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**FINAL**

# PROPOSED REMEDIAL ACTION PLAN
# OPERABLE UNIT NO. 12 (SITE 3)

## MARINE CORPS BASE
## CAMP LEJEUNE, NORTH CAROLINA

**CONTRACT TASK ORDER 0274**

**OCTOBER 23, 1996**

*Prepared For:*

**DEPARTMENT OF THE NAVY**
**ATLANTIC DIVISION**
**NAVAL FACILITIES**
**ENGINEERING COMMAND**
*Norfolk, Virginia*

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ARAR | applicable or relevant and appropriate requirement |
| Baker | Baker Environmental, Inc. |
| bgs | below ground surface |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| COPC | contaminant of potential concern |
| CP | Concrete Pad Area |
| DoN | Department of the Navy |
| DW | deep well |
| ELISA | enzyme linked immunosorbent assay |
| FFA | Federal Facilities Agreement |
| FS | Feasibility Study |
| HI | hazard index |
| ICR | incremental lifetime cancer risk |
| IW | intermediate well |
| µg/L | microgram per liter |
| µg/kg | microgram per kilogram |
| MCB | Marine Corps Base |
| MCL | Maximum Contaminant Level |
| MW | monitoring well |
| NA | Northern Area |
| NC DEHNR | North Carolina Department of Environment, Health, and Natural Resources |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NCWQS | North Carolina Water Quality Standards |
| ND | non detect |
| NPW | net present worth |
| O&M | operation and maintenance |
| OU | Operable Unit |
| PAH | polynuclear aromatic hydrocarbon |
| POL | petroleum, oil, and lubricant |
| ppb | parts per billion |
| ppm | parts per million |
| PRAP | Proposed Remedial Action Plan |
| psi | pounds per square inch |
| QI | quotient index |

## LIST OF ACRONYMS AND ABBREVIATIONS
## (Continued)

| | |
|---|---|
| RA | risk assessment |
| RAA | remedial action alternative |
| RCRA | Resource Conservation and Recovery Act |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| RS | Rail Spur Area |
| SB | soil boring |
| SD | sediment |
| SSSV | surface soil screening value |
| SVOC | semivolatile organic compound |
| TA | Treatment Area |
| TAL | target analyte list |
| TBC | to be considered criteria |
| TCL | target compound list |
| USEPA | United States Environmental Protection Agency |
| VOC | volatile organic compound |

## INTRODUCTION

This Proposed Remedial Action Plan (PRAP) is issued to describe the Marine Corps Base (MCB), Camp Lejeune's and the Department of the Navy's (DoN's) preferred remedial action plan for Operable Unit (OU) No. 12 (Site 3) at MCB, Camp Lejeune.

MCB, Camp Lejeune and the DoN are issuing this PRAP as part of the public participation responsibility under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and the Federal Facilities Agreement (FFA) between MCB, Camp Lejeune, the DoN, the United States Environmental Protection Agency (USEPA) Region IV, and the North Carolina Department of Environment, Health, and Natural Resources (NC DEHNR). The purpose of this PRAP is to: identify the preferred remedial action alternatives for OU No. 12 (Site 3) and explain the rationale for the preferences; solicit public review of the alternatives; and provide information on how the public can be involved in the remedial action selection process.

This document summarizes information that can be found in greater detail in the Remedial Investigation (RI) and Feasibility Study (FS) Reports prepared for OU No. 12 (Site 3), and other documents referenced in the RI and FS Reports. These documents, which will be the basis for the selection of a remedial action plan at OU No. 12, are contained within an administrative record file. The administrative record file is available for public review at the MCB, Camp Lejeune Installation Restoration Division Office (Building 67, Room 238) and at the Onslow County Library in Jacksonville, North Carolina. The DoN encourages the public to review the administrative record file in order to gain a more comprehensive understanding of OU No. 12.

The public is also encouraged to comment on information contained within the administrative record file and this PRAP. Public comments will be accepted by the DoN, USEPA Region IV, and NC DEHNR representatives listed at the end of this document. The public is encouraged to submit comments on this PRAP since the comments can influence the DoN's, USEPA's and State's preference. The 30-day public comment period will begin on November 6, 1996 and end on December 6, 1996. The DoN, with the assistance of the USEPA and the NC DEHNR, may modify the preferred alternative or select another remedial action based on new information or comments received from the public.

MCB, Camp Lejeune and the DoN, with the assistance of USEPA Region IV and the NC DEHNR, will select a final remedy for OU No. 12 only after the public comment period has ended and the information submitted during this time has been reviewed and considered. A Record of Decision (ROD) stating the selected remedial action plan for OU No. 12 will be prepared based upon the results of the RI, the PRAP, and the public comment period. The Final ROD may recommend a different remedial action than is presented in this PRAP depending upon public comments and any new information that may become available.

## BACKGROUND INFORMATION

This section presents the following background information: a description of MCB, Camp Lejeune, a description of Site 3 and its history, and a summary of previous investigations conducted at Site 3.

## Description of MCB, Camp Lejeune

Located in Onslow County, North Carolina, MCB, Camp Lejeune is a training base for the United States Marine Corps. The Base covers approximately 236 square miles and includes 14 miles of coastline. MCB, Camp Lejeune is bounded to the southeast by the Atlantic Ocean, to the northeast by State Route 24, and to the west by U.S. Route 17. The town of Jacksonville, North Carolina is located north of the Base.

OU No. 12 is one of 17 operable units located within MCB, Camp Lejeune. Operable units were developed at the Base to combine one or more individual sites that share a common element. OU No. 12 contains only one site, Site 3, which is otherwise known as the Old Creosote Plant. Figure 1 depicts the location of OU No. 12 (Site 3) within MCB, Camp Lejeune.

## Site Description and History

Figure 2 presents a map of OU No. 12 (Site 3). Located within the Mainside Supply and Storage areas at MCB, Camp Lejeune, Site 3 encompasses an area of approximately five acres and is generally flat and unpaved. Open Storage Lots 201 and 203 (i.e., Site 6) are located nearby along Holcomb Boulevard approximately 1-1/2 miles from Site 3. However, Site 3 itself is not currently used for open storage.

As shown in Figure 2, the site is intersected by two roadways: a dirt path that runs north-south and forms a loop in the southern portion of the site, and a gravel road that runs east-west and leads directly to Holcomb Boulevard. Access to the site via these roadways is currently unrestricted. In addition, the Camp Lejeune Railroad line runs parallel to the site's western edge and intersects an old railroad spur line at the site's southern extreme. The intersection of these two lines creates a spike formation that points south. Wooded areas lie north and east of the site.

The old creosote plant reportedly operated from 1951 to 1952 to supply treated lumber during construction of the Base railroad. Reportedly, an on site sawmill, located in the northern portion of the site, was used to trim logs into railroad ties. The ties were then treated with hot creosote in pressure cylinder chambers. Although the exact treatment procedures that were used are not known, records show that preservatives (i.e., creosote) were stored for reuse in a railroad tank car.

In typical pressure treatment processes, wood ties are placed inside cylindrical chambers which are filled with wood-treating preservatives. Then, hydrostatic or pneumatic pressures, ranging from 50 to 200 pounds per square inch (psi), are applied within the treatment chamber until the wood absorbs the desired amount of preservative. When the treatment process is complete, a pump removes the excess preservative from the chamber and sends it to a storage vessel for reuse. Excess preservative is then removed from the wood by applying a vacuum, or by allowing the wood to drip dry. In the past, treated wood lay in open areas for several days, allowing preservative to drip. Today, treated wood is typically placed on lined and covered drip pads to collect excess preservative.

The main treatment area at Site 3 was most likely located within and immediately surrounding the dirt path loop in the southern portion of the site. This area contains an abandoned chimney that was probably associated with creosote heating/thinning activities. (Creosote is heated and mixed with fuel oil to create a less viscous consistency.) The 240 foot long concrete pad encircled by the dirt path loop was probably used as a drip track for pressure cylinder chambers or treated wood ties. However, the concrete pad does not contain visual evidence of contamination. South of the pad,

evidence of rail lines was observed indicating that a railroad connection may have been located in this area. The railroad connection may have transported creosote or ties to and from the treatment area. The portable steel bridge identified in Figure 2 is not associated with the former creosote plant. It was more recently stationed in the area by Base personnel.

Several concrete pads, which may also be remnants of the former creosote plant, are scattered throughout the northern and southern portions of Site 3. However, these pads do not contain visual evidence of contamination. In addition, a small trash pile containing palettes and metal debris is located in the northern portion of Site 3. However, this trash pile does not appear to have been associated with the former creosote plant.

## Previous Investigations

Previous investigations conducted at Site 3 include an Initial Assessment Study (1983), a Site Inspection (1991), and a Remedial Investigation (1994-95). The Initial Assessment Study identified the presence of the site (Water and Air Research, Inc., 1983). The following paragraphs briefly describe the Site Inspection and the RI; more detailed information is located in the Site Inspection Report (Halliburton/NUS, 1991) and the Remedial Investigation Report (Baker, 1996).

### Site Inspection, 1991

In June 1991, Halliburton/NUS conducted a Site Inspection that included soil, groundwater, and sediment investigations. Figure 3 identifies the sampling locations associated with these investigations.

During the soil investigation, 7 surface soil samples were collected from 0 to 2 feet below ground surface (bgs), and 7 subsurface soil samples were collected from 3 to 17 feet bgs. All soil samples were analyzed for target compound list (TCL) semivolatile organic compounds (SVOCs). Table 1 presents the results of soil sample analyses. The results indicated that surficial soil samples from locations 03-SB04 and 03-MW02 (zero to two feet bgs) contained polynuclear aromatic hydrocarbons (PAHs). These PAHs were detected at concentrations ranging from 260 microgram per kilogram (µg/kg) for benzo(g,h,i)perylene to 2,200 µg/kg for benzo(b)fluoranthene. Several PAHs, including chrysene, benzo(k)fluoranthene, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene, were detected in the surficial soil at concentrations exceeding 1,000 µg/kg. PAHs were not detected in the shallow subsurface soil samples collected from three to five feet bgs. However, a deep subsurface soil sample from boring 03-MW02 (15 to 17 feet bgs) contained elevated PAH concentrations. In this sample, several PAHs, including acenaphthene, fluoranthene, fluorene, naphthalene, and phenanthrene, were detected at concentrations exceeding 35,000 µg/kg; dibenzofuran was detected at 35,000 µg/kg. Based on the sample depth and sampling logs, this deep subsurface soil sample may have been collected from the saturated zone.

During the groundwater investigation, three shallow monitoring wells were installed, and three samples were collected from these wells. All of the groundwater samples were analyzed for full TCL SVOCs. Table 2 presents the results of groundwater sample analyses. Of the three groundwater samples collected, only the sample from well 03-MW02 contained SVOCs. Several PAHs, including acenaphthene, 2-methylnaphthalene, naphthalene, and phenanthrene, were detected at concentrations exceeding 1,000 microgram per liter (µg/L). Other detected PAHs included anthracene (260 µg/L), chrysene (96 µg/L), fluoranthene (640 µg/L), fluorene (890 µg/L), and pyrene (460 µg/L). In addition, dibenzofuran was detected at a concentration of 1,100 µg/L.

During the sediment investigation, two sediment samples were collected and analyzed for TCL SVOCs. The only SVOC detected was bis(2-ethylhexyl)phthalate. It was detected at a concentration of 750 µg/kg in sample 03-SD01. However, this constituent is a common laboratory contaminant so its presence is most likely not site-related.

**Remedial Investigation, 1994-95**

From 1994 through 1995, Baker Environmental, Inc. (Baker) conducted field activities for an RI at Site 3. These field activities, which included soil and groundwater investigations, were conducted in three phases. Phase 1, conducted in September 1994, consisted of a surface soil investigation using enzyme linked immunosorbent assay (ELISA) field screening (i.e., surface soil samples were collected and immediately analyzed for PAHs in the field using an ELISA field test kit). A total of 84 surface soil samples were collected and analyzed in the field. Thirty-seven of the 84 samples were sent to a laboratory for confirmatory analyses. The results of the Phase 1 surface soil investigation assisted in locating soil borings and monitoring wells at Site 3 during Phases 2 and 3 of the RI. Phase 2, conducted from October through December 1994, included surface soil, subsurface soil, and groundwater investigations. During this second phase, five shallow monitoring wells and one intermediate monitoring well (i.e., a well screened at the top of the Castle Hayne aquifer) were installed. Phase 3, conducted in June 1995, included surface soil, subsurface soil, and groundwater investigations. During this third phase, five additional shallow monitoring wells, one additional intermediate monitoring, and one deep monitoring well (i.e., a well screened in the middle of the Castle Hayne aquifer) were installed. In addition to these three RI phases, monitoring well 03-MW02DW was resampled a third time in January 1996.

Figures 4, 5, and 6 identify the soil sampling locations associated with the RI. Figure 4 identifies the sampling locations in the site's northern area (NA), Figure 5 identifies the sampling locations in the treatment area (TA)/concrete pad area (CP), and Figure 6 identifies the sampling locations in the railroad spur area (RS). Figure 7 identifies the groundwater sampling locations associated with the RI. In addition, Tables 3 and 4 present soil and groundwater sampling summaries, respectively.

Tables 5, 6, and 7 summarize the analytical results from the surface soil, subsurface soil, and groundwater investigations associated with the RI. Table 5 summarizes the surface soil results, Table 6 summarizes the subsurface soil results, and Table 7 summarizes the groundwater results. These tables present concentration ranges for positively detected chemical constituents, and a comparison of constituent concentrations to relevant comparison criteria (i.e., federal, state, and/or local standards; background concentrations; or risk-based concentrations).

As the analytical results indicate, the most frequently detected organic contaminants were PAHs, which exhibited the highest concentrations in both soil and groundwater. Because creosote is made up of PAH compounds, the PAHs detected at Site 3 are believed to be associated with operations at the former creosote plant. The highest PAH concentrations in soil occurred in the treatment area of the site (i.e., the area encircled by the dirt path loop). Fuel constituents, such as ethylbenzene and xylene, were also detected in surface and subsurface soil at the former treatment area.

In the shallow aquifer, benzene was detected above federal and/or state standards in the central portion of the treatment area during the first and third groundwater sampling rounds, but not during the second round. Several PAHs, including naphthalene, phenanthrene, benzo(a)anthracene, chrysene, and benzo(a)pyrene, were detected above federal and/or state standards during the first sampling round. However, naphthalene was the only PAH that was detected above standards during

the subsequent sampling rounds. Naphthalene was detected in the treatment area and in the rail spur area, but the locations and concentrations of detections were not consistent between the three groundwater sampling rounds.

In the Castle Hayne aquifer, volatile organic compounds (VOCs) (in particular, fuel constituents) and SVOCs (in particular, PAHs and phenols) were detected during all three sampling rounds. Benzene, chloroform, naphthalene, and phenol were the only organic contaminants detected above federal and/or state standards. Benzene was detected above standards in intermediate well 03-MW02IW during the first sampling round. During the second sampling round, benzene, phenol, and naphthalene were detected above standards in deep well 03-MW02DW (located in the treatment area). During the third sampling round, no contaminants were detected above federal and state standards in the Castle Hayne aquifer. When 03-MW02DW was resampled a third time (in January 1996) no contaminants were detected above federal and state standards.

## SUMMARY OF SITE RISKS

As part of the RI, a human health risk assessment (RA) and an ecological RA were conducted to determine the potential risks associated with the chemical constituents detected at Site 3. The following subsections briefly summarize the findings of the human health and ecological RAs.

### Human Health Risk Assessment

During the human health RA, contaminants of potential concern (COPCs) were selected for surface soil, subsurface soil, and groundwater, as shown in Table 8. The selection of COPCs was based on criteria provided in the USEPA Risk Assessment Guidance for Superfund.

For each COPC, incremental lifetime cancer risk (ICR) values and hazard index (HI) values were calculated to quantify potential carcinogenic and noncarcinogenic risks, respectively. Table 9 presents the ICR and HI values for each environmental medium and receptor evaluated. (Receptors included current military personnel, future child and adult residents, and future construction workers.) Table 9 also presents total ICR and HI values which represent risks to all environmental media combined, for each receptor. A shaded block in Table 9 indicates an ICR value that exceeds the USEPA acceptable limit of 1E-04 for carcinogens, or an HI value that exceeds the USEPA acceptable limit of 1.0 for noncarcinogens. As shown in Table 9, unacceptable risk values were generated for future child and adult residents upon exposure to groundwater.

