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CORRECTIVE MEASURES STUDY REPORT FOR COMBINED SOLID WASTE MANAGEMENT UNIT 23 (SWMU 23) ZONE E CNC CHARLESTON SC

3/18/2003

CH2M HILL

CORRECTIVE MEASURES STUDY REPORT

Combined SWMU 23. Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

CH2M·Jones

March 2003

Contract N62467-99-C-0960

CH2M HILL
3011 SW Williston Road
Gainesville, FL 32608-3928
P.O. Box 147009
Gainseville, FL 32614-7009
Tel 352.335.7991
Fax 352.335.2959

CH2MHILL

March 18, 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) – Combined SWMU 23, Zone E

Dear Mr. Scaturo:

Enclosed please find four copies of the CMS Report (Revision 0) for Combined SWMU 23 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

Combined SWMU 23, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

PREPARED BY
CH2M-Jones

March 2003

Revision 0
Contract N62467-99-C-0960
158814.ZE.PR.01

Certification Page for Corrective Measures Study Report (Revision 0) — Combined SWMU 23, 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.

3/14/2003

Date

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Acronyms and Abbreviations

AOC	Area of concern
BEQ	Benzo[a]pyrene equivalent
BRAC	Base Realignment and Closure Act
CA	Corrective action
CMS	Corrective measures study
CNC	Charleston Naval Complex
COC	Chemical of concern
CSI	Confirmatory Sampling Investigation
EnSafe	EnSafe, Inc.
EPA	U.S. Environmental Protection Agency
ft^2	Square feet
ft bls	Feet below land surface
HI	Hazard index
ILCR	Incremental Lifetime Cancer Risk
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
LUC	Land use control
LUCIP	Land Use Control Implementation Plan
MCL	Maximum contaminant level
MCS	Media cleanup standard
NAVBASE	Naval Base
PCB	Polychlorinated biphenyl
PPE	Personal protective equipment
RAO	Remedial action objective
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

Acronyms and Abbreviations, Continued

SWMU	Solid Waste Management Unit
SVOC	Semivolatile organic compound
VOC	Volatile organic compound
WWTS	Wastewater treatment system
yd^3	Cubic yard

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 (RFIRA/CMSWP) were prepared for Combined Solid Waste Management Unit (SWMU) 23 in Zone E of the CNC (CH2M-Jones, 2002). The RFIRA/CMSWP presented the remedial action objectives (RAOs) and media cleanup standards (MCSs) proposed for Combined SWMU 23. This CMS report has been prepared by CH2M-Jones to complete the next stage of the CA process for Combined SWMU 23.

1.1 Corrective Measures Study Report Purpose and Scope

This CMS report evaluates corrective measure (remedial) alternatives for preventing unacceptable exposure to benzo[a]pyrene equivalents (BEQs) and lead contamination found in surface soil at Combined SWMU 23. BEQs and lead in surface soil were identified as chemicals of concern (COCs) for the unrestricted (i.e., residential) future land use scenario. BEQs in surface soil were identified as COCs for the industrial land use scenario. Figure 1-1 illustrates the original location of Combined SWMU 23 within Zone E. Figure 1-2 is an aerial photograph showing the layout of Combined SWMU 23.

This CMS report consists of: 1) the identification of a set of corrective measure alternatives that are considered to be technically appropriate for addressing BEQ- and lead-impacted 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 with land use controls (LUCs), and 2) LUCs. The remedial activities associated with soil removal include excavation, backfilling, pavement (including the replacement of), and offsite disposal. The remedial activities that are associated with LUCs include maintaining the existing site use (commercial/industrial) and site controls (pavement/building), an LUC Implementation Plan (LUCIP) 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 Combined SWMU 23. 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

The Combined SWMU 23 area is located in and around Building 226, as can be seen in Figure 1-1. Prior to the construction of Building 226 in 1976, this area of Zone E originally included Buildings 1026, 73, and 1387, which were all demolished prior to the construction of Building 226. Building 1026 was used as a field electric shop and a storehouse. Building 73 was a battery charging area. No information is available regarding the historic operations at Building 1387.

This area of Zone E is zoned M-2 (for industrial land use). The CNC RCRA Permit identified SWMU 23 as requiring an RFI, and the other units within Combined SWMU 23 as requiring a Confirmatory Sampling Investigation (CSI).

1.2.2 Site History

SWMU 23

SWMU 23 is located outside Building 226 on the northeast corner, and is the location of the former wastewater treatment system (WWTS) associated with Building 226. The WWTS building is a concrete structure built around 1983 to replace an older system. The newer WWTS was installed to handle chrome effluent, acid/alkali effluent from metal plating, and cadmium effluent. The WWTS consisted of rinse water pumps, holding tanks, transfer

pumps, a clarifier, a neutralization tank, and a plate and frame filter press. The WWTS is no longer in use.

SWMU 63

SWMU 63 is in the area occupied by former Building 73, a battery-charging station which operated from 1941 to approximately 1970. Currently the site is occupied by Building 226, and it is used as a valve repair shop and a storage building in support of the shipyard.

AOC 540

AOC 540 consists of Building 226 and includes the former location of Building 73 (SWMU 63). Operations conducted at AOC 540 include a former pump and valve test area, a plating area, and a hydraulic repair area. A wet scrubber, plating dip tanks, a sludge pit, and a waste treatment facility were associated with this facility. Currently, the former pump and valve test areas and the hydraulic repair areas in Building 226 are being used as a valve repair shop and for storage in support of the shipyard. The plating tanks are not being used.

