 155 mg/kg.

The pattern of distribution of BEQs in soil at this site indicates two areas of exceedances above the CNC BEQ sitewide reference concentration of 1,304 µg/kg. At soil boring E596SB006, the surface soil BEQ concentration was 89,862 µg/kg and the subsurface soil concentration was 2,116 µg/kg. At soil boring E596SB013, the surface soil BEQ concentration was 4,461 µg/kg. This location is directly adjacent to railroad lines at the site. It is likely that activities associated with the railroad lines are responsible for the elevated level of BEQs at this location.

The focus of this CMS is to evaluate alternatives that will achieve the RAOs described above. The corrective measure alternatives evaluated include:

1) Soil removal and offsite disposal with land use controls (LUCs), and
2) LUCs.

These alternatives are discussed in Section 4.0 of this CMS report.

Section 3.0

3.0 Overall Approach for Evaluating Focused Alternatives for AOC 596

3.1 Preferred Remedies

A variety of corrective measure approaches are conceptually feasible for addressing arsenic and BEQs in soil at AOC 596. However, remedy selection at the CNC has focused on a few demonstrated technologies. For contaminants in soil that are limited in area, the preferred technologies that are expected to be effective at the CNC include: 1) soil excavation and offsite disposal with LUCs, and 2) LUCs. Generally, at sites similar to AOC 596 with limited soil contamination, a preference exists for implementing one of these remedies to expedite the remedy selection and implementation processes, improve predictability of the remedy, and lower costs. These candidate alternatives are screened and evaluated using the conventional criteria presented below.

In this focused CMS, these two alternatives will be described in Section 4.0, evaluated in detail in Section 5.0, and one alternative will be recommended in Section 6.0.

3.2 Evaluation Criteria

According to the EPA RCRA CA guidance, corrective measure alternatives should be evaluated using the following five criteria:

1. Protection of human health and the environment.
2. Attainment of MCSs.
3. The control of the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Compliance with applicable standards for the management of wastes generated by remedial activities.
5. Other factors, including (a) long-term reliability and effectiveness; (b) reduction in toxicity, mobility, or volume of wastes; (c) short-term effectiveness; (d) implementability; and (e) cost.

Each of these criteria is defined in more detail below:

1. **Protection of human health and the environment.** The alternatives will be evaluated on the basis of their ability to protect human health and the environment. The ability of an alternative to achieve this criterion may or may not be independent of its ability to achieve the other criteria. For example, an alternative may be protective of human health, but may not be able to attain the MCSs, if the MCSs were not developed based on human health protection factors.

2. **Attainment of MCSs.** The alternatives will be evaluated on the basis of their ability to achieve the MCS defined in this CMS. Another aspect of this criterion is the time frame required to achieve the MCS. Estimates of the time frame for the alternatives to achieve RGOs will be provided.

3. **The control of the source of releases.** This criterion deals with the control of releases of contamination from the source (the area in which the contamination originated) and the prevention of future migration to uncontaminated areas.

4. **Compliance with applicable standards for management of wastes.** This criterion deals with the management of wastes derived from implementing the alternatives (i.e., treatment or disposal of contaminated soil removed from excavations). Corrective measure alternatives will be designed to comply with all standards for the management of wastes. Consequently, this criterion will not be explicitly included in the detailed evaluation presented in the CMS, but such compliance would be incorporated into the cost estimates for which this criterion is relevant.

5. **Other factors.** Five other factors are to be considered if an alternative is found to meet the four criteria described above. These other factors are as follows:

    a. Long-term reliability and effectiveness

    Corrective measure alternatives will be evaluated on the basis of their reliability and the potential impact should the alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failing and the consequences of that failure.

    b. Reduction in the toxicity, mobility, or volume of wastes

    Alternatives with technologies that reduce the toxicity, mobility, or volume of the contamination will be generally favored over those that do not. Consequently, a qualitative assessment of this factor will be performed for each alternative.

    c. Short-term effectiveness

Alternatives will be evaluated on the basis of the risk they create during the implementation of the remedy. Factors that may be considered include fire, explosion, and exposure of workers to hazardous substances.

d. Implementability

The alternatives will be evaluated for their implementability by considering any difficulties associated with conducting the alternatives (such as the construction disturbances they may create), operation of the alternatives, and the availability of equipment and resources to implement the technologies comprising the alternatives.

e. Cost

A net present value of each alternative will be developed. These cost estimates will be used for the relative evaluation of the alternatives, not to bid or budget the work. The estimates will be based on information available at the time of the CMS and on a conceptual design of the alternative. They will be "order-of-magnitude" estimates with a generally expected accuracy of -50 percent to +100 percent for the scope of action described for each alternative. The estimates will be categorized into capital costs and operations and maintenance costs for each alternative.