As shown in Tables 8 and 9, the COPCs and risk values for groundwater were generated under two approaches: 1) the evaluation of Round 2 groundwater data, and 2) the evaluation of Rounds 1, 2, and 3 groundwater data combined (referred to as the "Worst Case" approach). The latter approach is more conservative.

### Ecological Risk Assessment

During the ecological RA, COPCs were selected for surface soil as shown in Table 10. Then, the potential ecological impacts to terrestrial receptors were evaluated for each COPC. Several COPCs, including some SVOCs and the inorganic chromium, exceeded surface soil screening values (SSSVs) in open grass areas or along tree lines. However, most of the studies used to develop SSSVs do not take into account the soil type, which may have a large influence on the toxicity of contaminants. In addition, most of the SSSVs are based on one or two studies which limits their

reliability for a wide range of site-specific circumstances. Overall, the SSSVs have a high degree of uncertainty associated with them and are not well-established. Consequently, potential ecological risks based on these SSSVs may not be completely accurate and most likely err on the conservative side. In addition, none of the quotient indices (QIs) generated for terrestrial receptors exceeded the acceptable limit of 1.0, so potential impacts to terrestrial mammals or birds are not expected. No threatened or endangered species are known to inhabit Site 3, and no wetlands were identified.

## SCOPE AND ROLE OF ACTION

The scope of the response action for Site 3 includes two environmental media of concern: 1) subsurface soil, and 2) groundwater in the shallow aquifer. Based on the results of the human health and ecological RAs, groundwater was the only environmental medium that generated unacceptable risk values (unacceptable human health risk values were generated under the future residential land use scenario - see Table 9). To address these unacceptable risk values, it was necessary to develop a response action for groundwater. Although subsurface soil did not generate unacceptable risk values, the subsurface soil was suspected to be contributing to the groundwater contamination by leaching PAHs. To address the potential for leaching contaminants, it was necessary to develop a response action for subsurface soil. Thus, two sets of remedial action alternatives were developed - one for subsurface soil and one for groundwater. The complete response action for Site 3 will combine one subsurface soil alternative and one groundwater alternative.

The response action for Site 3 focuses on specific areas of concern located within the subsurface soil and groundwater. Figure 8 depicts these areas of concern. The subsurface soil area of concern was defined based on SVOC concentrations that exceeded federal soil screening levels established to protect groundwater, and the depth of the water table. This area of concern extends from approximately three feet bgs to nine feet bgs (just above the water table). The total volume of soil within this area of concern is approximately 1,340 cubic yards. [Note: The soil area of concern does not include PAH contamination detected below the water table. This is because it is impractical to remediate this saturated soil. Long-term monitoring of groundwater, however, may be proposed to address this contamination.] The groundwater areas of concern were defined based on SVOC concentrations in the shallow aquifer that exceeded federal and/or state standards, or risk-based criteria. As shown in Figure 8, one groundwater area of concern is centered around well 03-MW02, and one groundwater area of concern is centered around well 03-MW06.

In the vicinity of 03-MW02, the subsurface soil area of concern is suspected to be the main source of groundwater contamination. Leaching PAHs from the subsurface soil most likely contaminated the groundwater in this area. Thus, the subsurface soil area of concern is considered a "source area" of contamination. The groundwater area of concern centered around 03-MW06 contains PAH concentrations, but at lower levels than the groundwater area of concern centered around 03-MW02. In the vicinity of 03-MW06, there does not appear to be a source area of contaminated soil.

## SUMMARY OF ALTERNATIVES

Based on the response action developed for Site 3, remedial action alternatives (RAAs) were developed and evaluated. Five alternatives were developed for subsurface soil:

- Soil RAA No. 1: No Action
- Soil RAA No. 2: Land Use Restrictions
- Soil RAA No. 3: Source Removal and Off Site Landfill Disposal

- Soil RAA No. 4: Source Removal and Off Site Incineration
- Soil RAA No. 5: Source Removal and Biological Treatment

Three alternatives were developed for groundwater:

- Groundwater RAA No. 1: No Action
- Groundwater RAA No. 2: Land Use Restrictions, Aquifer Use Restrictions, and Monitoring
- Groundwater RAA No. 3: Extraction and On Site Carbon Adsorption Treatment

The following paragraphs describe these soil and groundwater alternatives.

**Summary of Soil Alternatives**

**Soil RAA No. 1: No Action**

| | |
|---|---|
| Capital Cost: | $0 |
| Annual Operation and Maintenance (O&M) Cost: | $0 |
| Net Present Worth (NPW): | $0 |
| Years to Implement: | None |

Under Soil RAA No. 1, no remedial actions will be implemented to address the subsurface soil area of concern. The no action alternative is required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as a baseline for comparison with other remedial action alternatives that provide a greater level of response. Under this alternative, contaminants will remain untreated in the subsurface soil. As a result, the lead agency will be required to review the effects of this alternative at least once every five years.

**Soil RAA No. 2: Land Use Restrictions**

| | |
|---|---|
| Capital Cost: | $0 |
| Annual O&M Cost: | $0 |
| NPW: | $0 |
| Years to Implement: | Less Than One Month |

Under Soil RAA No. 2, land use restrictions will be implemented to limit future development and use of the site, and to avoid future exposure to the subsurface soil contaminants. Because the subsurface soil area of concern will not receive active treatment, the lead agency will be required to review the effects of the alternative at least once every five years.

**Soil RAA No. 3: Source Removal and Off Site Landfill Disposal**

| | |
|---|---|
| Capital Cost: | $920,000 |
| Annual O&M Cost: | $0 |
| NPW: | $920,000 |
| Years to Implement: | Less Than One Month |

Under Soil RAA No. 3, the subsurface soil area of concern, which is considered a source of groundwater contamination at Site 3, will be excavated to a depth of nine feet bgs. Confirmatory soil samples will be collected from the excavation area to ensure that contaminated soil above the

water table has been removed to acceptable limits. The excavated soil will be sent off site to a Resource Conservation and Recovery Act (RCRA) permitted Subtitle C facility for disposal. Finally, the excavation area will be backfilled with clean fill from an on Base borrow pit. In addition to source removal and landfill disposal, Soil RAA No. 3 includes land use restrictions. Although the subsurface soil area of concern will be removed, a 5-year review by the lead agency may still be required for contaminated groundwater remaining at the site.

**Soil RAA No. 4: Source Removal and Off Site Incineration**

| | |
|---|---|
| Capital Cost: | $3,150,000 |
| Annual O&M Cost: | $0 |
| NPW: | $3,150,000 |
| Years to Implement: | Less Than One Month |

Under Soil RAA No. 4, the subsurface soil area of concern will be excavated to a depth of nine feet bgs. Confirmatory soil samples will be collected from the excavation area to ensure that contaminated soil above the water table has been removed to acceptable limits. The excavated soil will be sent off site for thermal treatment at a permitted incineration facility. Finally, the excavation area will be backfilled with clean fill from an on Base borrow pit. In addition to source removal and incineration, Soil RAA No. 4 includes land use restrictions. Although the subsurface soil area of concern will be removed, a 5-year review by the lead agency may still be required for contaminated groundwater remaining at the site.

**Soil RAA No. 5: Source Removal and Biological Treatment**

| | |
|---|---|
| Capital Cost: | $362,000 |
| Annual O&M Cost: | $35,000 |
| NPW: | $514,000 |
| Years to Implement: | Assumed to be 5 years |

Under Soil RAA No. 5, the subsurface soil area of concern will be excavated to a depth of nine feet bgs. Confirmatory soil samples will be collected from the excavation area to ensure that contaminated soil above the water table has been removed to acceptable limits. The excavated soil will undergo aerobic, solid-phase biological treatment at one of two locations: 1) the existing Lot 203 biocell at MCB, Camp Lejeune, or 2) a biocell constructed at Site 3. The treatment location will depend on the availability of the Lot 203 biocell which is currently being used to treat petroleum, oil, and lubricant (POL)-contaminated soil from other sites at MCB, Camp Lejeune. In addition, the treatment location will depend on the ability to modify the permit for the Lot 203 biocell so that it can accept PAH-contaminated soil. Prior to implementation, a pilot-scale treatability study will be conducted at Site 3 to further determine the effectiveness of this alternative. The treatability study is currently scheduled for the winter of 1996-97.

The biological treatment will be conducted using landfarming technology within a controlled unit (the "biocell"). The contaminated soil will be placed in a 12 inch lift underlain by a 24 inch lift of coarse sand, a high density polyethylene geomembrane liner, and a non-woven geotextile fabric. Leachate will be collected by a leachate collection line and sump, and periodically resprayed back onto the contaminated soil. Maintenance of the biocell will consist of periodic leachate collection and respraying, soil tilling, nutrient and fertilizer addition, and soil sampling.

Soil RAA No. 5 also includes land use restrictions. Although the subsurface soil area of concern will be removed and treated, a 5-year review by the lead agency will be required until the remediation levels for soil are achieved.

**Summary of Groundwater Alternatives**

**Groundwater RAA No. 1: No Action**

| | |
|---|---|
| Capital Cost: | $0 |
| Annual O&M Cost: | $0 |
| NPW: | $0 |
| Years to Implement: | None |

Under Groundwater RAA No. 1, no remedial actions will be implemented to address the groundwater areas of concern. The no action alternative is required by the NCP as a baseline for comparison with other remedial action alternatives that provide a greater level of response. Under this alternative, contaminants will remain untreated in the groundwater. As a result, the NCP requires the lead agency to review the effects of this alternative at least once every five years.

**Groundwater RAA No. 2: Land Use Restrictions, Aquifer Use Restrictions, and Monitoring**

| | |
|---|---|
| Capital Cost: | $0 |
| Annual O&M Cost (Years 1-5): | $64,000 |
| Annual O&M Cost (Years 6-30): | $33,000 |
| NPW: | $643,000 |
| Years to Implement: | 30 Years of Groundwater Monitoring |

Under Groundwater RAA No. 2, land use restrictions, aquifer use restrictions, and a long-term groundwater monitoring program will be implemented. The land use restrictions will prohibit future use of the shallow and Castle Hayne aquifers, in the immediate vicinity of Site 3, as potable water sources by prohibiting the installation of potable water supply wells. The long-term monitoring program will include periodic groundwater sampling and analysis at six shallow monitoring wells (03-MW02, 03-MW06, 03-MW07, and 03-MW08), two intermediate monitoring wells (03-MW02IW and 03-MW11IW), and one deep monitoring well (03-MW02DW). The samples will be analyzed for TCL VOCs and SVOCs to monitor contaminant concentrations in the shallow and Castle Hayne aquifers over time. For cost estimating purposes, quarterly sampling was assumed for years 1-5, and semiannual sampling was assumed for years 6-30. Additional wells may be added to the monitoring program if necessary. Under Groundwater RAA No. 2, the groundwater areas of concern will not receive active treatment so the lead agency will be required to review the effects of this alternative at least once every five years.

**Groundwater RAA No. 3: Extraction and On Site Carbon Adsorption Treatment**

| | |
|---|---|
| Capital Cost: | $422,000 |
| Annual O&M Cost (Years 1-5): | $64,000 |
| Annual O&M Cost (Years 6-30): | $33,000 |
| Annual O&M Cost (Treatment System Years 1-3): | $85,000 |
| NPW: | $2,370,000 |
| Years to Implement: | 30 Years of Treatment Plant O&M; 30 Years of Groundwater Monitoring |

Under Groundwater RAA No. 3, a groundwater extraction and treatment system (i.e., a pump and treat system) will be installed at Site 3. Two extraction wells will be installed within the shallow aquifer at depths of approximately 20 feet bgs. One extraction well will be located near existing well 03-MW02, and one extraction well will be located near existing well 03-MW06. The wells' pumping rates will allow their cones of influence to intercept the groundwater areas of concern. (For cost estimating purposes, it is assumed that each well will pump at 5 gallons per minute and generate a 220 foot radius of influence.) Once extracted, the contaminated groundwater will be transported via pipeline to an on site treatment plant located between existing wells 03-MW02 and 03-MW06. At the treatment plant, the groundwater will undergo pretreatment via oil/water separation, neutralization, precipitation, filtration, flocculation, and sedimentation. Then the groundwater will undergo liquid-phase carbon adsorption treatment. The treated groundwater will be discharged by pipeline to the nearest sanitary sewer line for subsequent discharge to a Base sewage treatment plant.

In addition to groundwater extraction and treatment, Groundwater RAA No. 3 includes land use and aquifer use restrictions, and a long-term groundwater monitoring program. (See Groundwater RAA No. 2 for a description of the restrictions and monitoring program included under Groundwater RAA No. 3.) Because the contaminated groundwater will remain on site indefinitely, 5-year reviews by the lead agency will be required.

## EVALUATION OF ALTERNATIVES

This section summarizes the detailed evaluation of alternatives that was conducted for the soil and groundwater RAAs. During the detailed evaluation, the RAAs were comparatively analyzed using seven USEPA evaluation criteria: overall protection of human health and the environment; compliance with applicable and relevant or appropriate requirements (ARARs)/ to-be-considered criteria (TBCs); long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Table 11 presents definitions of these evaluation criteria.

### Evaluation of Soil Alternatives

**Overall Protection of Human Health and the Environment**

Under Soil RAA No. 1 (No Action) and Soil RAA No. 2 (Land Use Restrictions), no remediation actions will be implemented to remove or treat the area of concern containing contaminated subsurface soil. Because the contaminated soil will be left as is, it will continue to be a potential

source of groundwater contamination (via contaminant leaching). As such, the contaminated soil will be contributing to the unacceptable human health risks associated with groundwater. (These risks were generated under the future residential land use scenario.) Soil RAA No. 1 provides no means for reducing these potential risks. Soil RAA No. 2, on the other hand, includes land use restrictions that will reduce some of the potential risks. Regardless, under both Soil RAA Nos. 1 and 2, contaminants may continue to leach from the subsurface soil to the groundwater.

Compared to Soil RAA Nos. 1 and 2, Soil RAA No. 3 (Source Removal and Off Site Landfill Disposal), Soil RAA No. 4 (Source Removal and Off Site Incineration), and Soil RAA No. 5 (Source Removal and Biological Treatment) will significantly reduce the human health risks associated with groundwater by completely removing a major source of the groundwater contamination - the subsurface soil area of concern above the water table. Because Soil RAA Nos. 3, 4, and 5 are source removal alternatives, they will prevent the further leaching of PAH contaminants from the subsurface soil (at 3 to 9 feet bgs) to the groundwater. Thus, Soil RAA No. 1 provides no additional protection of human health, Soil RAA No. 2 provides some additional protection, and Soil RAA Nos. 3, 4, and 5 provide significant protection.

Because ecological risks were determined to be insignificant, conditions at Site 3 are already considered to be protective of the environment. As a result, all five soil RAAs will provide overall protection of the environment. The biocell included under Soil RAA No. 5 could potentially present risks to terrestrial receptors. However, if the biocell is properly controlled (with a cover and a surrounding earthen berm), these ecological risks will be insignificant.

**Compliance with ARARs/TBCs**

Under Soil RAA Nos. 1 and 2, contaminants will remain in the subsurface soil at concentrations that exceed chemical-specific TBCs (i.e., the federal soil screening levels developed for USEPA Region III; no chemical-specific ARARs were identified for soil). Thus, soil conditions at the site will not meet chemical-specific TBCs. Under Soil RAA Nos. 3, 4, and 5, soil contaminants that exceed the federal soil screening levels will be removed from the subsurface. Thus, soil conditions at the site will meet chemical-specific TBCs.

Soil RAA Nos. 3, 4, and 5 can be designed to meet all of the location- and action-specific ARARs/TBCs that apply to them. No location- or action-specific ARARs/TBCs apply to Soil RAA Nos. 1 and 2.

**Long-Term Effectiveness and Permanence**

Soil RAA No. 1 does not provide long-term effectiveness and permanence. This is because Soil RAA No. 1 allows a source of groundwater contamination, the subsurface soil area of concern, to remain in place and untreated. In addition, Soil RAA No. 1 does not provide controls to manage the remaining soil contaminants. Like Soil RAA No. 1, Soil RAA No. 2 allows the subsurface soil area of concern to remain in place and untreated. However, Soil RAA No. 2 includes land use restrictions to manage the remaining soil contaminants. Therefore, Soil RAA No. 2 provides a greater level of long-term effectiveness and permanence than Soil RAA No. 1. The restrictions will effectively prevent human exposure to the PAH contaminants. However, under Soil RAA No. 2, the contaminants will continue to leach from the subsurface soil to the groundwater.