AOC 541

AOC 541 is the area of former Building 38, an oil storage house, which operated from 1909 until 1939, and was demolished in 1970. No other information was found during the RFI regarding its historical operating practices. The site is currently an asphalt parking lot between Buildings 6 and 226, west of Building 226.

AOC 542

AOC 542 is located in the area of former Building 22, which was a paint shop and oxyacetylene plant. Operations of the oxyacetylene plant began in 1922, and in 1943 the building was converted into a paint shop and served that purpose until it was demolished in 1976. During this period, paint stripping using chemicals and abrasives was conducted. Currently this site is an open paved area between Buildings 3, 6, and 226.

AOC 543

AOC 543 is the site of former Building 1026, which was constructed in 1922 and used as a storehouse until 1943. From 1943 to 1955, the site was a field electric shop. From 1955 until approximately 1970, this site was used again as a storehouse. This area is now under the footprint of Building 226.

A review of historical engineering drawings for the Combined SWMU 23 site shows that railroad lines were installed between 1929 and 1935 adjacent to and across Combined SWMU 23. A copy of the site location from the Public Works Map of the Charleston Navy

Shipyard dated June 30, 1935, depicting the presence of railroad lines at the site is provided in Appendix A of this report.

The materials of concern, which were indicated in the *Final Zone E RFI Work Plan, Revision 1* (EnSafe Inc. [EnSafe]/Allen & Hoshall, 1995) for these sites are as follows:

- **SWMU 23:** Sulfuric acid, sodium metabisulfite, sodium hydroxide, potassium hydroxide, chromium, and cadmium.
- **SWMU 63:** Acids and metals.
- **AOC 540:** Acids, metals, hydraulic fluid, and petroleum hydrocarbons.
- **AOCs 541 and 543:** Petroleum hydrocarbons.
- **AOC 542:** Acids, metals, paints, solvents, acetylene gas, and abrasive grit.

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 RFIRA/CMSWP, prepared by CH2M-Jones, identified BEQs and lead as COCs in surface soil at Combined SWMU 23. 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 Combined SWMU 23, Zone E, Revision 0* (CH2M-Jones, 2002).

1.2.3 Soil COC Summary

Soil was sampled during two sampling events at Combined SWMU 23 during the RFI at the locations shown in Figure 1-3. RFI soil samples at Combined SWMU 23 were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), cyanides, metals, organotins, and pH.

The COCs identified in the RFI Report and the RFI Report Addendum at Combined SWMU 23 were the following:

- Unrestricted (i.e., Residential) Land Use Scenario – BEQs and lead in surface soil
- Commercial/Industrial Land Use Scenario– BEQs in surface soil

This CMS focuses on these COCs in surface soil. No COCs were identified for the subsurface soil or groundwater at this site.

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 Combined SWMU 23, Zone E, Revision 0.*

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 Combined SWMU 23, in addition to the criteria used in evaluating the corrective measure alternatives for the site.

3.0 Overall Approach for Evaluating Focused Alternatives for Combined SWMU 23 – 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 BEQs and lead 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 MCS and RGOs for BEQs and lead in soil based on a comparison of the alternatives.

7.0 References— Lists the references used in this document.

Appendix A contains a figure from the Public Works Map of the Charleston Navy Shipyard dated June 30, 1935, which depicts the historical presence of railroad lines at the Combined SWMU 23 site.