Section 4.0

4.0 Description of Candidate Corrective Measure Alternatives

4.1 General Description of Alternatives

Two candidate corrective measure alternatives were selected for this site:

- Alternative 1: Soil Excavation and Offsite Disposal with LUCs
- Alternative 2: LUCs

Alternative 1 would involve the removal of soil at locations where arsenic and BEQ concentrations exceed the MCSs. Based on an evaluation of arsenic and BEQs, two areas at the site will require surface soil removal in order for site soils to meet the arsenic and BEQ MCSs:

- Sample location E596SB006. This location is inside Building 101, beneath a reinforced concrete floor, and removal and replacement of the concrete would be required to complete the soil removal. This boring location is also where the elevated detection of arsenic (155 mg/kg) occurred.
- Sample location E596SB013. This location is approximately 2-3 feet away from the railroad line and within the right-of-way of the railroad line. Excavation of this location would impact the railroad lines, and removal and replacement of the railroad line, ballast and subsurface would be required to complete the soil removal.

The approximate soil area that would need to be removed to achieve the MCSs for Alternative 1 is shown on Figure 4-1. A 20-percent scope contingency is also assumed and included in the cost for this alternative.

For Alternative 2, it is assumed that the LUCs will include the following administrative controls:

- Restrictions limiting the property land use to non-residential uses.
- Restrictions to maintain the extent of paved area, unless a demonstration is made that changing a currently paved area to unpaved status will not cause a failure to meet one of the RAOs.

The sections below describe each alternative in detail.

4.2 Alternative 1: Soil Excavation and Offsite Disposal

4.2.1 Description of Alternative

This alternative will remove contaminated soil in areas shown on Figure 4-1 that exceed the MCS established in Section 2.0. Exceedance locations will involve soil removal in the areas shown in Figure 4-1. It is assumed that the concrete floor at E596SB006 will be removed to access surface soil exceeding the MCS and replaced.

Excavated soil would be transported to a permitted landfill facility for long-term disposal, and the excavation would be filled with clean fill from an offsite borrow source. Once the soil is removed, the site would be acceptable for unrestricted land use, with no long-term monitoring required. However, because the site is located in Zone E, there will continue to be LUCs applied at this site that are similar to other sites within the entire zone. These LUCs are expected to include restrictions of the property to non-residential activities.

At the E596SB006 location, the area of concrete flooring to be removed is approximately 10 feet by 10 feet, for a total excavated area of 100 square feet (ft^2). The removal and replacement of this concrete is required in order to access the surface soil proposed for removal. The concrete flooring is assumed to be about 1- foot thick, with an approximate volume of 3.7 cubic yards (yd^3). For an assumed average depth of soil excavation of 1 foot below the concrete flooring, the total in-place volume of soil to be removed from this area is about 3.7 yd^3. Confirmation sampling would involve five samples (four sidewall samples and one bottom sample). An equal amount of clean backfill will be required to fill in the excavated areas, and enough concrete to replace the impacted flooring.

At the E596SB013 location, the area of soil to be removed would be approximately 10 feet by 10 feet, for a total excavated area of 100 ft^2. For a 1 foot-deep excavation, an approximate volume of 3.7 yd^3 will have to be removed and replaced with clean backfill. This excavation would involve removing and replacing the railroad tracks and subgrade. Confirmation sampling would involve five samples (four sidewall samples and one bottom sample). An equal amount of clean backfill will be required to fill in the excavated areas and enough concrete to replace the impacted flooring.