Compared to Soil RAA Nos. 1 and 2, Soil RAA Nos. 3, 4, and 5, provide high levels of long-term effectiveness and permanence. Under Soil RAA Nos. 3, 4, and 5, the subsurface soil area of concern will be completely removed above the water table, preventing contaminants from leaching into the groundwater. Soil RAA Nos. 3, 4, and 5 also include land use restrictions which provide additional long-term effectiveness and permanence.

**Reduction of Toxicity, Mobility, or Volume Through Treatment**

Soil RAA Nos. 1 and 2 do not involve source removal or treatment processes, so these alternatives will not reduce toxicity, mobility, or volume of the soil contaminants. Soil RAA Nos. 3, 4, and 5, however, involve soil removal and treatment and/or disposal so these alternatives will result in toxicity, mobility, and volume reduction. Most importantly, Soil RAA Nos. 3, 4, and 5 will eliminate the mobility of PAH contaminants by preventing them from leaching into the groundwater.

Soil RAA Nos. 1, 2, and 3 do not satisfy the statutory preference for treatment. Soil RAA Nos. 4 and 5 do satisfy the statutory preference.

**Short-Term Effectiveness**

Implementation of Soil RAA Nos. 1 and 2 does not increase risks to the community or to workers because these alternatives include no actions other than administrative efforts. Soil RAA Nos. 3, 4, and 5, however, will present risks during soil excavation and backfilling activities. In addition, Soil RAA Nos. 3 and 4 will present risks during transportation of the contaminated soil to the treatment/disposal facility associated with each alternative. Soil RAA No. 4 will present additional risks by creating incinerator off-gas that may escape to the atmosphere. Soil RAA No. 5 will present risks during the initial placement of the contaminated soil, and during the treatment O&M.

Under RAAs Nos. 3 through 5, the following measures will be taken to provide adequate community and worker protection: proper materials handling procedures, personal protective equipment, and construction safety fencing. Air pollution control equipment at the incineration facility will also reduce the risks associated with off-gases under Soil RAA No. 4. In addition, a cover/liner system and periodic maintenance checks will provided additional protection for the treatment cell associated with Soil RAA No. 5. None of the RAAs will present significant environmental impacts.

**Implementability**

Soil RAA No. 1 is the most implementable, if not the most effective, alternative. Soil RAA No. 2 is the next most implementable alternative because the only activity it involves is ordinance procurement. The remaining RAAs (Soil RAA Nos. 3, 4, and 5) are similar in that they include the excavation of subsurface soil. Soil RAA Nos. 3 and 4 include transportation of contaminated soil to a treatment/disposal facility. This transportation will require appropriate materials handling procedures. Compared to Soil RAA Nos. 3 and 4, however, Soil RAA No. 5 will be less easy to implement because it involves mixing of the excavated soil with bulking agents and additives, and long-term O&M of the biocell. In addition, Soil RAA No. 5 requires a treatability study.

**Cost**

In terms of NPW, the no action alternative (Soil RAA No. 1) and the land use restrictions alternative (Soil RAA No. 2) will be the least expensive to implement, followed by Soil RAA No. 5, Soil RAA No. 3, and Soil RAA No. 4. The estimated NPW values, in increasing order, are

- $0 (Soil RAA No. 1 - No Action)
- $0 (Soil RAA No. 2 - Land Use Restrictions)
- $514,000 (Soil RAA No. 5 - Source Removal and Biological Treatment)
- $917,000 (Soil RAA No. 3 - Source Removal and Off Site Landfill Disposal)
- $3,150,000 (Soil RAA No. 4 - Source Removal and Off Site Incineration)

## Evaluation of Groundwater Alternatives

**Overall Protection of Human Health and the Environment**

Groundwater RAA No. 1 (No Action) will not reduce the human health risks associated with groundwater. On the other hand, Groundwater RAA No. 2 (Land Use Restrictions, Aquifer Use Restrictions, and Monitoring) and Groundwater RAA No. 3 (Extraction and On Site Carbon Adsorption Treatment) will reduce human health risks because both alternatives include restrictions and long-term monitoring. The restrictions will prevent human receptors from ingesting, dermally contacting, or inhaling groundwater contaminants. Long-term monitoring will provide a warning system against contaminants that have migrated to unsafe locations, and contaminant concentrations that have increased to unsafe levels, so that human exposure can be avoided. Thus, Groundwater RAA Nos. 2 and 3 will prevent the potential for direct exposure to contaminated groundwater, but Groundwater RAA No. 1 will not. In addition, Groundwater RAA Nos. 2 and 3 will provide overall protection of human health and the environment, but Groundwater RAA No. 1 will not.

Compared to Groundwater RAA Nos. 1 and 2, Groundwater RAA No. 3 provides some additional protection of human health and the environment by collecting the groundwater contaminants and actively treating them at an on site treatment plant. However, this additional protection is not necessary to prevent future human exposure to the groundwater contaminants. PAHs exhibit low volatility and low aqueous solubility. Due to their hydrophobic nature, PAHs tend to adsorb onto soils and sediment. As a result, the PAH contaminants at Site 3 will have a low migration potential so it is unlikely that they will horizontally or vertically migrate to the nearest current receptors.

**Compliance with ARARs/TBCs**

Groundwater RAA Nos. 1 and 2 will allow contaminant levels exceeding chemical-specific ARARs (i.e., federal and state standards, and risk-based criteria) to remain in groundwater at the site. Because of this, Groundwater RAA Nos. 1 and 2 may require a waiver of the chemical-specific ARARs before these alternatives can be implemented. Groundwater RAA No. 3 could potentially remediate the groundwater to chemical-specific ARARs, but most likely the pump and treat system will not be capable of achieving such stringent cleanup standards. Groundwater contaminants, especially PAHs, may sorb to solid particles or escape into subsurface pore spaces or fissures where they become difficult to extract. Most likely, extraction wells will only collect a portion of the PAH contamination; the remaining PAH contamination will remain in the aquifer. Therefore, a pump and treat system may not be able to achieve the chemical-specific ARARs.

No location- or action-specific ARARs/TBCs apply to Groundwater RAA Nos. 1 and 2. Groundwater RAA No. 3 can be designed to meet all of the location- and action- specific ARARs/TBCs that apply to it.

**Long-Term Effectiveness and Permanence**

Groundwater RAA No. 3 will provide long-term effectiveness and permanence because it involves collection and treatment of the contaminated groundwater. Although Groundwater RAA No. 2 will allow contaminants to remain untreated at the site, this alternative will also provide long-term effectiveness and permanence. Based on the hydrophobic nature of PAH contaminants, and the results of a two-dimensional flow model conducted for the FS, leaving PAH contaminants untreated at the site will not affect the nearest, current receptor (a potable water supply well located approximately 700 feet west of Site 3). It may affect future receptors occurring in the vicinity of Site 3, but Groundwater RAA No. 2 includes land use and aquifer use restrictions, and long-term monitoring that will effectively prevent future human exposure. Groundwater RAA No. 1, on the other hand, provides no means for preventing future human exposure so this alternative will not provide long-term effectiveness and permanence.

The pump and treat system included under Groundwater RAA No. 3 will only be adequate and reliable to a certain extent. Technologies for completely extracting contaminants from groundwater are not proven. Contaminants, especially PAHs, may adsorb to solid particles or escape into subsurface pore spaces or fissures where they become difficult to extract. Also, contaminants may continue to leach from solid particles into the groundwater. As a result, extraction wells may not be completely reliable for removing PAH contaminants from the shallow aquifer.

All three groundwater alternatives will require 5-year reviews by the lead agency to ensure that adequate protection of human health and the environment is maintained.

**Reduction of Toxicity, Mobility, or Volume Through Treatment**

Groundwater RAA No. 3 will reduce the toxicity, mobility, and volume of contaminated groundwater that is collected by the extraction wells. However, some of the contaminated groundwater will not be collected so it will not receive treatment. This is because PAH contaminants may adsorb to soils and sediments and escape in pore spaces and fissures. Unlike Groundwater RAA No. 3, Groundwater RAA Nos. 1 and 2 do not involve groundwater extraction or active treatment processes. Therefore, Groundwater RAA Nos. 1 and 2 will not reduce the toxicity, mobility, or volume of groundwater contamination.

Unlike Groundwater RAA Nos. 1 and 2, Groundwater RAA No. 3 will create treatment residuals. The residuals associated with Groundwater RAA No. 3 (sludge, separated oil, exhausted carbon, and treated groundwater) will be voluminous and will require proper treatment and/or disposal.

Groundwater RAA No. 3 satisfies the statutory preference for treatment; Groundwater RAA Nos. 1 and 2 do not.

**Short-Term Effectiveness**

Implementation of Groundwater RAA Nos. 1 and 2 does not pose substantial risks to the community or to workers. Implementation of Groundwater RAA No. 3 does pose risks because it involves

construction of extraction wells, underground pipelines, and a treatment facility. During pipeline construction, special care must be taken to avoid underground utilities. In addition, construction safety fencing and dust minimization procedures should provide adequate protection to the community and to workers. Groundwater RAA No. 3 also involves long-term operation and maintenance of an extraction well system and an on site treatment facility. The treatment facility will generate residual waste streams that must be properly treated and/or disposed. The use of personal protective equipment and proper materials handling procedures should provide adequate protection during operation and maintenance. Because it may create aquifer drawdown, Groundwater RAA No. 3 is the only alternative that could potentially create environmental impacts.

Under all three groundwater alternatives, the time for the action to be complete is unknown. Thirty years of groundwater monitoring was assumed for Groundwater RAA No. 2, and 30 years of groundwater monitoring and treatment system O&M was assumed for Groundwater RAA No. 3.

**Implementability**

Groundwater RAA No. 1 is the easiest alternative to implement, if not the most effective. Groundwater RAA No. 2 is the next most implementable alternative followed by Groundwater RAA No. 3. Groundwater RAA No. 1 requires no operation or maintenance. Groundwater RAA No. 2 requires minimal operation and maintenance (groundwater samples will be collected and wells will be replaced periodically). Groundwater RAA No. 3, however, requires extensive operation and maintenance. Under all three alternatives, additional remedial actions could easily be implemented.

Groundwater RAA Nos. 2 and 3 involve conventional equipment and services that should be readily available. Compared to Groundwater RAA No. 2, Groundwater RAA No. 3 will require more extensive coordination with the Base Public Works/Planning department. Unlike Groundwater RAA No. 1, Groundwater RAA Nos. 2 and 3 will require semiannual submission of reports that document sampling results. Unlike Groundwater RAA No. 3, Groundwater RAA Nos. 1 and 2 may require a waiver of ARARs since groundwater contaminants will be left untreated at the site.

**Cost**

In terms of NPW, the no action alternative (Groundwater RAA No. 1) will be the least expensive alternative to implement, followed by Groundwater RAA No. 2, then Groundwater RAA No. 3. The estimated NPW values in increasing order are

- $0 (Groundwater RAA No. 1 - No Action)
- $643,000 (Groundwater RAA No. 2 - Land Use Restrictions, Aquifer Use Restrictions, and Monitoring)
- $2,369,000 (Groundwater RAA No. 3 - Extraction and On Site Carbon Adsorption Treatment)

## THE PREFERRED ALTERNATIVES

Based on the detailed evaluation of remedial action alternatives, Soil RAA No. 5 (Source Removal and Biological Treatment) and Groundwater RAA No. 2 (Land Use Restrictions, Aquifer Use Restrictions, and Monitoring) were selected as the preferred alternatives for Site 3. Thus, the proposed remedial action plan for Site 3 includes removal of the subsurface soil area of concern, treatment of this soil at either the Lot 203 biocell or a biocell constructed at Site 3, land use and

aquifer use restrictions, and long-term groundwater monitoring. The following paragraphs explain the rationale behind the selection of the preferred alternatives for soil and groundwater.

**Soil RAA No. 5 - Source Removal and Biological Treatment**

The preferred alternative for soil is Soil RAA No. 5 - Source Removal and Biological Treatment. This alternative includes excavation of the subsurface soil area of concern, biological treatment of the soil at either the Lot 203 biocell or a biocell constructed at Site 3, and backfilling of the excavation area with clean soil. This alternative also includes land use restrictions.

At Site 3, the subsurface soil area of concern appears to be the main source of groundwater contamination (via contaminant leaching). As a result, source removal alternatives (i.e., Soil RAA Nos. 3, 4, and 5) were considered to be more appropriate than alternatives that leave the soil in situ and untreated (i.e., Soil RAA Nos. 1 and 2). This is because source removal alternatives eliminate the potential for soil contaminants to leach into the groundwater. Under the source removal alternatives, contaminants that could potentially leach will be removed from the subsurface and treated and/or disposed. Because Soil RAA Nos. 1 and 2 allow a source area of contamination to remain in situ and untreated, these alternatives do not provide adequate protection of human health.

Compared to Soil RAA Nos. 3 and 4, Soil RAA No. 5 is the most cost effective source removal alternative. Although the NPW of Soil RAA No. 5 ($514,000) is similar to the NPW of Soil RAA No. 3 ($917,000), Soil RAA No. 5 includes an extra advantage. Under Soil RAA No. 5, the treated soil may be reused as backfill for some other purpose on the Base. Under Soil RAA No. 3, the contaminated soil will be landfilled. Thus, Soil RAA No. 5 may allow for the beneficial reuse of the contaminated soil.

**Groundwater RAA No. 2 - Land Use Restrictions, Aquifer Use Restrictions, and Monitoring**

The preferred alternative for groundwater is Groundwater RAA No. 2 - Land Use Restrictions, Aquifer Use Restrictions, and Monitoring. This alternative includes land use and aquifer use restrictions, and a long-term groundwater monitoring program. The monitoring program includes periodic sampling of wells 03-MW02, 03-MW02IW, 03-MW02DW, 03-MW06, 03-MW07, 03-MW08, 03-MW11, and 03-MW11IW; all groundwater samples will be analyzed for TCL VOCs and SVOCs.

The groundwater contamination at Site 3 mainly consisted of PAH compounds. Because PAHs exhibit low water solubility, they tend to adsorb to soil and sediment making them relatively immobile contaminants. As a result, the PAH-contaminated groundwater, if left untreated, is not likely to migrate beyond the limits identified in Figure 8. To reinforce this theory, a two-dimensional horizontal flow model was conducted during the FS. The results of the model indicated that untreated PAH-contaminated groundwater will not pose unacceptable risks to the nearest receptor (a potable water supply well) that is currently located on Base. However, future potential receptors located in the vicinity of Site 3 could be affected by the PAH-contaminated groundwater. Thus, a no action plan (i.e., Groundwater RAA No. 1) will not maintain adequate protection of human health. Groundwater RAA No. 2, on the other hand, will maintain adequate protection. Groundwater RAA No. 2 provides land use and aquifer use restrictions that will prohibit the future use of the aquifer, thus protecting any future receptors. In addition, Groundwater RAA No. 2 includes a long-term monitoring program that will provide a warning system in case contaminant

concentrations increase to unsafe levels. This monitoring program provides additional protection of human health.

Compared to Groundwater RAA No. 2, Groundwater RAA No. 3 is not a cost effective alternative. The NPW of Groundwater RAA No. 2 is $643,000 and the NPW of Groundwater RAA No. 3 is $2,369,000. Although Groundwater RAA No. 3 includes extraction and treatment of the contaminated groundwater, the ability of a pump and treat system to effectively extract groundwater contamination is not proven. Contaminants, especially PAHs, will sorb to soil particles and become trapped in subsurface fissures and pores where they are difficult, if not impossible, to extract. Thus, Groundwater RAA No. 3 may only have limited effectiveness. Groundwater RAA No. 2, on the other hand, will have proven effectiveness (land use and aquifer use restrictions and groundwater monitoring are conventional and well-demonstrated). As long as the source of the contamination is removed (i.e., the subsurface soil area of concern), the PAHs in groundwater are expected to remain in the same general vicinity and naturally attenuate over time.

## COMMUNITY PARTICIPATION

A critical part of the selection of a remedial action alternative is community involvement. The following information is provided to solicit the community's input into the selection of a remedy for OU No. 12 (Site 3).

### Public Comment Period

The 30-day public comment period for the proposed remedial action plan at OU No. 12 (Site 3) will begin on November 6, 1996 and end on December 6, 1996. Written comments should be sent to the following address:

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attn: Ms. Katherine Landman, Code 18232

or Commanding General
ACIS EMD (IRD)
Marine Corps Base
PSC Box 20004
Camp Lejeune, North Carolina 28542-0004

A public meeting will be held at the Onslow County Library in Jacksonville, North Carolina on November 6, 1996. Representatives of the Navy, and their consultant, will be available at the meeting to answer questions and accept public comments on the proposed plan for OU No. 12 (Site 3). In addition, an overview of the site characterization will be presented.