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

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

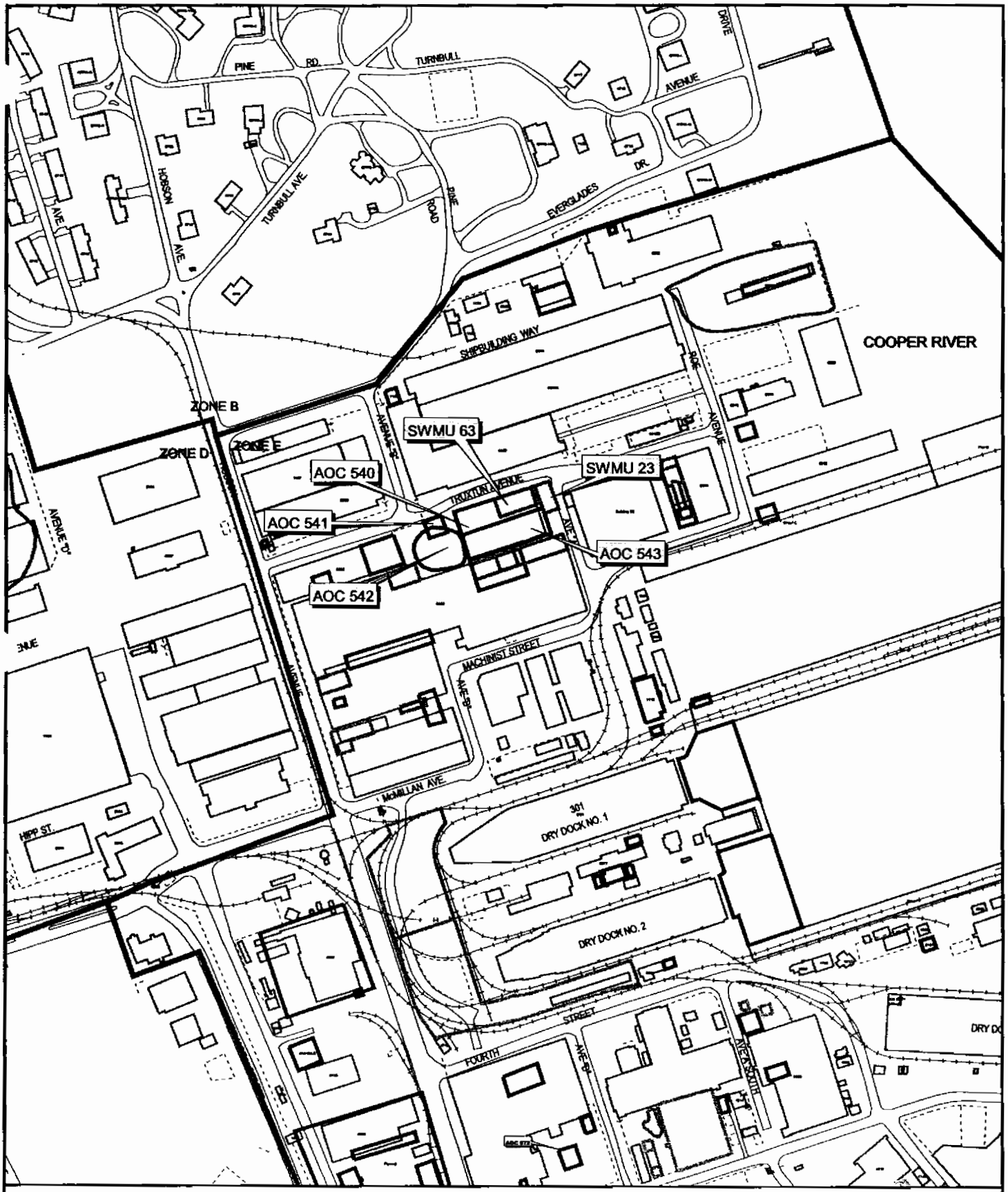

Figure 1-1
Location of Combined SWMU 23 in Zone E
Charleston Naval Complex

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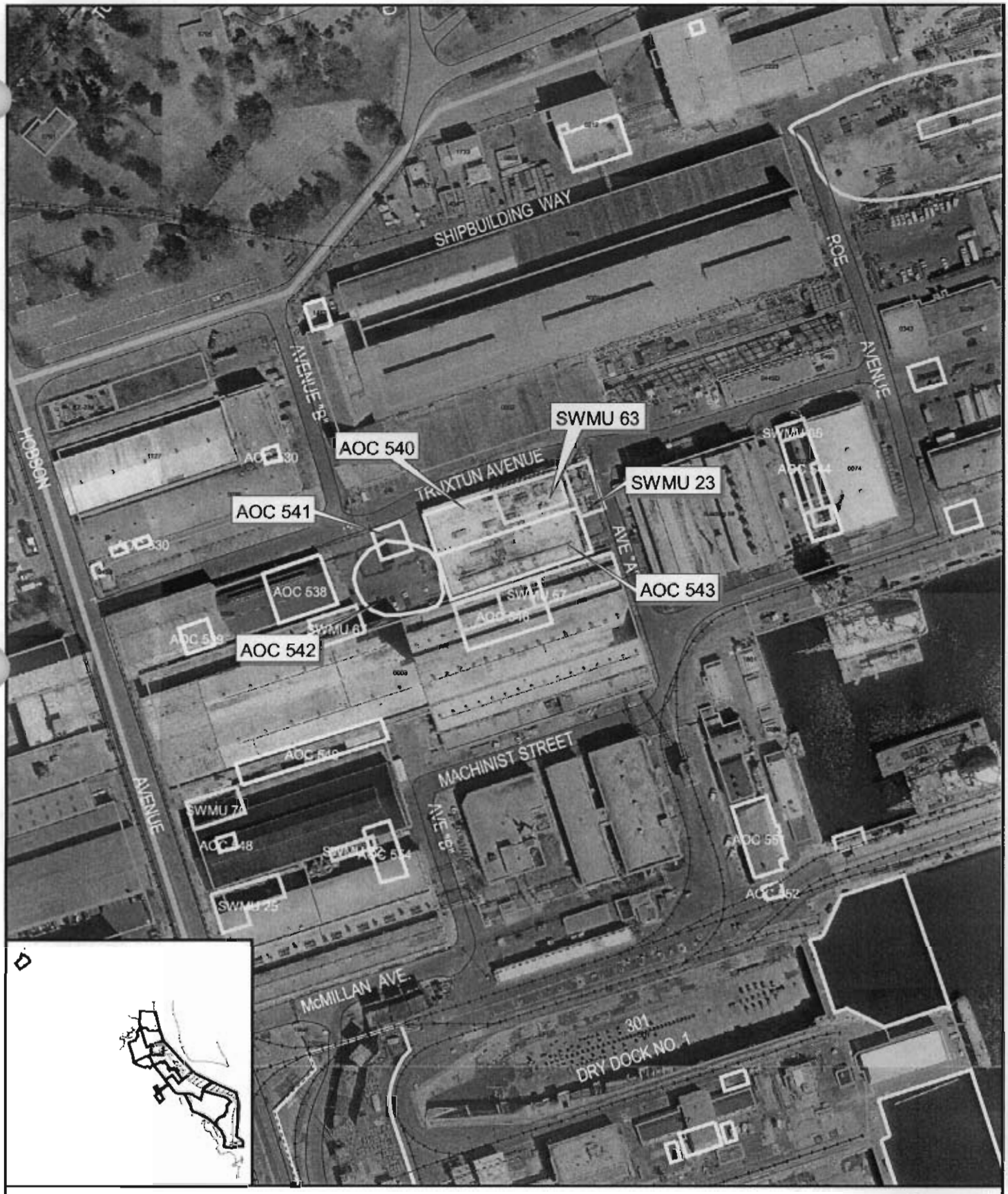