4.2.2 Other Considerations

Coordination with the CNC Redevelopment Authority (RDA) would be required for site restrictions during excavation and traffic control for the haul trucks. Additionally, since the location of E596SB006 is inside a smaller room attached to Building 101, access to this

location for excavation equipment would have to be through the shuttered doors on the northern side of Building 101.

At the E596SB012 location, removal and replacement of the railroad track will require coordination with the RDA and other agencies with jurisdiction over the railroad lines running through CNC.

The potential for expansion of scope during confirmation testing is moderate. Based on the above factors, a 40-percent scope contingency is assumed.

4.3 Alternative 2: Land Use Controls

4.3.1 Description of Alternative

This alternative involves leaving the contaminated soil and co-located overlying pavement and railroad lines in place and instituting administrative/legal controls to restrict future use of the land. The controls would limit land use to activities that present less frequent exposure by sensitive populations to surface soil and preclude uncontrolled disturbance to the contaminated soil, thus minimizing the potential for human exposure to the contamination. The addition of restrictions on soil disturbance and site occupancy would minimize the potential for human exposure that could occur in a residential or industrial setting. The controls may be in the form of deed restrictions and/or easements (property interests retained by the Navy during property transfer to assure protectiveness of the remedy). Periodic monitoring would be required to assure controls are maintained; periodic site inspections would be required to assure the institutional controls are complied with. Controls may be layered (multiple controls at the same time) to enhance protectiveness. The Navy is negotiating a comprehensive Land Use Control Implementation Plan (LUCIP) for the CNC.

4.3.2 Other Considerations

Currently, the Navy is the property owner and land use in Zone E of the CNC is restricted to non-residential. Existing engineering controls include pavement and structures that prevent or limit access to contaminated soil. The location and proximity of the site to other industrial properties make residential use highly unlikely. Periodic monitoring of the deed controls and the site would be required. For the purpose of developing a representative cost estimate for this process, an annual evaluation that would include a site inspection, is assumed.