Meeting minutes will be made available to the public through the information repositories at the libraries listed below. A responsiveness summary will be prepared at the conclusion of the comment period to summarize significant comments, criticisms, and new relevant information submitted to MCB, Camp Lejeune and the DoN during the comment period. The summary will include the responses to each issue/question raised at the public meeting. After the ROD is signed, MCB, Camp Lejeune and the DoN will publish a notice of availability of the ROD (including the responsiveness summary) in the Jacksonville and MCB, Camp Lejeune newspapers, and place a copy of the ROD in each information repository.

**Information Repositories**

A collection of general information, including the administrative record file, is available to the community in the information repositories at the following locations:

MCB, Camp Lejeune
Building 67, Room 238
Marine Corps Base
Camp Lejeune, NC 28542
(910) 451-5068

Hours:
M-F: 7:00 a.m.- 4:00p.m.
Closed Saturday and Sunday

Onslow County Library
58 Doris Avenue East
Jacksonville, NC 28540
(910) 455-7358

Hours:
M-Thu: 9:00 a.m.- 9:00 p.m.
F-Sat: 9:00 a.m.- 6:00 p.m.
Closed Sunday

**IF YOU HAVE ANY QUESTIONS ABOUT OU NO. 12 (SITE 3), PLEASE CONTACT ONE OF THE FOLLOWING:**

Commanding General
AC/S EMD, (IRD)
Marine Corps Base
PSC Box 20004
Camp Lejeune, North Carolina 28542-0004
Attention: Mr. Neal Paul
(910) 451-5068

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attention: Ms. Katherine Landman, Code 18232
(804) 322-4818

Remedial Project Manager
U.S. EPA, Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365
Attention: Ms. Gena Townsend
(404) 347-3016

N.C. Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
Superfund Section
P.O. Box 27687
Raleigh, North Carolina 27611-7687
Attention: Mr. Patrick Watters
(919) 733-2801

Community Information Line
Public Affairs Office
Marine Corps Base, PSC Box 2004
Camp Lejeune, North Carolina 28542-0004
Attention: Major Stephen Little
(910) 451-5782

**MAILING LIST**

If you are not on the mailing list and would like to receive future publications pertaining to OU No. 12 (Site 3) as it becomes available, please call or complete and mail a copy of this form to the point of contact listed below:

Commanding General
AC/S EMD (IRD)
Marine Corps Base
PSC Box 20004
Camp Lejeune, North Carolina 28542-0004
Attn: Mr. Neal Paul
(910) 451-5068

Name _____

Address _____

Affiliation _____

Phone (___) _____

# TABLES

**TABLE 1**

**SUMMARY OF THE ANALYTICAL RESULTS FOR SOIL**
**SITE INSPECTION, 1991**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Constituent | Surface Soil (0-2 feet bgs) | | Subsurface Soil (3-12 feet bgs) | | Subsurface Soil (> 12 feet bgs) | |
|---|---|---|---|---|---|---|
| | No. of Detections/ Total No. of Samples | Range of Detected Concentrations | No. of Detections/ Total No. of Samples | Range of Detected Concentrations | No. of Detections/ Total No. of Samples | Range of Detected Concentrations |
| Acenaphthene | 0/7 | ND | 0/5 | ND | 1/2 | 37,000 |
| Antracene | 1/7 | 1,900 | 0/5 | ND | 1/2 | 8,600 |
| Benzo(a)anthracene | 2/7 | 460-660 | 0/5 | ND | 1/2 | 5,600 |
| Benzo(b)fluoranthene | 2/7 | 520-2,200 | 0/5 | ND | 1/2 | 2,300 |
| Benzo(k)fluoranthene | 2/7 | 420-1,200 | 0/5 | ND | 1/2 | 2,100 |
| Benzo(g,h,i)perylene | 2/7 | 260-720 | 0/5 | ND | 0/2 | ND |
| Benzo(a)pyrene | 2/7 | 320-1,300 | 0/5 | ND | 0/2 | ND |
| Chrysene | 2/7 | 750-1,400 | 0/5 | ND | 1/2 | 5,900 |
| Flouranthene | 2/7 | 1,000-1,600 | 0/5 | ND | 1/2 | 35,000 |
| Fluorene | 0/7 | ND | 0/5 | ND | 1/2 | 35,000 |
| Indeno(1,2,3-cd)pyrene | 2/7 | 340-1,000 | 0/5 | ND | 0/2 | ND |
| 2-Methylnaphthalene | 0/7 | ND | 0/5 | ND | 1/2 | 26,000 |
| Naphthalene | 1/7 | 550 | 0/5 | ND | 1/2 | 52,000 |
| Phenanthrene | 1/7 | 310 | 0/5 | ND | 1/2 | 81,000 |
| Pyrene | 2/7 | 920-1,400 | 0/5 | ND | 1/2 | 27,000 |
| Dibenzofuran | 0/7 | ND | 0/5 | ND | 1/2 | 35,000 |

Notes:

Concentrations expressed in µg/kg (microgram per kilogram)
bgs = Below ground surface
ND = Not detected

Reference: Halliburton/NUS, 1991. Site Inspection Report for Site 3 Old Creosote Plant. Marine Corps Base, Camp Lejeune, North Carolina.

TABLE 2

SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER
SITE INSPECTION, 1991
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Constituent | North Carolina Standard | USEPA MCL | No. of Detections/ Total No. of Samples | Range of Detected Concentrations[1] | Location of Maximum Concentration |
|---|---|---|---|---|---|
| Acenaphthene | 80 | -- | 1/3 | 1,500 | 3MW02 |
| Anthracene | 2,100 | -- | 1/3 | 260 | 3MW02 |
| Chrysene | 5 | 2 | 1/3 | 96 | 3MW02 |
| Fluoranthene | 280 | -- | 1/3 | 640 | 3MW02 |
| Fluorene | -- | -- | 1/3 | 890 | 3MW02 |
| 2-Methylnaphthalene | -- | -- | 1/3 | 1,500 | 3MW02 |
| Naphthalene | -- | -- | 2/3 | 9-4,400 | 3MW02 |
| Phenanthrene | -- | -- | 1/3 | 1,600 | 3MW02 |
| Pyrene | 210 | -- | 1/3 | 460 | 3MW02 |
| Dibenzofuran | -- | -- | 1/3 | 1,100 | 3MW02 |

Notes:

[1] Shaded blocks indicate detections above the North Carolina Standard of Federal MCL.

Concentrations expressed in µg/L (microgram per liter)
USEPA = U.S. Environmental Protection Agency
MCL = Federal Maximum Contaminant Level
-- = No criteria established

Reference: Halliburton/NUS, 1991. Site Inspection Report for Site 3 Old Creosote Plant. Marine Corps Base, Camp Lejeune, North Carolina.

**TABLE 3**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®)[1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| Rail Spur Area | | | | | | | | | | | |
| 3-RS-SB01 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-RS-SB02 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | X | |
| | 04 | 9.0 | 0.0 - 9.0 | | | X [4] | | | | | |
| 3-RS-SB03 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-RS-SB04 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-RS-SB05 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |
| 3-RS-SB06 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |
| 3-RS-SB07 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |
| 3-RS-SB08 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-RS-SB09 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-RS-SB10 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | X | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| Concrete Pad Area | | | | | | | | | | | |
| 3-CP-SB01 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-CP-SB02 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | X [6] | |
| 3-CP-SB03 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-CP-SB04 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-CP-SB05 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-CP-SB06 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-CP-SB07 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-CP-SB08 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-CP-SB09 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-CP-SB10 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| Treatment Area | | | | | | | | | | | |
| 3-TA-SB01 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | X | |
| 3-TA-SB02 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB03 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | X | |
| 3-TA-SB04 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB05 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB06 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters [3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-TA-SB07 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB08 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | X | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |
| 3-TA-SB09 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-TA-SB10 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |
| 3-TA-SB11 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB12 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-TA-SB13 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-TA-SB14 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X [4] | | | | | |
| 3-TA-SB15 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB16 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB17 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-TA-SB18 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-TA-SB19 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB20 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB21 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | X [6] | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | X | |
| 3-TA-SB22 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB23 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB24 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB25 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X [4] | | | | | |
| 3-TA-SB26 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB27 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB28 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB29 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | X | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X [4] | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-TA-SB30 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB31 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB32 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB33 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB34 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-TA-SB35 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB36 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-TA-SB37 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X [4] | | | | | |
| 3-TA-SB38 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB39 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X [4] | | | | | |
| 3-TA-SB40 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-TA-SB41 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X [4] | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters [3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-TA-SB42 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-TA-SB43 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-TA-SB44 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-TA-SB45 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-TA-SB46 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-TA-SB47 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-TA-SB48 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | X | X | | | | | |
| 3-TA-SB49 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | X | X | | | | | |
| 3-TA-SB50 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | X | X | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters [3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| North Area | | | | | | | | | | | |
| 3-NA-SB01 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | X [6] | |
| 3-NA-SB02 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB03 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-NA-SB04 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | X | |
| 3-NA-SB05 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-NA-SB06 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB07 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-NA-SB08 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X [4] | | | | | |
| 3-NA-SB09 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB10 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-NA-SB11 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB12 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-NA-SB13 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | X | |
| 3-NA-SB14 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB15 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB16 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-NA-SB17 | 00 | 1.0 | 0.0 - 1.0 | X | | X [2] | | | | | |
| 3-NA-SB17A [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-NA-SB18 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-NA-SB19 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| EnSys Background | | | | | | | | | | | |
| 3-BB-SB01 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-BB-SB02 | 00 | 1.0 | 0.0 - 1.0 | X | | | | | | | |
| 3-BB-SB03 | 00 | 1.0 | 0.0 - 1.0 | X | | X[2] | | | | X | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| Soil Investigation Background | | | | | | | | | | | |
| 3-BB-SB01 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X | | | | | |
| 3-BB-SB02 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X | | | | | |
| 3-BB-SB03 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 03 | 7.0 | 5.0 - 7.0 | | | X | | | | | |
| Monitoring Wells | | | | | | | | | | | |
| 3-MW02IW [4] | 00 | 1.0 | 0.0 - 1.0 | | X | X | X | X | | X | X |
| | 03 | 7.0 | 5.0 - 7.0 | | X | X | X | X | | X | X |
| | 09 | 19.0 | 17.0 - 19.0 | | | X | | | | | |
| 3-MW02DW [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-MW04 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-MW05 [4] | 00 | 1.0 | 0.0 - 1.0 | | X | X | X | X | X | | |
| | 10 | 21.0 | 19.0 - 21.0 | | X | X | X | X | X | | |
| 3-MW06 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | | X | | | | | |
| 3-MW07 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X | | | | | |
| 3-MW08 [4] | 00 | 1.0 | 0.0 - 1.0 | | | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | | X | | | | | |
| 3-MW09 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-MW10 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-MW11 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 08 | 19.0 | 17.0 - 19.0 | | X | X | | | | | |
| 3-MW11IW [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 08 | 19.0 | 17.0 - 19.0 | | X | X | | | | | |

**TABLE 3 (Continued)**

**SOIL SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Depth Interval Identification | Depth of Borehole (feet, bgs) | Sampling Interval (feet, bgs) | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | EnSys Sample (PAH RISC ®) [1] | TCL Volatiles | TCL Semivolatiles | TCL Pesticides/ PCBs | TAL Metals | Engineering Parameters[3] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-MW12 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 02 | 5.0 | 3.0 - 5.0 | | X | X | | | | | |
| 3-MW13 [5] | 00 | 1.0 | 0.0 - 1.0 | | X | X | | | | | |
| | 04 | 9.0 | 7.0 - 9.0 | | X | X | | | | | |

Notes:

(1) Sample was collected during the first phase of the soil investigation (September 19 through September 22, 1994)
(2) EnSys confirmation sample
(3) Engineering Parameters includes Particle Size, Atterberg limits, and TOC
(4) Sample was collected during the second phase of the soil investigation (November 15 through November 22, 1994)
(5) Sample was collected during the third phase of the soil investigation (June 13 through June 20, 1995)
(6) Duplicate samples were collected for both PAH RISC ® and TCL Semivolatiles

Reference: Baker Environmental, Inc., 1996. Remedial Investigation Report Operable Unit No. 12 (Site 3). Marine Corps Base, Camp Lejeune, North Carolina.

**TABLE 4**

**GROUNDWATER SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Date of Sampling | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TCL Volatiles | TCL Semivolatiles | TCL Pest.icides/ PCBs | TAL Inorganics | TAL Dissolved Metals | Engineering Parameters [1] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| Shallow Monitoring Wells, Round 1 | | | | | | | | | |
| 3-MW02-01 | 12/1/94 | | X | | | | | | |
| 3-MW03-01 | 12/1/94 | | X | | | | | | |
| 3-MW04-01 | 12/1/94 | | X | | | | | | |
| 3-MW05-01 | 12/2/94 | | X | | | | | | |
| 3-MW06-01 | 12/1/94 | | X | | | | | | |
| 3-MW07-01 | 12/1/94 | X | X | X | X | X | | | |
| 3-MW08-01 | 12/1/94 | X | X | X | X | X | | | |
| Intermediate Monitoring Well, Round 1 | | | | | | | | | |
| 3-MW02IW-01 | 12/3/94 | X | X | X | X | X | | X | X |
| Shallow Monitoring Wells, Round 2 | | | | | | | | | |
| 3-MW01-01 | 7/13/95 | X | X | | | | | | |
| 3-MW02-02 | 7/11/95 | X | X | | | | X | | |
| 3-MW03-02 | 7/13/95 | X | X | | | | | | |
| 3-MW04-02 | 7/11/95 | X | X | | | | | | |

**TABLE 4 (Continued)**

**GROUNDWATER SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Date of Sampling | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TCL Volatiles | TCL Semivolatiles | TCL Pest.icides/ PCBs | TAL Inorganics | TAL Dissolved Metals | Engineering Parameters [1] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| 3-MW05-02 | 7/11/95 | X | X | | | | | | |
| 3-MW06-02 | 7/12/95 | X | X | | | | | | |
| 3-MW07-02 | 7/12/95 | X | X | | | | | | |
| 3-MW08-02 | 7/11/95 | X | X | | | | X | | |
| 3-MW09-01 | 7/13/95 | X | X | | | | | | |
| 3-MW10-01 | 7/12/95 | X | X | | | | | | |
| 3-MW11-01 | 7/12/95 | X | X | | | | | | |
| 3-MW12-01 | 7/12/95 | X | X | | | | | | |
| 3-MW13-01 | 7/13/95 | X | X | | | | | | |
| Intermediate and Deep Monitoring Wells, Round 2 | | | | | | | | | |
| 3-MW02IW-02 | 6/12/95 | X | X | | | | | | |
| 3-MW02DW-01 | 7/13/95 | X | X | | | | X | | |
| 3-MW11IW-01 | 7/12/95 | X | X | | | | | | |

**TABLE 4 (Continued)**

**GROUNDWATER SAMPLING SUMMARY**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Sample Location | Date of Sampling | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TCL Volatiles | TCL Semivolatiles | TCL Pest.icides/ PCBs | TAL Inorganics | TAL Dissolved Metals | Engineering Parameters [1] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| Shallow Monitoring Wells, Round 3 | | | | | | | | | |
| 3-MW01-02 | 9/28/95 | X | X | | | | | | |
| 3-MW02-03 | 9/28/95 | X | X | | | | | | |
| 3-MW03-03 | 9/28/95 | X | X | | | | | | |
| 3-MW04-03 | 9/28/95 | X | X | | | | | | |
| 3-MW05-03 | 9/28/95 | X | X | | | | | | |
| 3-MW06-03 | 9/28/95 | X | X | | | | | | |
| 3-MW07-03 | 9/29/95 | X | X | | | | | | |
| 3-MW08-03 | 9/29/95 | X | X | | | | | | |
| 3-MW09-02 | 9/29/95 | X | X | | | | | | |
| 3-MW10-02 | 9/29/95 | X | X | | | | | | |
| 3-MW11-02 | 9/29/95 | X | X | | | | | | |
| 3-MW12-02 | 9/29/95 | X | X | | | | | | |
| 3-MW13-02 | 9/29/95 | X | X | | | | | | |

TABLE 4 (Continued)

GROUNDWATER SAMPLING SUMMARY
REMEDIAL INVESTIGATION, 1994-95
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Sample Location | Date of Sampling | Sample Analyses | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TCL Volatiles | TCL Semivolatiles | TCL Pest.icides/ PCBs | TAL Inorganics | TAL Dissolved Metals | Engineering Parameters [1] | Duplicate Samples | Matrix Spike/Matrix Spike Duplicate |
| Intermediate and Deep Monitoring Wells, Round 3 | | | | | | | | | |
| 3-MW02IW-03 | 9/29/95 | X | X | | | | | | |
| 3-MW02DW-02 | 9/28/95 | X | X | | | | | | |
| 3-MW11IW-02 | 9/29/95 | X | X | | | | | | |
| Deep Monitoring Well, Round 4 | | | | | | | | | |
| 3-MW02DW-03 | 1/29/96 | X | X | | | | | | |

Note:

[1] Engineering Parameters include (BOD, COD, TDS, TSS, and TOC)

Reference: Baker Environmental, Inc., 1996. Remedial Investigation Report Operable Unit No. 12 (Site 3). Marine Corps Base, Camp Lejeune, North Carolina.