Fence
Roads
AOC Boundary
SWMU Boundary
Buildings

N

0 200 400 Feet

1 inch = 193 feet

Figure 1-2
Aerial Photograph of Combined SWMU 23
Zone E
Charleston Naval Complex

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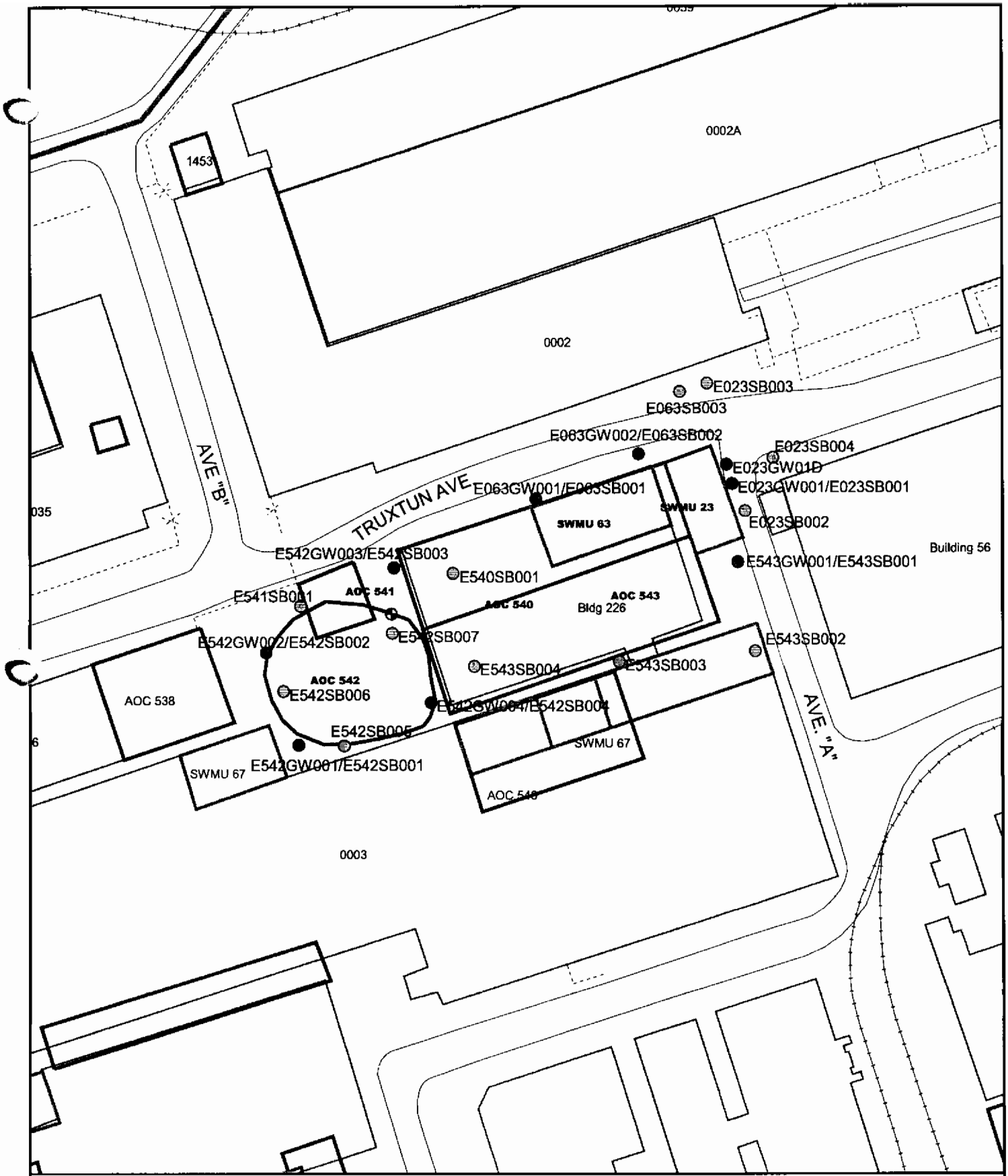

Figure 1-3
RFI Sampling Locations
Combined SWMU 23, Zone E
Charleston Naval Complex

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2.0 Remedial Goal Options and Proposed Media Cleanup Standards

RGOs and MCSs are typically developed after the RFI during development of the CMSWP. 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 Combined SWMU 23, Zone E, Revision 0* (CH2M-Jones, 2002), the RAO for surface soil is to prevent ingestion and direct/dermal contact with soil containing COCs at unacceptable levels.

2.2 Media Cleanup Standards

The MCSs for Combined SWMU 23 were presented in the RFIRA/CMSWP. The CNC BEQ sitewide reference concentration of 1,304 micrograms per kilogram (μg/kg) developed by the BCT was recommended in the CMSWP as the MCS for BEQs in surface soil. For lead, the target MCS for surface soil should be the Zone E maximum background concentration of lead in surface soil of 400 milligrams per kilogram (mg/kg). This lead value is also the concentration generally accepted by EPA as adequately protective to allow for unrestricted land use.