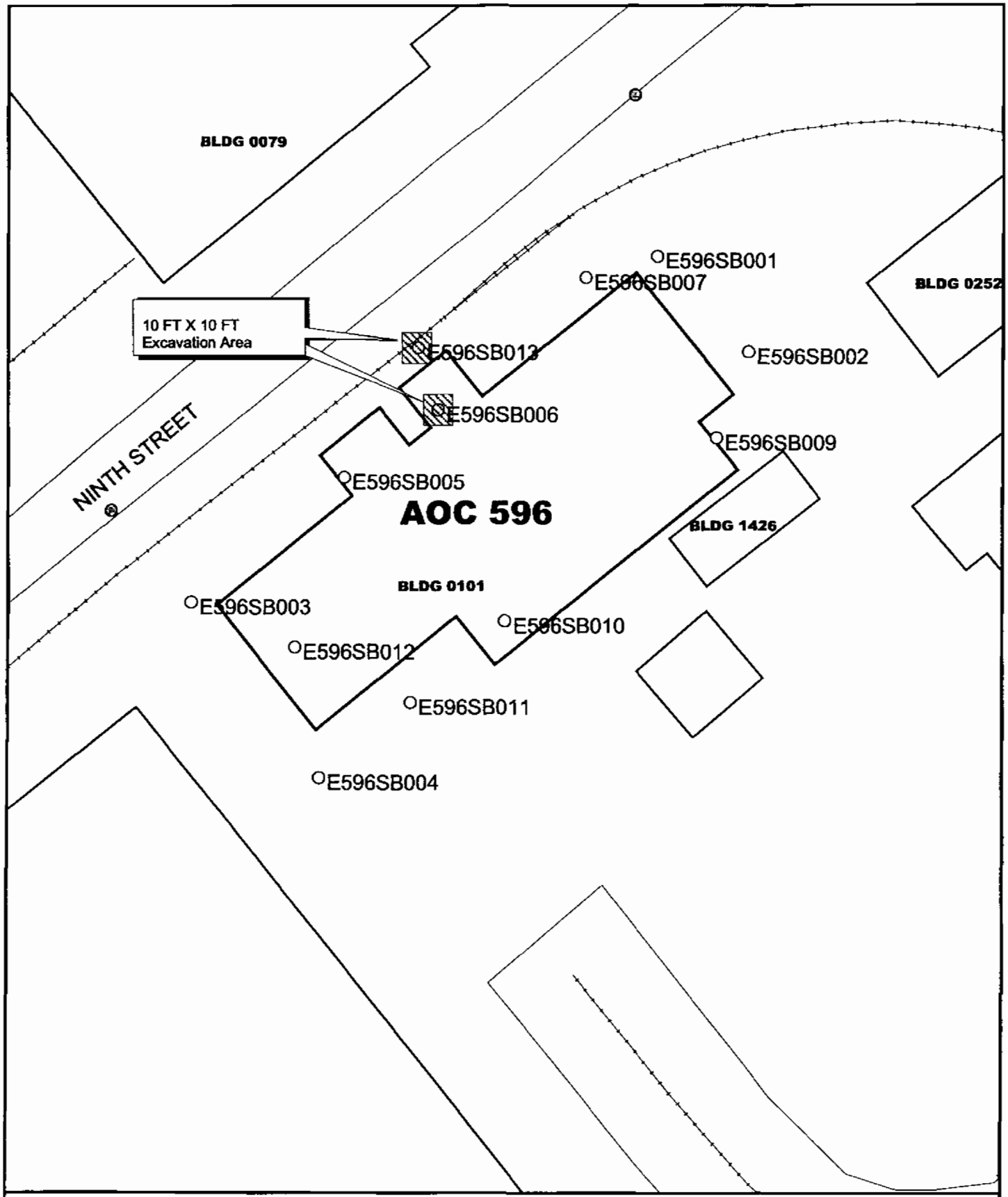


Figure 4-1
Excavation Areas Under CMS Alternative 1
AOC 596, Zone E
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\cnct2003proj.apr, Date: 07 Mar 2003 12 33, User: SNAIK1

Section 5.0

5.0 Evaluation and Comparison of Corrective Measure Alternatives

The corrective measure alternatives were evaluated relative to the criteria previously described in Section 2.0 and then subjected to a comparative evaluation. A cost estimate for each alternative was also developed; the assumptions and unit costs used for these estimates are included in Appendix A.

5.1 Alternative 1: Soil Excavation and Offsite Disposal

The following assumptions were made for Alternative 1:

- Two areas would be targeted for soil excavation, as shown in Figure 4-1.
- A total of 7.4 yd^3 of soil (in-place measurement) would be excavated for offsite disposal at a Subtitle D facility and replaced with clean backfill.
- Approximately 100 ft^2 of concrete flooring would be removed/replaced and approximately 3.7 yd^3 of concrete (in-place measurement) would be removed/replaced.
- Approximately 20 feet of railroad line would have to be removed and reset in place.
- Excavations would include known exceedances plus extrapolated areas to account for uncertainty.
- Confirmation testing will validate that the extent of contaminated soil is limited to that shown on Figure 4-1, plus a maximum contingency of 20 percent.

5.1.1 Protection of Human Health and the Environment

This alternative is effective at protecting human health and the environment because it removes soil with arsenic and BEQ concentrations that exceed the MCSs from the site. The replacement soil will have concentrations of arsenic and BEQs below the MCSs.

5.1.2 Attain MCSs

This alternative will permanently remove soil with arsenic and BEQ concentrations that exceed the MCSs. The MCSs will be achieved at the completion of soil removal actions.

5.1.3 Control the Source of Releases

There are no ongoing sources of releases at AOC 596. For this reason, this issue is not applicable.

5.1.4 Compliance with Applicable Standards for the Management of Generated Wastes

Excavated soil will be sampled and analyzed for waste characterization prior to disposal. Soil, decontamination waste, and personal protective equipment (PPE) will be disposed of in accordance with applicable regulations and permits. Offsite transportation and disposal will be performed by properly permitted and licensed subcontractors.

5.1.5 Other Factors (a) Long-term Reliability and Effectiveness

This alternative would have long-term reliability and be effective for the site, as long as all exceedances are removed. The removal of contamination from the site would be permanent. Uncertainty in the distribution of arsenic and BEQs in soil is addressed by expanding the excavations beyond the RFI delineation, thus reducing the risk of failure of this alternative. Confirmation sampling would verify that the excavations have removed soil exceedances. It is much less likely that any significant amount of soil with arsenic and BEQ concentrations above the MCSs will be left in place; site-wide average concentrations will be below the MCS for the unrestricted land use scenario.