## TABLE 5

## SUMMARY OF THE ANALYTICAL RESULTS FOR SURFACE SOIL
## REMEDIAL INVESTIGATION, 1994-95
## OPERABLE UNIT NO. 12 (SITE 3)
## *MCB CAMP LEJEUNE, NORTH CAROLINA*

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | RBC Residential Soils (µg/kg) | | (µg/kg) | (µg/kg) | | | RBC Residential Soils | | |
| Surface Soils | Volatile Organic Compounds | Toluene | 1,600,000 | NE | 2J | 2J | 3-MW13-00 | 2/17 | 0 | NA | Treatment Area |
| | | Ethylbenzene | 780,000 | NE | 2J | 2J | 3-TA-SB50-00 | 1/17 | 0 | NA | Treatment Area |
| | | Xylenes (total) | 16,000,000 | NE | 6J | 6J | 3-TA-SB50-00 | 1/17 | 0 | NA | Treatment Area |
| | Semivolatile Organic Compounds | Phenol | 4,700,000 | NE | 38J | 38J | 3-RS-SB03-00 | 1/58 | 0 | NA | Rail Spur |
| | | Naphthalene | 310,000 | NE | 38J | 200J | 3-NA-SB05-00 | 2/58 | 0 | NA | North Area, Rail Spur |
| | | 2-Methyl-naphthalene | 310,000 | NE | 41J | 41J | 3-RS-SB02-00 | 1/58 | 0 | NA | Rail Spur |
| | | Acenaphthylene | 230,000 | NE | 40J | 2,700 | 3-NA-SB03-00 | 16/58 | 0 | NA | North Area, Rail Spur, Treatment Area |
| | | Acenaphthene | 470,000 | NE | 44J | 460J | 3-NA-SB05-00 | 2/58 | 0 | NA | North Area, Rail Spur |
| | | Dibenzofuran | 31,000 | NE | 370J | 370J | 3-NA-SB05-00 | 1/58 | 0 | NA | North Area |
| | | Fluorene | 310,000 | NE | 39J | 620J | 3-NA-SB05-00 | 5/58 | 0 | NA | North Area, Rail Spur, Treatment Area |
| | | Penanthrene | 230,000 | NE | 37J | 2,900 | 3-NA-SB05-00 | 9/58 | 0 | NA | North Area, Rail Spur, Treatment Area |
| | | Anthracene | 2,300,000 | NE | 40J | 7,700 | 3-NA-SB03-00 | 26/58 | 0 | NA | Scattered |
| | | Carbazole | 32,000 | NE | 40J | 830J | 3-NA-SB03-00 | 14/58 | 0 | NA | Scattered |
| | | di-n-Butyl-phthalate | 780,000 | NE | 37J | 340J | 3-TA-SB13-00 | 37/58 | 0 | NA | Scattered |
| | | Fluoranthene | 310,000 | NE | 42J | 11,000 | 3-NA-SB03-00 | 32/58 | 0 | NA | Scattered |
| | | Pyrene | 230,000 | NE | 39J | 14,000 | 3-NA-SB03-00 | 34/58 | 0 | NA | Scattered |
| | | Benzo(a)anthracene | 880 | NE | 32J | 8,300 | 3-NA-SB03-00 | 24/58 | 5 | NA | Scattered |
| | | Chrysene | 88,000 | NE | 40J | 12,000 | 3-NA-SB03-00 | 32/58 | 0 | NA | Scattered |
| | | bis(2-Ethylhexyl)phthalate | 46,000 | NE | 36J | 91J | 3-NA-SB01-00 | 30/58 | 0 | NA | Scattered |
| | | Benzo(b)fluoranthene | 880 | NE | 39J | 13,000 | 3-NA-SB03-00 | 37/58 | 6 | NA | Scattered |
| | | Benzo(k)fluoranthene | 8,800 | NE | 37J | 9,000 | 3-NA-SB03-00 | 34/58 | 1 | NA | Scattered |
| | | Benzo(a)pyrene | 88 | NE | 38J | 8,700 | 3-NA-SB03-00 | 30/58 | 20 | NA | Scattered |
| | | Indeno(1,2,3-cd)pyrene | 880 | NE | 40J | 6,800 | 3-NA-SB03-00 | 26/58 | 5 | NA | Scattered |
| | | Dibenzo(a,h)anthracene | 88 | NE | 40J | 2,900 | 3-NA-SB03-00 | 16/58 | 6 | NA | North Area, Rail Spur, Treatment Area |
| | | Benzo(g,h,i)perylene | 230,000 | NE | 39J | 4700 | 3-NA-SB03-00 | 22/58 | 0 | NA | North Area, Rail Spur, Treatment Area |

**TABLE 5 (Continued)**

**SUMMARY OF THE ANALYTICAL RESULTS FOR SURFACE SOIL**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | RBC Residential Soils (mg/kg) | Base Background (mg/kg) | (mg/kg) | (mg/kg) | | | RBC Residential Soils | Base Background | |
| Surface Soils (Cont.) | Inorganics | Aluminum | 7,800 | 9,570 | 1,740 | 4,240 | 3-MW05-00 | 2/2 | 0 | 0 | -- |
| | | Barium | 550 | 20.8 | 6.4J | 7.8J | 3-MW05-00 | 2/2 | 0 | 0 | -- |
| | | Calcium | NE | 10,700 | 4,020 | 67,700 | 3-MW02IW-00 | 2/2 | NA | 1 | Treatment Area |
| | | Chromium | 39 | 12.5 | 2.7 | 7.1 | 3-MW02IW-00 | 2/2 | 0 | 0 | -- |
| | | Iron | 23,000 | 9,640 | 1,390 | 1,970 | 3-MW05-00 | 2/2 | 0 | 0 | -- |
| | | Lead | 400 | 142 | 4.4J | 4.4J | 3-MW02IW-00 | 1/2 | 0 | 0 | -- |
| | | Magnesium | NE | 610 | 150 | 1,020 | 3-MW02IW-00 | 2/2 | NA | 1 | Treatment Area |
| | | Manganese | 1,100 | 66 | 11.7 | 13.1 | 3-MW05-00 | 2/2 | 0 | 0 | -- |
| | | Sodium | NE | 126 | 112 | 112 | 3-MW02IW-00 | 1/2 | NA | 0 | -- |
| | | Vanadium | 55 | 28.3 | 3.3 | 5.2 | 3-MW05-00 | 2/2 | 0 | 0 | -- |
| | | Zinc | 2,300 | 2.4 | 16.6 | 16.6 | 3-MW02IW-00 | 1/2 | 0 | 0 | -- |

Notes:

[1] Shaded blocks indicate detections above comparison criteria.

NE = No criteria established
NA = Not applicable
J = Estimated value
RBC = Risk-Based Concentration
µg/kg = microgram per kilogram (ppb)
mg/kg = milligram per kilogram (ppm)

Reference: Baker Environmental, Inc. 1996. Remedial Investigation Report Operable Unit No. 12 (Site 3). Marine Corps Base, Camp Lejeune, North Carolina.

## TABLE 6

## SUMMARY OF THE ANALYTICAL RESULTS FOR SUBSURFACE SOIL
## REMEDIAL INVESTIGATION, 1994-95
## OPERABLE UNIT NO. 12 (SITE 3)
## MCB CAMP LEJEUNE, NORTH CAROLINA

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | RBC Residential Soils (µg/kg) | | (µg/kg) | (µg/kg) | | | RBC Residential Soils | | |
| Subsurface Soils | Volatile Organic Compounds | Acetone | 780,000 | NE | 120 | 120 | 3-NA-SB17A-02 | 1/18 | 0 | NA | North Area |
| | | Carbon Disulfide | 780,000 | NE | 1J | 1J | 3-MW12-02 | 1/18 | 0 | NA | West of North Area |
| | | Chloroform | 100,000 | NE | 3J | 3J | 3-MW11IW-08 | 1/18 | 0 | NA | West of Treatment Area |
| | | 2-Butanone | 4,700,000 | NE | 3J | 3J | 3-NA-SB19-02 | 1/18 | 0 | NA | North Area |
| | | Benzene | 22,000 | NE | 2J | 2J | 3-MW02IW-03 | 2/18 | 0 | NA | Treatment Area |
| | | Toluene | 1,600,000 | NE | 3J | 13 | 3-TA-SB49-04 | 4/18 | 0 | NA | Treatment Area |
| | | Ethylbenzene | 780,000 | NE | 3J | 110 | 3-TA-SB49-04 | 4/18 | 0 | NA | Treatment Area |
| | | Styrene | 1,600,000 | NE | 4J | 5J | 3-MW09-02 | 2/18 | 0 | NA | Treatment Area |
| | | Xylenes (total) | 16,000,000 | NE | 7J | 300 | 3-TA-SB49-04 | 4/18 | 0 | NA | Treatment Area |
| | Semivolatile Organic Compounds | Phenol | 4,700,000 | NE | 7,200J | 7,200J | 3-TA-SB48-08 | 1/47 | 0 | NA | Treatment Area |
| | | 2-Methylphenol | 390,000 | NE | 2,000J | 2,000J | 3-TA-SB48-08 | 1/47 | 0 | NA | Treatment Area |
| | | 4-Methylphenol | 39,000 | NE | 5,900J | 5,900J | 3-TA-SB48-08 | 1/47 | 0 | NA | Treatment Area |
| | | Naphthalene | 310,000 | NE | 55J | 95,000 | 3-TA-SB48-08 | 9/47 | 0 | NA | Treatment Area |
| | | 2-Methylnaphthalene | 310,000 | NE | 100J | 31,000 | 3-TA-SB48-08 | 6/47 | 0 | NA | Treatment Area |
| | | Acenaphthylene | 230,000 | NE | 190J | 190J | 3-MW02IW-09 | 1/47 | 0 | NA | Treatment Area |
| | | Acenaphthene | 470,000 | NE | 560 | 47,000 | 3-TA-SB48-08 | 6/47 | 0 | NA | Treatment Area |
| | | 4-Nitrophenol | 480,000 | NE | 570J | 570J | 3-TA-SB50-04 | 1/47 | 0 | NA | Treatment Area |
| | | Dibenzofuran | 31,000 | NE | 440 | 36,000J | 3-TA-SB48-08 | 6/47 | 0 | NA | Treatment Area |
| | | Fluorene | 310,000 | NE | 710 | 35,000J | 3-TA-SB48-08 | 6/47 | 0 | NA | Treatment Area |
| | | N-nitrosodiphenylamine | 13,000 | NE | 400J | 1,100J | 3-TA-SB48-08 | 2/47 | 0 | NA | Treatment Area |
| | | Phenanthrene | 230,000 | NE | 61J | 110,000J | 3-TA-SB50-04 | 8/47 | 0 | NA | Treatment Area |
| | | Anthracene | 2,300,000 | NE | 42J | 12,000J | 3-TA-SB48-08 | 7/47 | 0 | NA | Treatment Area |
| | | Carbazole | 32,000 | NE | 200J | 4,900 | 3-TA-SB50-04 | 6/47 | 0 | NA | Treatment Area |
| | | di-n-Butyl-phthalate | 780,000 | NE | 39J | 170J | 3-TA-SB43-03 | 18/47 | 0 | NA | Scattered |
| | | Fluoranthene | 310,000 | NE | 51J | 66,000 | 3-TA-SB50-04 | 7/47 | 0 | NA | Treatment Area |

**TABLE 6 (Continued)**

**SUMMARY OF THE ANALYTICAL RESULTS FOR SUBSURFACE SOIL**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | RBC Residential Soils (µg/kg) | | (µg/kg) | (µg/kg) | | | RBC Residential Soils | | |
| Subsurface Soils (Cont.) | | Pyrene | 230,000 | NE | 43J | 38,000J | 3-TA-SB48-08 | 10/47 | 0 | NA | Treatment Area, North Area, Rail Spur |
| | | Benzo(a)anthracene | 880 | NE | 77J | 8,000 | 3-TA-SB50-04 | 7/47 | 5 | NA | Treatment Area |
| | | Chrysene | 88,000 | NE | 86J | 8,400J | 3-TA-SB48-08 | 7/47 | 0 | NA | Treatment Area |
| | | Bis(2-ethylhexyl)phthalate | 46,000 | NE | 53J | 240J | 3-MW11IW-08 | 2/47 | 0 | NA | West of Treatment Area |
| | | Benzo(b)fluoranthene | 880 | NE | 96J | 3,500J | 3-TA-SB48-08 | 7/47 | 4 | NA | Treatment Area |
| | | Benzo(k)fluoranthene | 8,800 | NE | 79J | 3,300J | 3-TA-SB50-04 | 6/47 | 0 | NA | Treatment Area |
| | | Benzo(a)pyrene | 88 | NE | 55J | 3,300J | 3-TA-SB48-08 | 7/47 | 6 | NA | Treatment Area |
| | | Indeno(1,2,3-cd)pyrene | 880 | NE | 46J | 3,100J | 3-TA-SB48-08 | 5/47 | 1 | NA | Treatment Area |
| | | Benzo(g,h,i)perylene | 230,000 | NE | 71J | 1,200J | 3-TA-SB48-08 | 4/47 | 0 | NA | Treatment Area |
| | | | RBC Residential Soils (mg/kg) | Base Background (mg/kg) | (mg/kg) | (mg/kg) | | | RBC Residential Soils | Base Background | |
| | Inorganics | Aluminum | 7,800 | 11,000 | 3,950 | 6,570 | 3-MW021W-03 | 2/2 | 0 | 0[2] | -- |
| | | Barium | 550 | 22.6 | 4.6J | 6.6J | 3-MW02IW-03 | 2/2 | 0 | 0 | -- |
| | | Calcium | NE | 4,410 | 77.4 | 638 | 3-MW02IW-03 | 2/2 | NA | 0 | -- |
| | | Chromium | 39 | 66.4 | 3.7 | 7.5 | 3-MW02IW-03 | 2/2 | 0 | 0 | -- |
| | | Iron | 23,000 | 90,500 | 734 | 1,030 | 3-MW02IW-03 | 2/2 | 0 | 0 | -- |
| | | Lead | 400 | 21.4 | 5.7J | 5.7J | 3-MW02IW-03 | 1/2 | 0 | 0 | -- |
| | | Magnesium | NE | 852 | 104 | 112 | 3-MW02IW-03 | 2/2 | NA | 0 | -- |
| | | Manganese | 1,100 | 19.9 | 2.8J | 2.8J | 3-MW02IW-03 | 1/2 | 0 | 0 | -- |
| | | Vanadium | 55 | 69.4 | 3.7 | 5 | 3-MW02IW-03 | 2/2 | 0 | 0 | -- |

**TABLE 6 (Continued)**

**SUMMARY OF THE ANALYTICAL RESULTS FOR SUBSURFACE SOIL**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Notes:

(1) Shaded blocks indicate detections above comparison criteria.
(2) Detections compared to maximum base background concentrations.

NE = No criteria established
NA = Not applicable
J = Estimated value
RBC = Risk-Based Concentration
µg/kg = microgram per kilogram (ppb)
mg/kg = milligram per kilogram (ppm)

Reference: Baker Environmental, Inc., 1996. Remedial Investigation Report Operable Unit No. 12 (Site 3). Marine Corps Base, Camp Lejeune, North Carolina.