The pattern of distribution of BEQs in surface soil at this combined site indicates four areas of exceedances. Four surface soil samples (E542SB005, LE037SB009, LE037SB010, and LE037SB012) had BEQ concentrations above the CNC sitewide BEQ reference concentration of 1.304 mg/kg, at 1.67 mg/kg, 1.48 mg/kg, 1.37 mg/kg, and 73.5 mg/kg, respectively.

The pattern of distribution of lead in surface soil indicates one area of exceedance. One surface soil detection at location E23SB004 had a lead concentration above the EPA Region III residential risk-based concentration (RBC) of 400 mg/kg, at 434 mg/kg. These locations are shown in Figure 2-1.

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 LUCs, and
2) LUCs

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

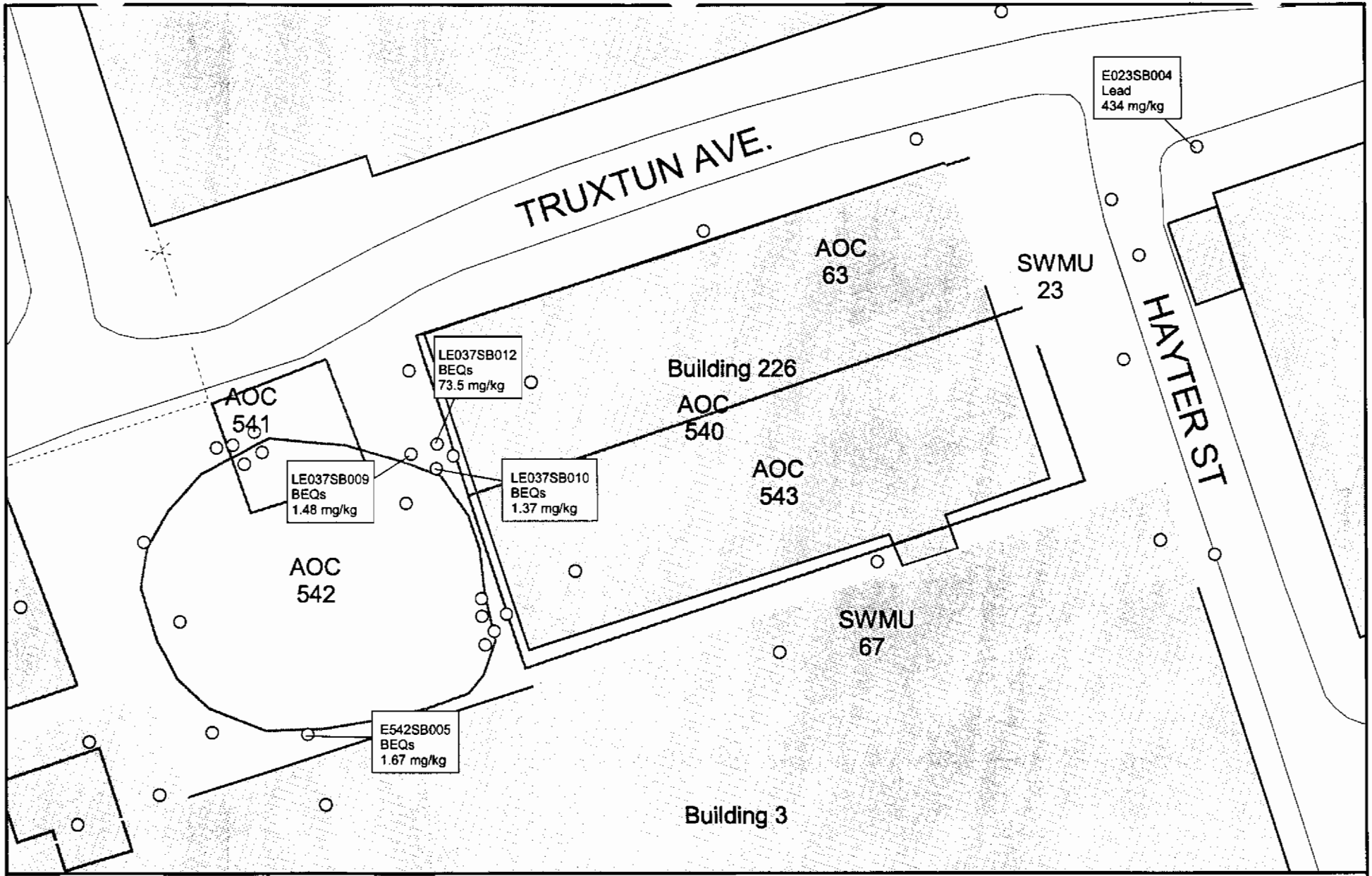

Figure 2-1
Surface Soil Exceedances
Combined SWMU 23, Zone E
Charleston Naval Complex

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Section 3.0

3.0 Overall Approach for Evaluating Focused Alternatives for Combined SWMU 23

3.1 Preferred Remedies

A variety of corrective measure approaches are conceptually feasible for addressing BEQs and lead in soil at Combined SWMU 23. 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 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 (Section 4.0), evaluated in detail (Section 5.0), and one will be proposed as a recommended alternative (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 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

The implementation of Alternative 1 would involve the removal of soil at locations where BEQ and lead concentrations exceed the MCS. Five areas at the site will require surface soil removal in order for site soils to meet the MCS for BEQs and lead:

- Sample location E542SB005. This location is beneath concrete/asphalt pavement, and removal and replacement of the pavement would be required to complete the soil removal.
- Sample location LE037SB009. This location is beneath concrete/asphalt pavement, and removal and replacement of the pavement would be required as part of the excavation.
- Sample location LE037SB010. This location is beneath concrete/asphalt pavement, and removal and replacement of the pavement would be required as part of the excavation.
- Sample location LE037SB012. This location is beneath concrete/asphalt pavement, and removal and replacement of the pavement would be required as part of the excavation.
- Sample location E023SB004. This location is in an unpaved area, and no pavement removal or replacement is required as part of the excavation.