5.1.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

Alternative 1 reduces the mobility of the contaminated soil by transporting it to a regulated containment facility (landfill). Treatment will not be required unless the soil exhibits toxicity characteristics per 40 *Code of Federal Regulations* (CFR) 261.24. If required, soil will be treated at the disposal facility to further reduce mobility of the arsenic and BEQs.

5.1.7 Other Factors (c) Short-term Effectiveness

The excavation and hauling of contaminated soil in this alternative has the potential to create dust containing contaminated soil particles. However, standard engineering controls such as dust suppression during excavation, tarp covers on trucks, and worker PPE to prevent dust inhalation will be implemented. Thus, with controls, the alternative provides short-term effectiveness in preventing ingestion of or contact with the contaminated soil and minimizes the potential for migration of soil particles. The technologies for dust control and worker protection are well-established and robust. No unmanageable hazards would be created during implementation.

5.1.8 Other Factors (d) Implementability

This alternative will be moderately difficult to implement. Most of the required activities have been routinely implemented at nearby sites using standard equipment and procedures.

Utility clearance, subcontracting, waste characterization, and base approval are customary activities. The field implementation of this remedy is estimated to require 4 to 6 weeks, and the benefits will be immediate. There is ample offsite capacity for disposal (and treatment, if required) of the contaminated soil.

5.1.9 Other Factors (e) Cost

Appendix A presents the overall cost estimate for implementing this remedy. These costs reflect soil removal based on available RFI sample results, plus removal and replacement of concrete flooring. A scope contingency (20 percent) is added to cover minor additional excavation that may be required per results of confirmation testing. In summary, the costs include the following:

- Remove soil in each area with an MCS exceedance.
- Perform confirmation tests in each area to verify compliance with MCS.
- Apply 20 percent contingency for additional scope that may be required based on compliance tests.
- Apply 20 percent contingency for additional scope that may be required based on access to E596SB006 and removal and replacement of railroad lines at E596SB013.

Using the assumptions listed above, the total present value of Alternative 1 is $63,000.

5.2 Alternative 2: Land Use Controls

The assumptions for Alternative 2 include the following:

- A base-wide LUCIP will be developed for the CNC. The plan will allow for restrictions on the use of land at AOC 596 and other areas, and it will be developed outside the scope of this CMS.
- Periodic monitoring will be performed for 30 years. The monitoring will consist of an annual site visit to confirm that site use(s) are consistent with the LUCIP. Although the present worth costs have been calculated for a 30-year period of monitoring, it is assumed that LUCs could be in place for as long as required. The present worth costs for a longer period of monitoring are not significantly different from those for a 30-year period of monitoring.

5.2.1 Protection of Human Health and the Environment

This alternative is effective at protecting human health because it restricts future use of the site that would be inappropriate for the MCS exceedances at the site.

5.2.2 Attain MCS

This alternative would not achieve the MCSs for arsenic and BEQs.

5.2.3 Control the Source of Releases

There are no ongoing sources of releases at AOC 596. For this reason, this issue is not applicable.

5.2.4 Compliance with Applicable Standards for the Management of Generated Wastes

Alternative 2 does not generate any wastes that would require special management.

5.2.5 Other Factors (a) Long-term Reliability and Effectiveness

This alternative provides some level of protection that has long-term reliability and effectiveness. The risk of failure is low, provided the LUCIP is enforced by the responsible entity. If the LUCs were not enforced, unpermitted use of the site may result in human exposure to arsenic and BEQs above the MCS.

5.2.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

This alternative involves no treatment and does not reduce the toxicity, mobility, or volume of contaminated soil at AOC 596.

5.2.7 Other Factors (c) Short-term Effectiveness

The Navy retains ownership and control of the site use until LUCs are implemented. This alternative does not involve any site activities, so no short-term risks are created.

5.2.8 Other Factors (d) Implementability

Alternative 2 is relatively easy to implement since it requires only the development of LUCs and an appropriate monitoring program.