TABLE 7

SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER
REMEDIAL INVESTIGATION, 1994-95
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | MCL (µg/L) | NCWQS (µg/L) | (µg/L) | (µg/L) | | | MCL | NCWQS | |
| Groundwater - Surficial Aquifer (Round One) | Volatile Organic Compounds | Carbon Disulfide | NE | 700 | 1 J | 1 J | 3-MW07-01 | 1/2 | NA | 0 | Treatment Area |
| | | Benzene | 5 | 1 | 13J | 40J | 3-MW08-01 | 2/2 | 2[2] | 2 | Treatment Area |
| | | Toluene | 1,000 | 1,000 | 5 J | 10 J | 3-MW08-01 | 2/2 | 0 | 0 | Treatment Area |
| | | Xylenes (total) | 10,000 | 530 | 6 J | 9 J | 3-MW08-01 | 2/2 | 0 | 0 | Treatment Area |
| | Semivolatile Organic Compounds | Phenol | NE | 300 | 3 J | 3 J | 3-MW02-01 | 1/7 | NA | 0 | Treatment Area |
| | | 2-Methylphenol | NE | NE | 1 J | 1 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | 4-Methylphenol | NE | NE | 3 J | 3 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | 2-Nitrophenol | NE | NE | 2 J | 2 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | 2,4-Dimethylphenol | NE | NE | 2 J | 2 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | Naphthalene | NE | 21 | 5 J | 64 | 3-MW02-01 | 4/7 | NA | 1 | Treatment Area |
| | | 2-Methylnaphthalene | NE | NE | 65 | 65 | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | Acenaphthylene | NE | 210 | 3 J | 3 J | 3-MW02-01 | 1/7 | NA | 0 | Treatment Area |
| | | Acenaphthene | NE | 800 | 2 J | 280 | 3-MW02-01 | 2/7 | NA | 0 | Treatment Area |
| | | Dibenzofuran | NE | NE | 2 J | 230 | 3-MW02-01 | 2/7 | NA | NA | Treatment Area |
| | | Fluorene | NE | 280 | 1 J | 210 | 3-MW02-01 | 2/7 | NA | 0 | Treatment Area |
| | | Phenanthrene | NE | 210 | 410 | 410 | 3-MW02-01 | 1/7 | NA | 1 | Treatment Area |
| | | Anthracene | NE | 2,100 | 33 | 33 | 3-MW02-01 | 1/7 | NA | 0 | Treatment Area |
| | | Carbazole | NE | NE | 39 J | 39 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | di-n-Butylphthalate | NE | 700 | 1 J | 1 J | 3-MW02-01 | 1/7 | NA | 0 | Treatment Area |
| | | Fluoranthene | NE | 280 | 100 | 100 | 3-MW02-01 | 1/7 | NA | 0 | Treatment Area |
| | | Pyrene | NE | 210 | 58 | 58 | 3-MW02-01 | 1/7 | NA | 0 | Treatment Area |
| | | Benzo(a)anthracene | NE | 0.05 | 8 J | 8 J | 3-MW02-01 | 1/7 | NA | 1 | Treatment Area |
| | | Chrysene | NE | 5 | 8 J | 8 J | 3-MW02-01 | 1/7 | NA | 1 | Treatment Area |
| | | Benzo(b)fluroanthene | NE | NE | 3 J | 3 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | Benzo(k)fluoranthene | NE | NE | 3 J | 3 J | 3-MW02-01 | 1/7 | NA | NA | Treatment Area |
| | | Benzo(a)pyrene | 2 | NE | 3 J | 3 J | 3-MW02-01 | 1/7 | 1 | NA | Treatment Area |

TABLE 7 (Continued)

SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER
REMEDIAL INVESTIGATION, 1994-95
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | MCL (µg/L ) | NCWQS (µg/L) | (µg/L) | (µg/L) | | | MCL | NCWQS | |
| Groundwater - Surficial Aquifer (Round One) | Inorganics | Aluminum | 50 | NE | 447 | 4,030 | 3-MW08-01 | 2/2 | 2 | NA | -- |
| | | Barium | 2,000 | 2,000 | 88.1 | 120 | 3-MW07-01 | 2/2 | 0 | 0 | -- |
| | | Calcium | NE | NE | 2,870 | 3,870 | 3-MW08-01 | 2/2 | 0 | 0 | -- |
| | | Chromium | 100 | 50 | 31.6 | 31.6 | 3-MW08-01 | 1/2 | 0 | 0 | -- |
| | | Iron | 300 | 300 | 840 | 2,190 | 3-MW08-01 | 2/2 | 2 | 2 | -- |
| | | Lead | 15 | 15 | 3.2J | 3.2J | 3-MW08-01 | 1/2 | 0 | 0 | -- |
| | | Magnesium | NE | NE | 2,080 | 4,200 | 3-MW07-01 | 2/2 | NA | NA | -- |
| | | Manganese | 50 | 50 | 17.1J | 21.7J | 3-MW08-01 | 2/2 | 0 | 0 | -- |
| | | Nickel | 100 | 100 | 34.1 | 34.1 | 3-MW08-01 | 1/2 | 0 | 0 | -- |
| | | Potassium | NE | NE | 1,490 | 1,900 | 3-MW08-01 | 2/2 | NA | NA | -- |
| | | Sodium | NE | NE | 4,750 | 8,890 | 3-MW08-01 | 2/2 | NA | NA | -- |
| | | Zinc | 500 | 2,100 | 114 | 114 | 3-MW08-01 | 1/2 | 0 | 0 | -- |
| Groundwater - Castle Hayne (Round One) | Volatile Organic Compounds | Benzene | 5 | 1 | 11 J | 11 J | 3-MW02IW-01 | 1/1 | 1 | 1 | -- |
| | | Toluene | 1,000 | 1,000 | 4 J | 4 J | 3-MW02IW-01 | 1/1 | 0 | 0 | -- |
| | | Xylenes (total) | 100,000 | 530 | 7 J | 7 J | 3-MW02IW-01 | 1/1 | 0 | 0 | -- |
| | Semivolatile Organic Compounds | Naphthalene | NE | 21 | 3 J | 3 J | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Acenaphthylene | NE | 210 | 3 J | 3 J | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Acenaphthene | NE | 800 | 95 | 95 | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Dibenzofuran | NE | NE | 57 | 57 | 3-MW02IW-01 | 1/1 | NA | NA | -- |
| | | Fluorene | NE | 280 | 59 | 59 | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Phenanthrene | NE | 210 | 75 | 75 | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Anthracene | NE | 2,100 | 5 J | 5 J | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Fluoranthene | NE | 280 | 10 | 10 | 3-MW02IW-01 | 1/1 | NA | 0 | -- |
| | | Pyrene | NE | 210 | 7 J | 7 J | 3-MW02IW-01 | 1/1 | NA | 0 | -- |

TABLE 7 (Continued)

SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER
REMEDIAL INVESTIGATION, 1994-95
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | MCL (µg/L) | NCWQS (µg/kg) | (µg/L) | (µg/L) | | | MCL | NCWQS | |
| Groundwater - Surficial Aquifer (Round Two) | Volatile Organic Compounds | Chloroform | 100 | 0.19 | 1 J | 1 J | 3-MW02-02 | 1/13 | 0 | 1 | Treatment Area |
| | | Trichloroethene | 5 | NE | 1 J | 1 J | 3-MW12-01 | 2/13 | 0 | NA | Treatment Area |
| | Semivolatile Organic Compounds | Naphthalene | NE | 21 | 4 J | 110 | 3-MW06-02 | 2/13 | NA | 1 | Rail Spur |
| | | 2-Methylnaphthalene | NE | NE | 10 | 10 | 3-MW06-02 | 1/13 | NA | NA | Rail Spur |
| | | Acenaphthene | NE | 800 | 24 | 24 | 3-MW06-02 | 1/13 | NA | 0 | Rail Spur |
| | | Dibenzofuran | NE | NE | 25 | 25 | 3-MW06-02 | 1/13 | NA | NA | Rail Spur |
| | | Fluorene | NE | 280 | 28 | 28 | 3-MW06-02 | 1/13 | NA | 0 | Rail Spur |
| | | Phenanthrene | NE | 210 | 21 | 21 | 3-MW06-02 | 1/13 | NA | 0 | Rail Spur |
| | | Anthracene | NE | 2,100 | 1 J | 1 J | 3-MW06-02 | 1/13 | NA | 0 | Rail Spur |
| | | Carbazole | NE | NE | 10 | 10 | 3-MW06-02 | 1/13 | NA | NA | Rail Spur |
| | | Fluoranthenene | NE | 280 | 2 J | 2 J | 3-MW06-02 | 1/13 | NA | 0 | Rail Spur |
| | | bis(2-Ethylhexyl)phthalate | 6 | 3 | 2 J | 11 | 3-MW09-01 | 4/13 | 1 | 2 | Scattered |

**TABLE 7 (Continued)**

**SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER**
**REMEDIAL INVESTIGATION, 1994-95**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | MCL (µg/L) | NCWQS (µg/L) | (µg/L) | (µg/L) | | | MCL | NCWQS | |
| Groundwater - Castle Hayne (Round Two) | Volatile Organic Compounds | 1,1-Dichloroethene | 7 | 7 | 1 J | 1 J | 3-MW02IW-02 | 1/3 | 0 | 0 | Treatment Area |
| | | Chloroform | 100 | 0.19 | 1 J | 1 J | 3MW11IW-01 | 1/3 | 0 | 1 | West of Treatment Area |
| | | Trichloroethene | 5 | NE | 1 J | 1 J | 3-MW02IW-02 | 1/3 | 0 | NA | Treatment Area |
| | | Benzene | 5 | 1 | 3 J | 3 J | 3-MW02DW-01 | 2/3 | 0 | 1 | Treatment Area |
| | | Toluene | 1,000 | 1000 | 2 J | 15 J | 3-MW02DW-01 | 1/3 | 0 | 0 | Treatment Area |
| | | Ethylbenzene | 700 | 29 | 14 J | 14 J | 3-MW02DW-01 | 1/3 | 0 | 0 | Treatment Area |
| | | Xylenes (total) | 10,000 | 530 | 32 J | 32 J | 3-MW02DW-01 | 1/3 | 0 | 0 | Treatment Area |
| | Semivolatile Organic Compounds | Phenol | NE | 300 | 430 J | 430 J | 3-MW02DW-01 | 1/3 | NA | 1 | Treatment Area |
| | | 2-Methylphenol | NE | NE | 300 J | 300 J | 3-MW02DW-01 | 1/3 | NA | NA | Treatment Area |
| | | 4-Methylphenol | NE | NE | 690 J | 690 J | 3-MW02DW-01 | 1/3 | NA | NA | Treatment Area |
| | | 2,4-Dimethylphenol | NE | NE | 170 J | 170 J | 3-MW02DW-01 | 1/3 | NA | NA | Treatment Area |
| | | Naphthalene | NE | 21 | 2,400 J | 2,400 J | 3-MW02DW-01 | 1/3 | NA | 1 | Treatment Area |
| | | 2-Methylnaphthalene | NE | NE | 250 J | 250 J | 3-MW02DW-01 | 1/3 | NA | 0 | Treatment Area |
| | | Acenaphthylene | NE | 210 | 1 J | 1 J | 3-MW02DW-01 | 1/3 | NA | NA | Treatment Area |
| | | Acenaphthene | NE | 800 | 34 | 320 J | 3-MW02IW-02 | 2/3 | NA | 0 | Treatment Area |
| | | Dibenzofuran | NE | NE | 17 | 140 J | 3-MW02DW-01 | 2/3 | NA | 0 | Treatment Area |
| | | Fluorene | NE | 280 | 23 | 160 J | 3-MW02DW-01 | 2/3 | NA | NA | Treatment Area |
| | | Phenanthrene | NE | 210 | 130 J | 130 J | 3-MW02DW-01 | 1/3 | NA | 0 | Treatment Area |
| | | Anthracene | NE | 2,100 | 3 J | 13 J | 3-MW02DW-01 | 2/3 | NA | 0 | Treatment Area |
| | | Carbazole | NE | NE | 3 J | 87 J | 3-MW02DW-01 | 2/3 | NA | 0 | Treatment Area |
| | | Fluoranthene | NE | 280 | 17 | 21 J | 3-MW02DW-01 | 2/3 | NA | 0 | Treatment Area |
| | | Pyrene | NE | 210 | 11 | 14 J | 3-MW02DW-01 | 2/3 | NA | 0 | Treatment Area |

TABLE 7 (Continued)

SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER
REMEDIAL INVESTIGATION, 1994-95
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| | | | MCL (µg/L) | NCWQS (µg/L) | (µg/L) | (µg/L) | | | MCL | NCWQS | |
| Groundwater - Surficial Aquifer (Round Three) | Volatile Organic Compounds | Benzene | 5 | 1 | 3 J | 3 J | 3-MW02-03 | 1/13 | 0 | 1 | Treatment Area |
| | | Toluene | 1,000 | 1,000 | 8 J | 11 | 3-MW02-03 | 2/13 | 0 | 0 | Treatment Area |
| | | Ethylbenzene | 700 | 29 | 1 J | 10 | 3-MW02-03 | 2/13 | 0 | 0 | Treatment Area |
| | | Xylenes (total) | 10,000 | 530 | 20 | 20 | 3-MW02-03 | 1/13 | 0 | 0 | Treatment Area |
| | Semivolatile Organic Compounds | Phenol | NE | 300 | 68 | 68 | 3-MW02-03 | 1/13 | NA | 0 | Treatment Area |
| | | 2-Methylphenol | NE | NE | 160 J | 160 J | 3-MW02-03 | 1/13 | NA | NA | Treatment Area |
| | | 4-Methylphenol | NE | NE | 200 J | 200 J | 3-MW02-03 | 1/13 | NA | NA | Treatment Area |
| | | 2,4-Dimethylphenol | NE | NE | 64 J | 64 J | 3-MW02-03 | 1/13 | NA | NA | Treatment Area |
| | | Naphthalene | NE | 21 | 360 | 1,500 | 3-MW02-03 | 2/13 | NA | 2 | Treatment Area |
| | | 2-Methylnaphthalene | NE | NE | 23 | 94 | 3-MW02-03 | 2/13 | NA | NA | Treatment Area |
| | | Acenaphthylene | NE | 210 | 2 J | 2 J | 3-MW02-03 | 1/13 | NA | 0 | Treatment Area |
| | | Acenaphthene | NE | 800 | 45 J | 55 | 3-MW02-03 | 2/13 | NA | 0 | Treatment Area |
| | | Dibenzofuran | NE | NE | 24 | 120 J | 3-MW02-03 | 2/13 | NA | NA | Treatment Area |
| | | Fluorene | NE | 280 | 20 | 80 | 3-MW02-03 | 2/13 | NA | 0 | Treatment Area |
| | | Phenanthrene | NE | 210 | 23 | 97 J | 3-MW02-03 | 2/13 | NA | 0 | Treatment Area |
| | | Anthracene | NE | 2,100 | 5 NJ | 5 NJ | 3-MW02-03 | 1/13 | NA | 0 | Treatment Area |
| | | Carbazole | NE | NE | 11 J | 82 | 3-MW02-03 | 2/13 | NA | NA | Treatment Area |
| | | Fluoranthene | NE | 280 | 3 J | 10 J | 3-MW02-03 | 2/13 | NA | 0 | Treatment Area |
| | | Pyrene | NE | 210 | 2 J | 8 J | 3-MW02-03 | 2/13 | NA | 0 | Treatment Area |
| | | bis(2-Ethylhexyl)phthalate | 6 | 3 | 1 J | 1 J | 3-MW02-03 | 2/13 | 0 | 0 | Treatment Area |

TABLE 7 (Continued)

SUMMARY OF THE ANALYTICAL RESULTS FOR GROUNDWATER
REMEDIAL INVESTIGATION, 1994-95
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Environmental Medium | Fraction | Constituent | Comparison Criteria | Comparison Criteria | Detection Summary | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min. Concentration | Max. Concentration | Max. Concentration Location | No. of Detections/ Total No. of Samples | Number of Detections Above Comparison Criteria[1] | Number of Detections Above Comparison Criteria[1] | Distribution |
| Groundwater - Castle Hayne (Round Three) | Semivolatile Organic Compounds | Phenol | NE | 300 | 1 J | 1 J | 3-MW11IW-02 | 1/3 | NA | 0 | Treatment Area |
| | | Naphthalene | NE | 21 | 4 J | 4 J | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |
| | | 2-Methylnaphthalene | NE | NE | 1 J | 1 J | 3-MW02IW-03 | 1/3 | NA | NA | Treatment Area |
| | | Acenaphthene | NE | 800 | 25 | 25 | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |
| | | Dibenzofuran | NE | NE | 29 | 29 | 3-MW02IW-03 | 1/3 | NA | NA | Treatment Area |
| | | Fluorene | NE | 280 | 35 | 35 | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |
| | | Phenanthrene | NE | 210 | 120 | 120 | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |
| | | Anthracene | NE | 2,100 | 11 NJ | 11 NJ | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |
| | | Carbazole | NE | NE | J | 4 J | 3-MW02IW-03 | 1/3 | NA | NA | Treatment Area |
| | | Fluoranthene | NE | 280 | 28 | 28 | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |
| | | Pyrene | NE | 210 | 16 | 16 | 3-MW02IW-03 | 1/3 | NA | 0 | Treatment Area |

Notes:

(1) Shaded blocks indicate detections above comparison criteria.