The approximate soil areas estimated to be necessary for removal to achieve the MCS for Alternative 1 is shown in Figure 4-1. A 20-percent scope contingency is also assumed and included in the cost for this alternative.

Additionally, because Combined SWMU 23 is located within Zone E of the CNC, LUCs will be applied to this site even after excavation and removal of the impacted soil. Thus, LUCs will also be an integral part of the remedy for this site even after the soil excavation.

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 one of the RAOs to not be met.

The sections below describe each alternative in detail.

4.2 Alternative 1: Soil Excavation and Offsite Disposal with Land Use Controls

4.2.1 Description of Alternative

This alternative will remove contaminated soil in areas 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 pavement would be removed to access surface soil exceeding the MCS and be 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 that apply to the entire zone. These LUCs are expected to include restrictions of the property to non-residential activities.

The proposed excavation areas involve three locations consisting of a total of five separate pavement areas. The five pavement areas are each approximately 10 feet by 10 feet, for a total excavated area of 500 square feet (ft^2) (see Figure 4-1). The removal and replacement of this pavement will be required to access all of the soil proposed for removal. For an assumed average depth of soil excavation of 1 ft below land surface (bls), the total in-place volume of soil to be removed from the two areas is about 18.5 cubic yards (yd^3), plus a 1-ft thick pavement structure with an approximate volume of 18.5yd^3. Confirmation sampling would involve eight sidewall samples and three bottom samples in the three adjacent excavations at LE037SB009, LE037SB0010 and LE037SB0012, and four sidewall samples and one bottom sample in each of the isolated excavations at E542SB005 and E023SB004. There will be a total of 21 confirmatory samples. A quantity of clean backfill equal to the quantity

of excavated soil will be required to fill in the excavated areas, and enough concrete or bituminous asphalt to replace the excavated pavement.

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. The potential for expansion of scope during confirmation testing is moderate. Thus, a 20-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) 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 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 LUCIP for the CNC.

4.3.2 Other Considerations

The Navy is currently 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, and the substantial dock structures hinder access to the soil by commercial/industrial users. 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.