5.2.9 Other Factors (e) Cost

Alternative 2 is not costly to implement since it requires no construction of treatment facilities or disposal of wastes. The cost for this alternative is for administrative/legal services and periodic monitoring/review for 30 years. Longer monitoring would likely be required, but its cost impact to present value of this alternative is minimal. Although the

present worth costs have been calculated for a 30-year period of monitoring, it is assumed that LUCs would be in place for as long as required. The present worth costs for a longer period of monitoring are not significantly different from those for a 30-year period of monitoring.

Using the assumptions described earlier, the total present value of Alternative 2 is $20,000.

5.3 Comparative Ranking of Corrective Measure Alternatives

The overall ability of each corrective measure alternative to meet the evaluation criteria is described above. In Table 5-1, a comparative evaluation of the degree to which each alternative meets a particular criteria is presented. Alternative 2: LUCs is the preferred alternative. It provides a protective and reliable remedy at a lower cost.

TABLE 5-1
Qualitative Comparison of Corrective Measure Alternatives
Corrective Measures Study Report, AOC 596, Zone E, Charleston Naval Complex

Criterion	Alternative 1 Soil Excavation and Offsite Disposal	Alternative 2 Land Use Controls (LUCs)
Overall Protection of Human Health and the Environment	Protects human health and the environment	Protects human health and the environment
Attainment of MCS	Would achieve MCS	Would not achieve MCS
Control of the source of releases	N/A	N/A
Compliance with applicable standards for the management of wastes	Complies with applicable standards	Complies with applicable standards
Long-term Reliability and Effectiveness	Reliable and effective long term	Reliable and effective long term, provided that periodic inspections are performed
Reduction of Toxicity, Mobility, or Volume through Treatment	Reduces mobility via placement of soil in landfill	Does not reduce toxicity, mobility, or volume
Short-term Effectiveness	Effective in short term	Effective in short term
Implementability	Moderately difficult to implement due to need to remove/replace railroad track, concrete, and asphalt pavement and work inside a building in a busy industrial area.	Easy to implement
Cost Ranking	Moderately Expensive	Inexpensive
Estimated Cost	$63,000	$20,000

N/A = not applicable

Section 6.0

6.0 Recommended Corrective Measure Alternative

Two corrective measure alternatives were evaluated using the criteria described in Section 2.0 of this CMS report: (1) Alternative 1: Soil Excavation and Offsite Disposal with LUCs, and (2) Alternative 2: LUCs.

The preferred corrective measure alternative is Alternative 2: LUCs. The remedy would be protective at a moderate cost.

Alternative 2 would protect human health and the environment by maintaining the current and planned future use of the site as industrial/commercial. Limitations would prevent residential and other unrestricted land use that could expose sensitive populations.

Engineering controls to minimize future releases are already in place. Most of the area is paved or covered by a structure. Planning is already underway to develop and implement administrative controls that would limit future site activities to those that would not involve unrestricted exposures. The expected reliability of this alternative is good.

There are no community safety issues associated with implementation of this remedy, and the controls would be relatively easy to implement. This alternative provides long-term effectiveness for the planned industrial/commercial use, and relies on administrative controls to prevent future residential use.

Section 7.0

7.0 References

CH2M-Jones. *RFI Report Addendum and CMS Work Plan for AOC 596, Zone E, Revision 0.* November 2002.

CH2M-Jones. *RFI Report Addendum and CMS Work Plan, for AOC 596, Zone E, Revision 1.* May 2003.

EnSafe Inc./Allen & Hoshall. *Final Zone E RCRA Facility Investigation (RFI) Work Plan, Revision 1.* 1995.

EnSafe Inc. *Zone E RFI Report, NAVBASE Charleston, Revision 0.* November 1997.