NE = No criteria established
NA = Not applicable
J =Estimated value
MCL = Federal Maximum Contaminant Level
NCWQS = North Carolina Water Quality Standard
NJ = Estimated value/tentative identification
µg/L = microgram per liter (ppb)

Reference: Baker Environmental, Inc., 1996. Remedial Investigation Report Operable Unit No. 12 (Site 3). Marine Corps Base, Camp Lejeune, North Carolina.

## TABLE 8

## CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT OPERABLE UNIT NO. 12 (SITE 3) MCB CAMP LEJEUNE, NORTH CAROLINA

| Contaminant | Surface Soil | Subsurface Soil | Round 2 Groundwater | Combined Rounds Groundwater |
|---|---|---|---|---|
| **Volatiles:** | | | | |
| 1,1-Dichloroethene | | | X | X |
| Chloroform | | | X | X |
| Trichloroethene | | | | |
| Benzene | | | X | X |
| Toluene | | | | |
| Ethylbenzene | | | | |
| Xylenes (total) | | | | |
| **Semivolatiles:** | | | | |
| Phenol | | | | |
| 2-Methylphenol | | | X | X |
| 4-Methylphenol | | | X | X |
| 2,4-Dimethylphenol | | | X | X |
| Naphthalene | | | X | X |
| 2-Methylnaphthalene | | | X | X |
| Acenaphthene | | | X | X |
| Acenaphthylene | | | | |
| Dibenzofuran | | X | X | X |
| Fluorene | | | X | X |
| Phenanthrene | | | X | X |
| Anthracene | | | | |
| Carbazole | | | X | X |
| Fluoranthene | | | | |
| Pyrene | | | | |
| Bis(2-ethylhexyl)phthalate | | | | |
| Benzo(a)anthracene | X | X | | X |
| Benzo(b)fluoranthene | X | X | | X |
| Chrysene | X | X | | X |
| Benzo(k)fluoranthene | X | X | | X |
| Benzo(a)pyrene | X | X | | X |
| Indeno(1,2,3-cd)pyrene | X | X | | |
| Dibenz(a,h)anthracene | X | | | |
| 2-Nitrophenol | | | | X |
| **Inorganics:** | | | | |
| Aluminum | | | | X |
| Chromium | | | | X |

X = Selected as a COPC for human health risk assessment.

**TABLE 9**

**SUMMARY OF HUMAN HEALTH RISKS**
**OPERABLE UNIT NO. 12 (SITE 3)**
**MCB CAMP LEJEUNE, NORTH CAROLINA**

| Receptors | Soil | | Round 2 Groundwater | | Worst Case Groundwater | | Total with Round 2 Groundwater Contamination | | Total with Worst Case Groundwater Contamination | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ICR | HI | ICR | HI | ICR | HI | ICR | HI | ICR | HI |
| Military Personnel | 1.7E-06 (100) | NA | NE | NE | NE | NE | 1.7E-06 | NA | 1.7E-06 | NA |
| Future Child Resident | 1.4E-05 (70)/(<1) | NA | 5.3E-06 (30) | 1.7 (100) | 7.5E-04 (100) | 2.3 (100) | 1.9E-05 | 1.7 | 7.6E-04 | 2.3 |
| Future Adult Resident | 5.4E-06 (39)/(<1) | NA | 1.1E-05 (61) | 0.7 (100) | 1.8E-03 (100) | 3.7 (100) | 1.7E-05 | 0.7 | 1.8E-03 | 3.7 |
| Future Construction Worker | 1.0E-07 (100) | <0.01 (100) | NE | NE | NE | NE | 1.7E-07 | <0.01 | 1.0E-07 | <0.01 |

Notes:

ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
Total = Soil + Groundwater
NE = Not evaluated for potential receptor
NA = Not applicable (no noncarcinogenic COPCs)
( ) = Percent contribution to total risk
( )/( ) = First is percent contribution to total risk with round 2 groundwater results; Second is percent contribution to total risk with worst case groundwater results (combined Rounds 1, 2, 3)

Shaded blocks indicate an ICR value that exceeds the acceptable limit of 1E-04, or an HI value that exceeds the acceptable limit of 1.0.

TABLE 10

CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
EVALUATED DURING THE ECOLOGICAL RISK ASSESSMENT
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

| Contaminant of Potential Concern in Surface Soil |
|---|
| **Inorganics** |
| Chromium |
| Zinc |
| **Semivolatiles** |
| Acenaphthylene |
| Anthracene |
| Benzo(a)anthracene |
| Benzo(b)fluoranthene |
| Benzo(k)fluoranthene |
| Benzo(g,h,i)perylene |
| Benzo(a)pyrene |
| Bis(2-ethylhexyl)phthalate |
| Carbazole |
| Chrysene |
| Dibenz(a,h)anthracene |
| Di-n-butylphthalate |
| Fluoranthene |
| Fluorene |
| Indeno(1,2,3-cd)pyrene |
| Phenanthrene |
| Pyrene |
| **Volatiles** |
| Ethylbenzene |
| Toluene |
| Xylenes |

TABLE 11

GLOSSARY OF EVALUATION CRITERIA
OPERABLE UNIT NO. 12 (SITE 3)
MCB CAMP LEJEUNE, NORTH CAROLINA

- **Overall Protection of Human Health and the Environment** - addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment engineering or institutional controls
- **Compliance with ARARs/TBCs** - addresses whether or not an alternative will meet the applicable or relevant and appropriate requirements (ARARs), criteria to-be-considered (TBCs), and other federal and state environmental statutes, and/or provide grounds for invoking a waiver.
- **Long-Term Effectiveness and Permanence** - refers to the magnitude of residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time once cleanup goals have been met.
- **Reduction of Toxicity, Mobility, or Volume Through Treatment** - refers to the anticipated performance of the treatment options that may be employed within an alternative.
- **Short-Term Effectiveness** - refers to the speed with which the alternative achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may occur during the construction and implementation period.
- **Implementability** - refers to the technical and administrative feasibility of an alternative, including the availability of materials and services required to implement the chosen solution.
- **Cost** - includes capital and operation and maintenance costs. For comparative purposes, present worth values are provided.

# FIGURES

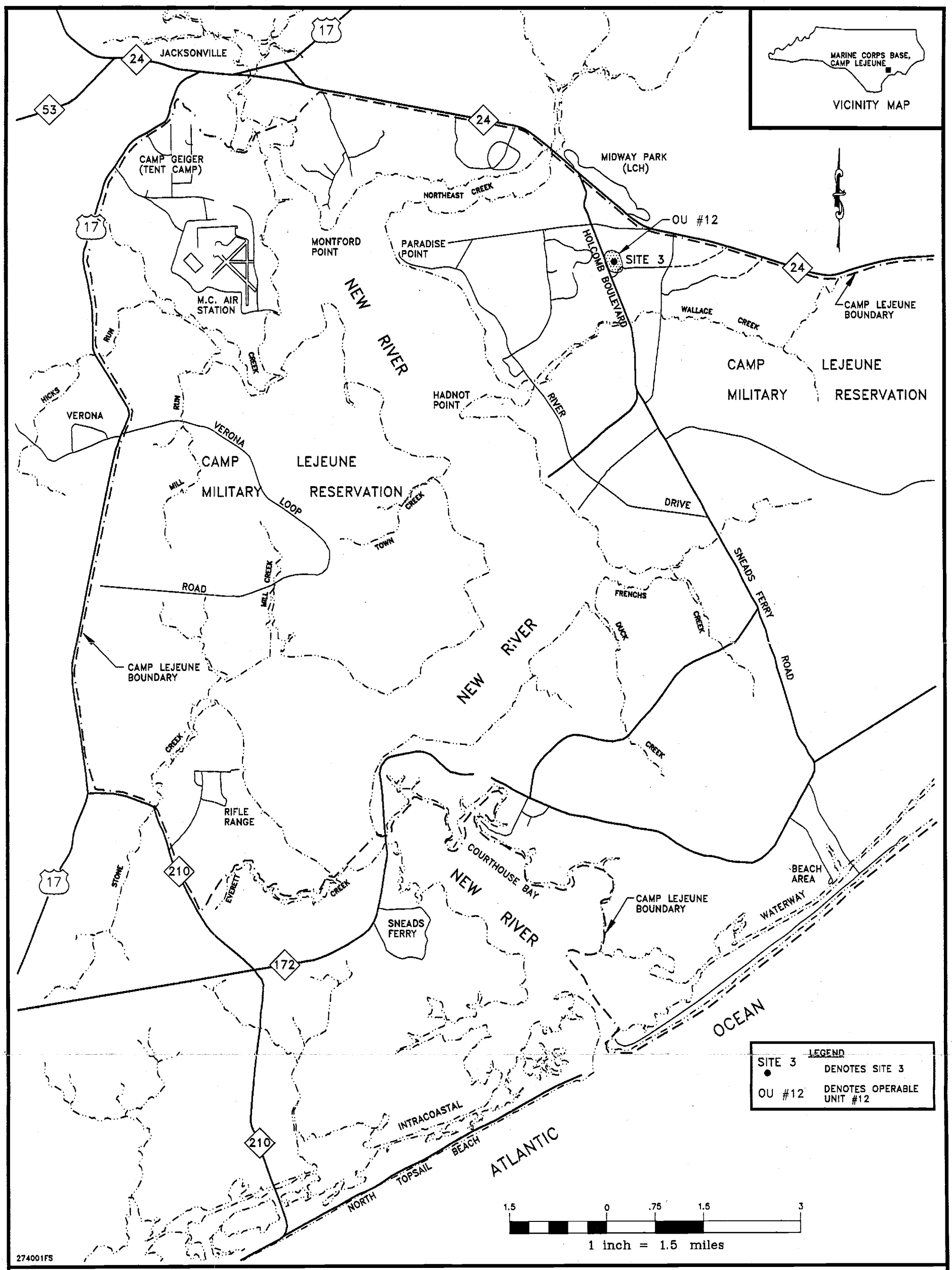
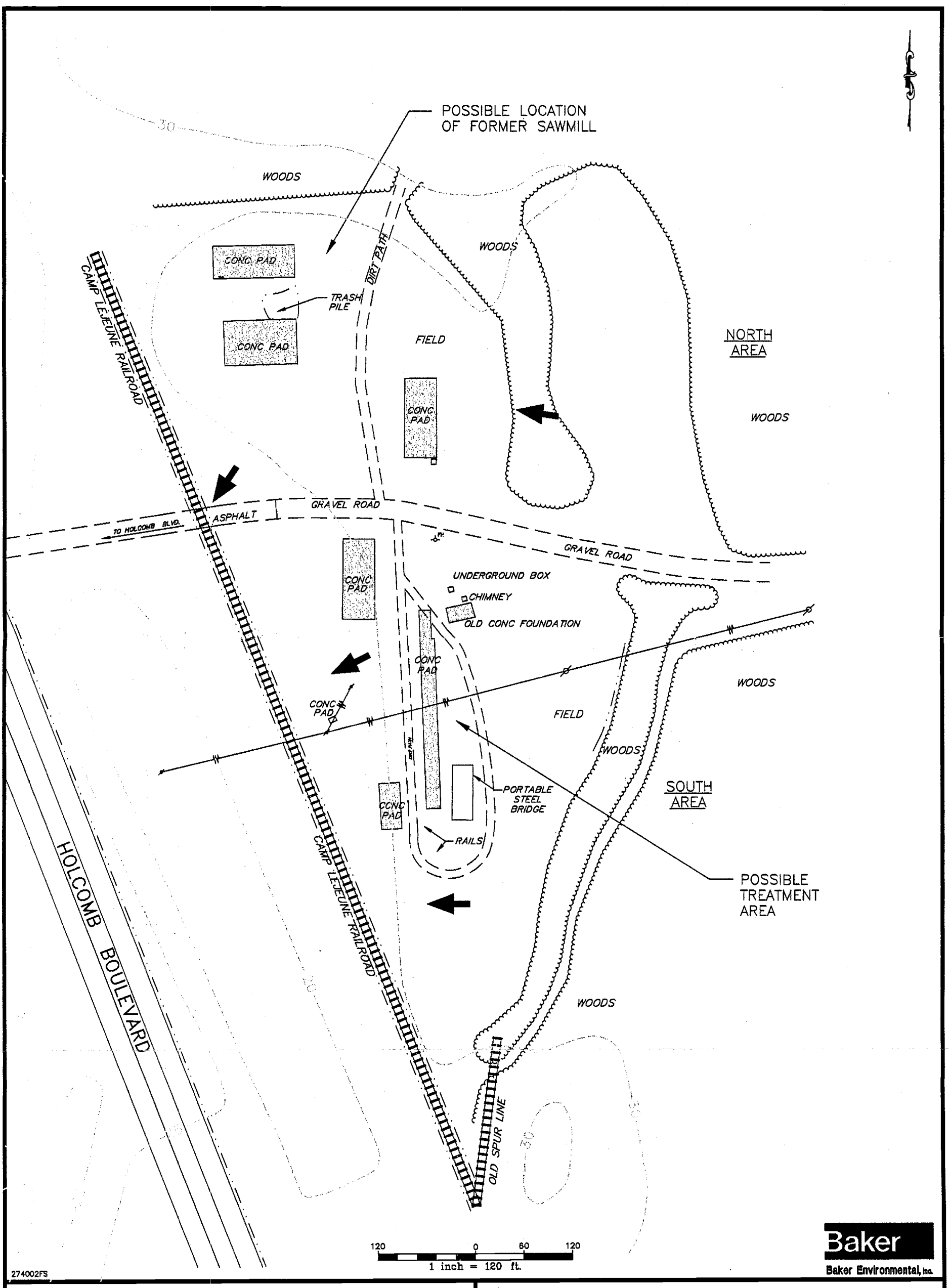



FIGURE 1

OPERABLE UNIT NO. 12 (SITE 3)
MARINE CORPS BASE, CAMP LEJEUNE

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

02132DDB1Z




LEGEND

— · · — DRAINAGE PATH

= = = GRAVEL ROAD/DIRT PATH

➡ GROUNDWATER FLOW DIRECTION IN THE SHALLOW AQUIFER

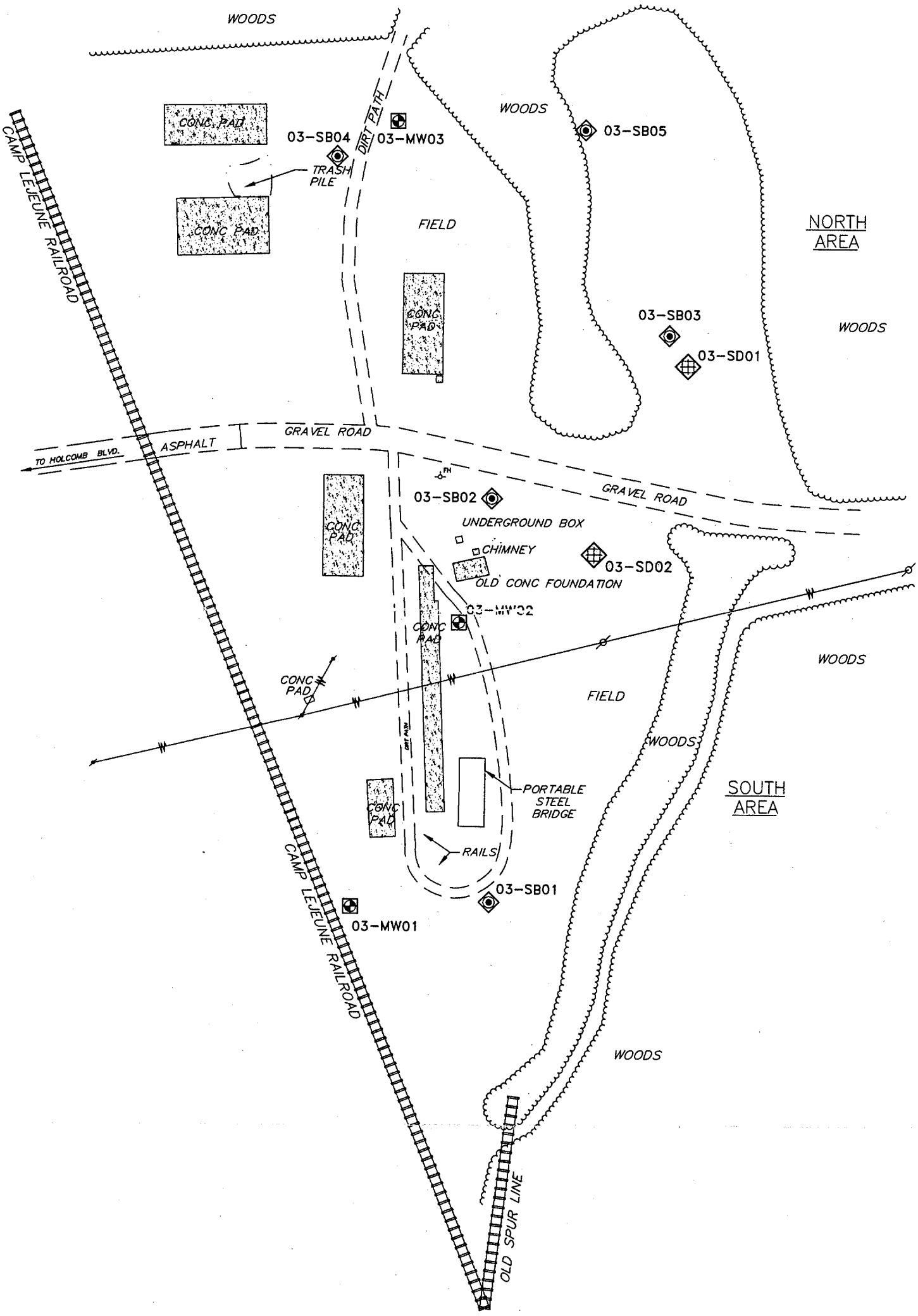
TOPOGRAPHIC ELEVATION LINE (FEET, MSL)

SOURCE: W.K. DICKSON & Co., INC., JANUARY 1995

FIGURE 2

SITE MAP
SITE 3 – OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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Baker

Baker Environmental, Inc.