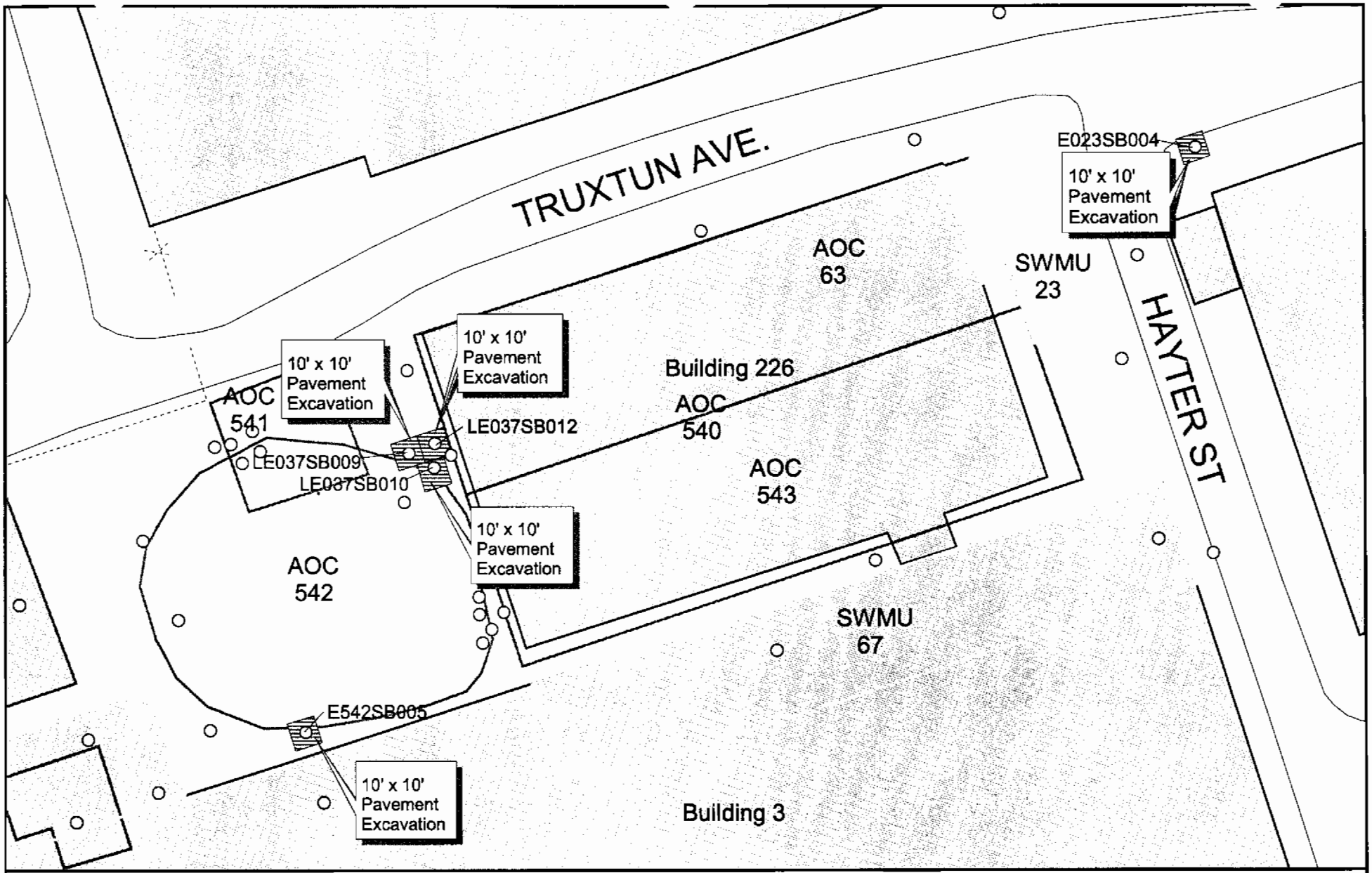

Figure 4-1
CMS Alternative 1
Combined SWMU 23, Zone E
Charleston Naval Complex

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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 B.

5.1 Alternative 1: Soil Excavation and Offsite Disposal with Land Use Controls

The following assumptions were made for Alternative 1:

- Three areas would be targeted for soil excavation, as shown in Figure 4-1.
- A total of 18.5 yd^3 of soil (in-place measurement) would be excavated for offsite disposal at a Subtitle D facility, and replaced with clean backfill.
- Approximately 500 ft^2 of pavement would be removed/replaced and approximately 18.5 yd^3 of asphalt/concrete (in-place measurement) would be removed/replaced.
- Excavations would include known exceedances plus extrapolated areas to account for uncertainty.
- Confirmation testing will validate the extent of contaminated soil is limited to that shown in Figure 4-1, plus a maximum contingency of 20 percent.
- LUCs that apply to all of Zone E will also be applied to this site after the soil removal.

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 BEQ and lead concentrations that exceed the MCS from the site. The replacement soil will have concentrations of BEQs and lead below the MCS.

5.1.2 Attain MCS

This alternative will permanently remove soil with BEQ and lead concentrations that exceed the MCS. The MCS 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 Combined SWMU 23, therefore 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 BEQs and lead in soil is addressed by expanding the excavations beyond the RFI delineation, thus reducing the risk of failure of this alternative. Confirmation sampling would confirm that the excavations have removed soil exceedances. It is much less likely any significant amount of soil with BEQ and lead concentrations above the MCS will be left in place; sitewide average concentrations will be below the unrestricted land use MCS.

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 CFR 261.24. If required, soil will be treated (stabilized/fixated) at the disposal facility to further reduce mobility of the BEQs and lead.

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 simple to implement. Most of the required activities have been routinely implemented at other 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 four to six 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 B 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 loading dock and pavement. 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 areas at each occurrence of MCS exceedance.
- Perform confirmation tests in each area to confirm compliance with MCS.
- Apply 20-percent contingency for additional scope that may be required based on compliance tests.
- Maintain LUCs applied as part of the Zone E LUCs for a 30-year period.

Using the assumptions listed above, the total present value of Alternative 1 is $60,000.

5.2 Alternative 2: Land Use Controls

- The assumptions for Alternative 2 include the following: A basewide LUCIP will be developed for the CNC. The plan will allow for restrictions on the use of land at Combined SWMU 23 and other areas, and 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.

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 MCS for BEQs and lead.

5.2.3 Control the Source of Releases

There are no ongoing sources of releases at Combined SWMU 23, therefore 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 LUCs were not enforced, unpermitted use of the site may result in human exposure to BEQs and lead 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 Combined SWMU 23.

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, thus, no short-term risks are created.

5.2.8 Other Factors (d) Implementability

Alternative 2 is relatively easy to implement since it only requires 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.

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 below, 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, Combined SWMU 23, Zone E, Charleston Naval Complex

Criterion	1. Soil Excavation and Offsite Disposal	2. Land Use Controls
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 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 simple to implement due to need to remove/replace concrete and asphalt pavement and work in busy industrial area.	Easy to implement
Cost Ranking	Comparatively Expensive	Inexpensive
Estimated Cost	$60,000	$20,000

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. These alternatives included: Alternative 1: Soil Excavation and Offsite Disposal with LUCs; and Alternative 2: LUCs.

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

Alternative 2 would provide protection of 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, Combined SWMU 23, Zone E.* Revision 0. November 2002.

EnSafe Inc./Allen & Hoshall. *Final RCRA Facility Assessment, NAVBASE Charleston.* June 6, 1995.