Appendix A

COMPARISON OF TOTAL COST OF REMEDIAL SOLUTIONS

Site: Charleston Naval Complex
Location: AOC 596
Phase: Corrective Measures Study
Base Year: 2002
Date: 12/30/02

	Alternative Number 1	Alternative Number 2
Total Project Duration (Years)	<1	30
Capital Cost	$43,000	$6,000
Annual O&M Cost	$0	$1,100
Total Present Value of Solution	$63,000	$20,000

Disclaimer The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative This is an order-of-magnitude cost estimate that is expected to be within -50 to +100 percent of the actual project costs

Alternative: Number 1 — **COST ESTIMATE SUMMARY**
Elements: Soil Excavation and Offsite Disposal

Site: Charleston Naval Complex
Location: AOC 596
Phase: Corrective Measures Study
Base Year: 2002
Date: 12/30/02

Description: Excavation of contaminated soil, disposal offsite at permitted landfill, backfill with clean soil Extent includes RFI sample points plus 20% scope contingency

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation Sampling	1	EA	$2,700	$2,700	See Confirmation Worksheet
Removal, Disposal and Backfill	1	EA	$24,000	$24,000	See Excavation 1 Worksheet
				$0	
SUBTOTAL				$26,700	
Contingency	20%		$26,700	$5,340	
SUBTOTAL				**$32,040**	
Project Management	8%		$32,040	$2,563	USEPA 2000, p. 5-13, $100K-$500K
Remedial Design	15%		$32,040	$4,806	USEPA 2000, p 5-13, $100K-$500K
Construction Management	10%		$32,040	$3,204	USEPA 2000, p 5-13, $100K-$500K
SUBTOTAL				**$10,573**	
TOTAL CAPITAL COST				**$43,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SUBTOTAL				$0	
Allowance for Misc Items	20%		$0	$0	
SUBTOTAL				$0	
TOTAL ANNUAL O&M COST				**$0**	

PRESENT VALUE ANALYSIS

Discount Rate = 7%

End Year	COST TYPE	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
0	CAPITAL COST	$43,000	$43,000	1 000	$43,000	
	ANNUAL O&M COST	$0	$0	0 000	$0	
		$43,000			$43,000	
	PRESENT VALUE OF LAND USE CONTROLS COST				$20,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$63,000**	

SOURCE INFORMATION

1 United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study EPA 540-R-00-002 (USEPA, 2000)

Alternative: Number 2
Elements: Land Use Controls

COST ESTIMATE SUMMARY

Site: Charleston Naval Complex
Location: AOC 596
Phase: Corrective Measures Study
Base Year: 2002
Date: 12/30/02

Description: Implementation of base-wide land use management plan to put institutional controls in place to restrict site use to commercial/industrial

Assumes this site is part of a multi-site implementation, and costs are shared among all the sites.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Deed Restrictions - Attorney	4	hour	$200	$800	
Record Deed	4	each	$500	$2,000	
LUC Implementation	24	hours	$75	$1,800	
SUBTOTAL				$4,600	
Contingency	20%		$4,600	$920	
SUBTOTAL				$5,520	
Project Management	10%		$5,520	$552	USEPA 2000, p 5-13, <$100K
Remedial Design	0%		$5,520	$0	Not applicable
Construction Management	0%		$5,520	$0	Not applicable
SUBTOTAL				$552	
TOTAL CAPITAL COST				**$6,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Annual Evaluation	12	hour	$75	$900	
SUBTOTAL				$900	
Allowance for Misc. Items	20%		$900	$180	
SUBTOTAL				$1,080	
TOTAL ANNUAL O&M COST				**$1,100**	

PRESENT VALUE ANALYSIS - 20 years

Discount Rate = 7%

End Year	COST TYPE	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
0	CAPITAL COST	$6,000	$6,000	1 000	$6,000	
30	ANNUAL O&M COST	$33,000	$1,100	12 409	$13,650	
		$39,000			$19,650	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$20,000**	

SOURCE INFORMATION

1 United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study EPA 540-R-00-002 (USEPA, 2000).

Alternative: **Subtask** **COST WORKSHEET 1**

Element: **Confirmation Testing**

Site: Charleston Naval Complex
Location: AOC 596
Phase: Corrective Measures Study
Base Year: 2002

Prepared By: tbw **Date:** 12/30/02
Checked By: sn **Date:** 03/05/03

WORK STATEMENT

Costs for soil confirmation sample collection, shipment and analysis on a per event basis
Total of 12 samples 1 per excavation wall plus 1 bottom = 5 X 2 excavations plus 2 more bottom

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor					
Jar Kits	12	EA	$10	$120	CH2M-Jones Est
Coolers	3	EA	$10	$30	CH2M-Jones Est.
Disposable Gloves	1	BOXES	$20	$20	CH2M-Jones Est
Collection of samples	5	HR	$68	$340	CH2M-Jones Est
Sample Shipment	3	EA	$20	$60	CH2M-Jones Est
Sample Analysis (SVOC + As)	12	SAMPLE	$95	$1,140	GEL, PEL, STL average
Analysis of data	5	HR	$100	$500	CH2M-Jones Est
SUBTOTAL				$2,210	
Allowance for Misc. Items	20%		$2,210	$442	
SUBTOTAL				$2,652	
TOTAL COST				**$2,700**	

OPERATION AND MAINTENANCE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SUBTOTAL				$0	
Allowance for Misc. Items	20%		$0	$0	
SUBTOTAL				$0	
TOTAL O&M COST				**$0**	

Source of Cost Data

1 Analytical Bid Form - Charleston Naval Complex - Level II

Alternative: 1 **COST WORKSHEET 2**

Element: **Soil Excavation and Disposal**

Site: Charleston Naval Complex **Prepared By:** tbw **Checked By:** SN
Location: AOC 596 **Date:** 12/10/02 **Date:** 03/05/03
Phase: Corrective Measures Study
Base Year: 2002

WORK STATEMENT

Excavate soil and haul to disposal area; backfill with clean soil and restore surface to original condition.
See quantity calcs

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Mob/demob/decon	1	EA	$1,000	$1,000	CH2M-Jones Est.
Utility checks and permits	8	HR	$100	$800	CH2M-Jones Est.
Air monitoring and sampling					
Concrete cutting	40	LF	$1.15	$46	CH2M-Jones Est.
Concrete removal	100	SF	$3.15	$315	CH2M-Jones Est.
Excavation (soil) - machine	3	DAYS	$700	$2,100	CH2M-Jones Est.
Concrete disposal - Non-Haz	16	tons	$45	$720	CH2M-Jones Est.
Clean Fill	7.41	CY	$12	$89	CH2M-Jones Est.
Compaction	1	DAY	$100	$100	CH2M-Jones Est.
Replace concrete	1	TRUCK	$300	$300	CH2M-Jones Est.
Site Operator-Oversight	40	HR	$100	$4,000	CH2M-Jones Est.
Railroad removal/replacement	20	ft	$300	$6,000	CH2M-Jones Est.
Waste characterization TCLP	1	EA	$150	$150	
Waste disposal - Non-Haz	1	ROLLOFF	$600	$600	CH2M-Jones Est.
SUBTOTAL				$16,220	
Allowance for Misc. Items	50%		$16,220	$8,110	40% Scope + 10% Bid
SUBTOTAL				$24,330	
TOTAL UNIT COST				**$24,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SUBTOTAL				$0	
Allowance for Misc. Items	20%		$0	$0	
SUBTOTAL				$0	
TOTAL ANNUAL O&M COST				**$0**	

Source of Cost Data

1. Means. 2002. Environmental Remediation Cost Data - Assemblies, 8th Edition. R.S. Means Company Kingston, MA.
2. Eden's estimates from AOC 559 CMS cost estimate.

Removal Areas/Volumes

COST WORKSHEET 3

AOC 596 tbw 12/30/2002

Alternative 1

Location	Excavation, ft L	W	D	Surface Area, sf	In Situ Pavement Thickness, ft	Pavement Volume, cy	Soil Volume, cy	
E596SB006	10	10	1	100	1	3.7	3.7	See Note 1.
E596SB013	10	10	1	100	1	3.7	3.7	See Note 1.

Sum	200 SF	a	7.4	7.4	CY, in situ volume (bank CY)
		b	1.3	1.15	Bulk ratio (load factor)
		c	9.6	8.5	CY, bulk volume
		d	1.6	1.3	Ton ratio
		e	16	12	Tons, bulk weight (rounded)
	CHECK:				
	Typical in situ unit weight		150	110	PCF
	Weight of in situ volume = e/a		160	120	PCF OK

Notes

1 Pavement (thickness assumed).