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

Appendix A

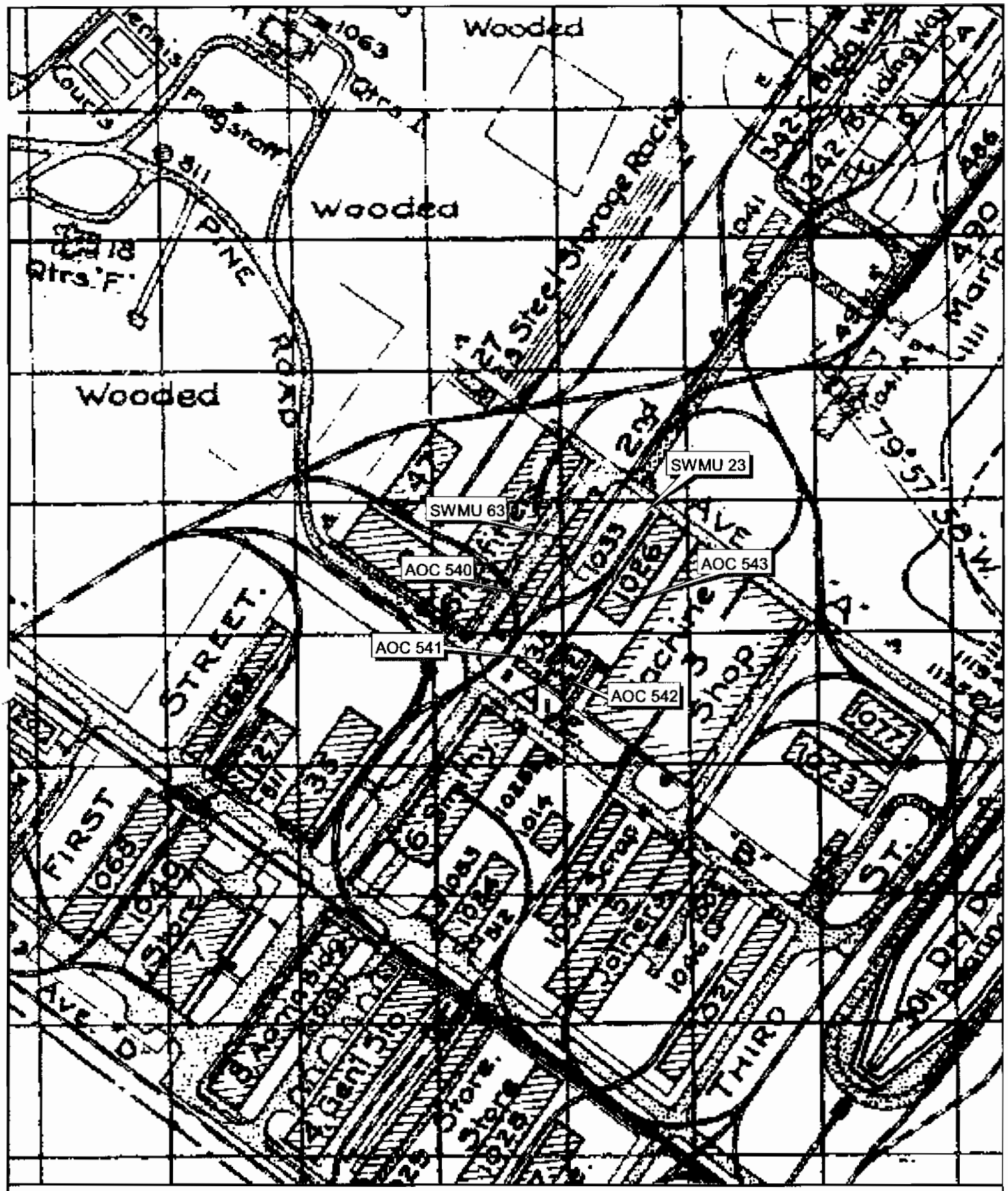

Figure A-1
Historic Rairoad Line Locations
June 30, 1935
SWMU 23/63, AOC 540 through 543, Zone E
Charleston Naval Complex

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Appendix B

COMPARISON OF TOTAL COST OF REMEDIAL SOLUTIONS

Site:	Charleston Naval Complex	**Base Year:**	2002
Location:	Combined SWMU 23	**Date:**	12/31/02
Phase:	Corrective Measures Study		

	Alternative Number 1	Alternative Number 2
Total Project Duration (Years)	<1	30
Capital Cost	$40,000	$6,000
Annual O&M Cost	$0	$1,100
Total Present Value of Solution	$60,000	$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
Elements: Soil Excavation and Offsite Disposal

COST ESTIMATE SUMMARY

Site: Charleston Naval Complex
Location: Combined SWMU 23
Phase: Corrective Measures Study
Base Year: 2002
Date: 12/31/02

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	$4,300	$4,300	See Confirmation Worksheet
Removal, Disposal and Backfill	1	EA	$21,000	$21,000	See Excavation 1 Worksheet
				$0	
SUBTOTAL				$25,300	
Contingency	20%		$25,300	$5,060	
SUBTOTAL				**$30,360**	
Project Management	8%		$30,360	$2,429	USEPA 2000, p. 5-13, $100K-$500K
Remedial Design	15%		$30,360	$4,554	USEPA 2000, p. 5-13, $100K-$500K
Construction Management	10%		$30,360	$3,036	USEPA 2000, p. 5-13, $100K-$500K
SUBTOTAL				**$10,019**	
TOTAL CAPITAL COST				**$40,000**	

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	$40,000	$40,000	1.000	$40,000	
	ANNUAL O&M COST	$0	$0	0.000	$0	
		$40,000			$40,000	
	PRESENT VALUE OF LAND USE CONTROLS COST				$20,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$60,000**	

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** **COST ESTIMATE SUMMARY**
Elements: **Land Use Controls**

Site: Charleston Naval Complex
Location: Combined SWMU 23
Phase: Corrective Measures Study
Base Year: 2002
Date: 12/31/02

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).