## LEGEND

03-MW01 — MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

03-SB03 — SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

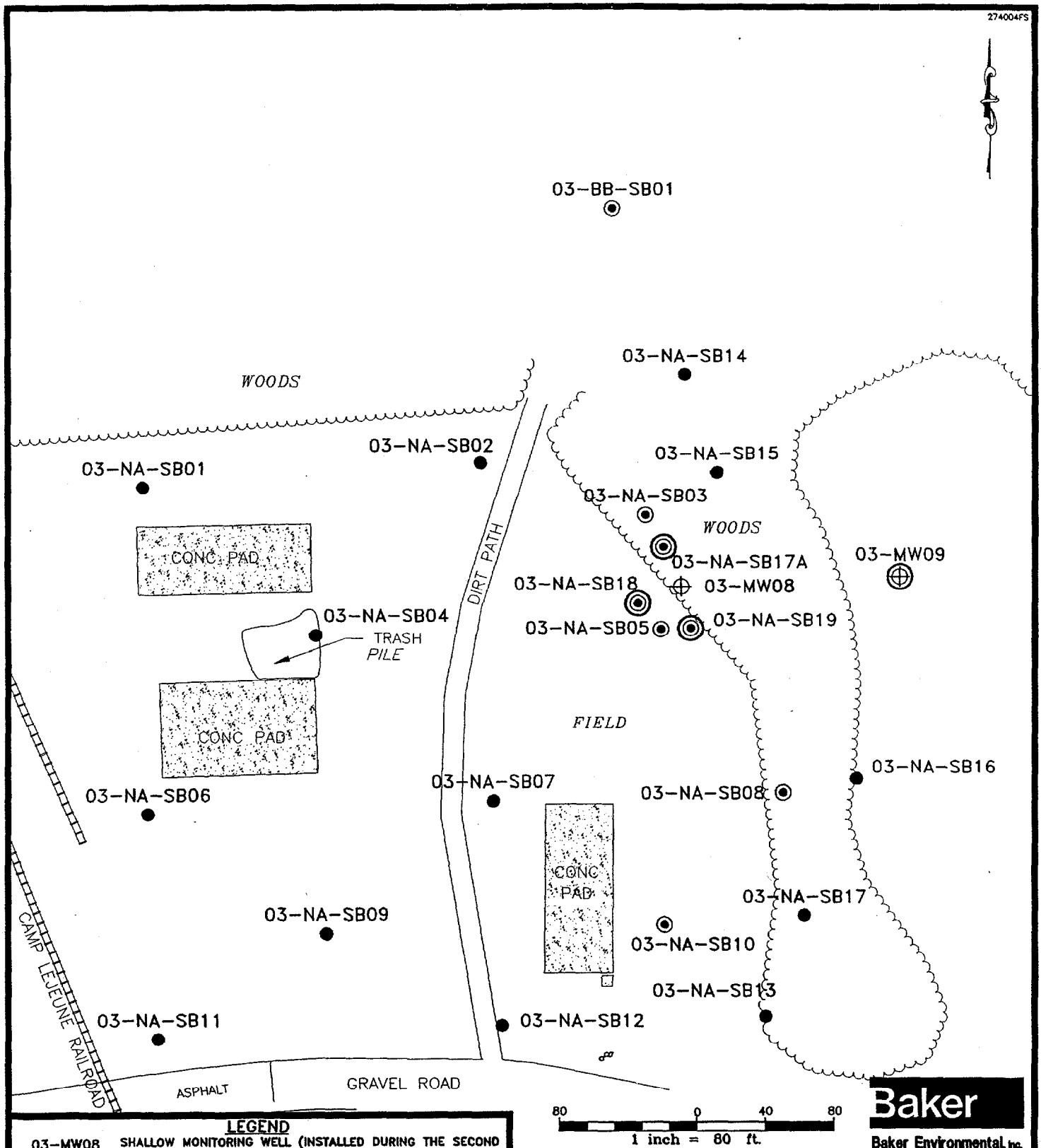
03-SD01 — SEDIMENT SAMPLE COLLECTED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: W.K. DICKSON & Co., INC., JANUARY 1995

# FIGURE 3

## SAMPLING LOCATIONS
## SITE INSPECTION, 1991
## SITE 3 – OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA




**LEGEND**

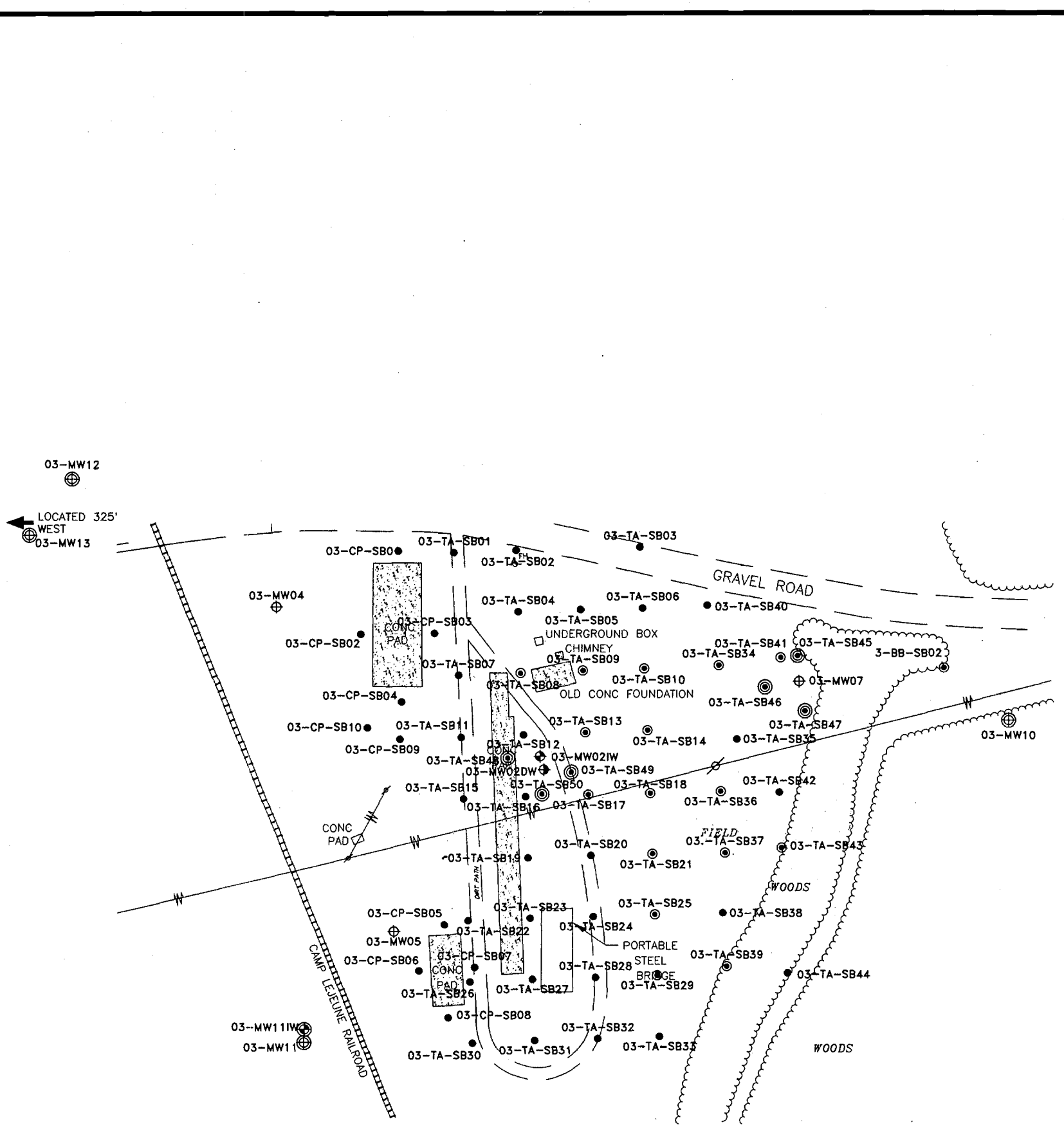
| | |
|---|---|
| 03-MW08 ⊕ | SHALLOW MONITORING WELL (INSTALLED DURING THE SECOND PHASE OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994). |
| 03-NA-SB03 ◉ | SOIL BORING LOCATION (INSTALLED DURING THE SECOND PHASE OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994). |
| 03-NA-SB01 ● | ENSYS SURFACE SOIL BORING (INSTALLED DURING THE FIRST PHASE OF THE SOIL INVESTIGATION SEPTEMBER 19 THROUGH SEPTEMBER 22, 1994). |
| 03-MW09 ⊕ | SHALLOW MONITORING WELL (INSTALLED DURING THE THIRD PHASE OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995). |
| 03-NA-SB17A ◉ | SOIL BORING LOCATION (INSTALLED DURING THE THIRD PHASE OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995). |

W.K. DICKSON & CO.,INC., JANUARY 1995

# FIGURE 4

## SOIL SAMPLING LOCATIONS REMEDIAL INVESTIGATION, 1994-95 SITE 3 - OLD CREOSOTE PLANT (NORTHERN AREA)

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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## LEGEND

- 03-MW04 — SHALLOW MONITORING WELL LOCATION (INSTALLED DURING THE SECOND PART OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994).
- 03-MW02IW — INTERMEDIATE MONITORING WELL LOCATION (INSTALLED DURING THE SECOND PART OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994).
- 03-TA-SB08 — SOIL BORING LOCATION (INSTALLED DURING THE FIRST AND SECOND PART OF THE SOIL INVESTIGATION AUGUST 19 THROUGH AUGUST 22, 1994 AND NOVEMBER 15 THROUGH NOVEMBER 22, 1994).
- 03-TA-SB01 — ENSYS SURFACE SOIL BORING (INSTALLED DURING THE FIRST PART OF THE SOIL INVESTIGATION AUGUST 19 THROUGH AUGUST 22, 1994).
- 03-MW10 — SHALLOW MONITORING WELL LOCATION (INSTALLED DURING THE THIRD PART OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995).
- 03-MW11IW — INTERMEDIATE MONITORING WELL LOCATION (INSTALLED DURING THE THIRD PART OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995).
- 03-MW02DW — DEEP MONITORING WELL LOCATION (INSTALLED DURING THE THIRD PART OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995).
- 03-TA-SB45 — SOIL BORING LOCATION (INSTALLED DURING THE THIRD PART OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995).

SOURCE: LANTDIV, OCT. 1991

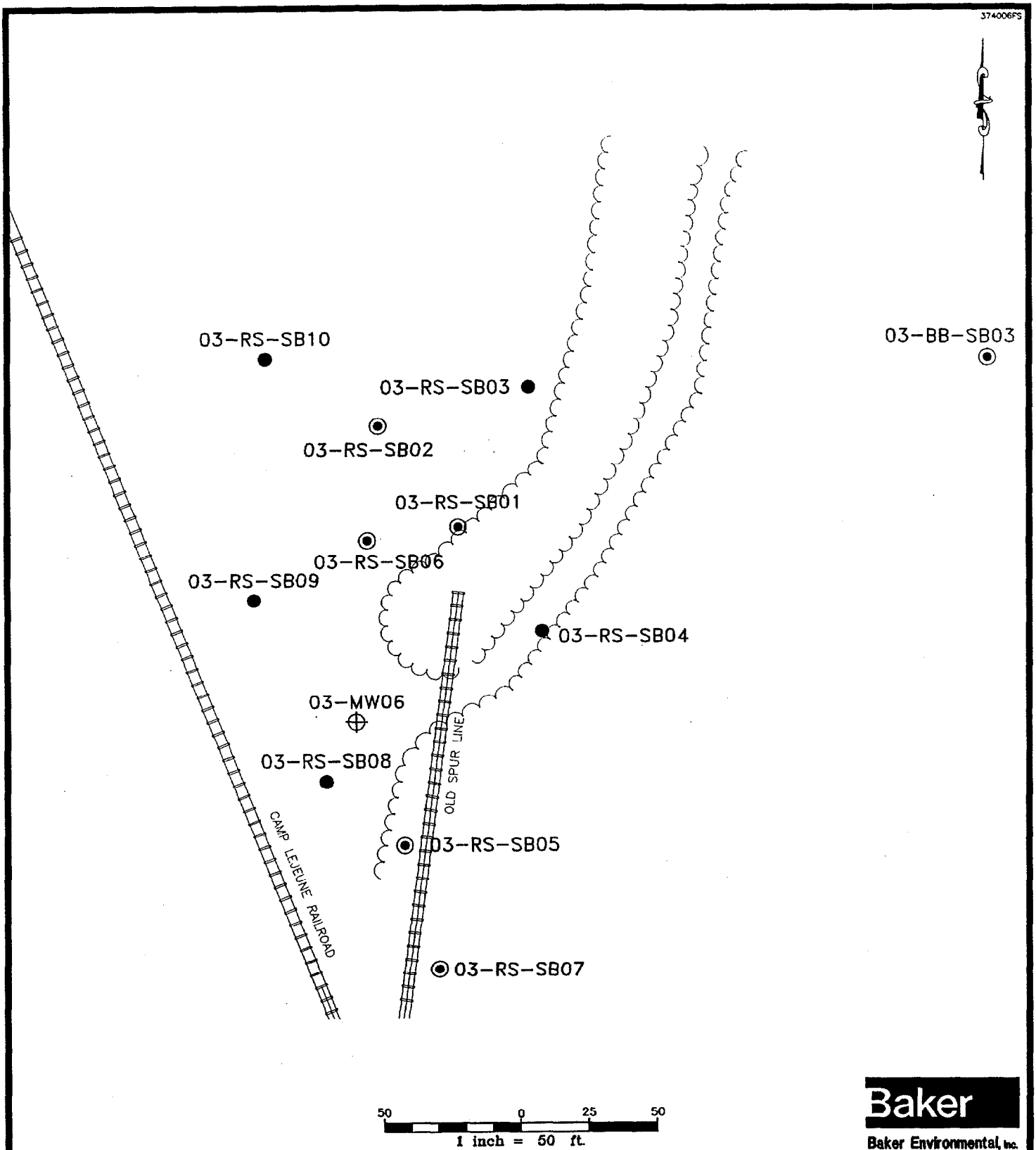
100 0 50 100
1 inch = 100 ft.

Baker
Baker Environmental, Inc.

# FIGURE 5
## SOIL SAMPLING LOCATIONS REMEDIAL INVESTIGATION, 1994-95 SITE 3 - OLD CREOSOTE PLANT (TREATMENT AND CONCRETE PAD AREAS)

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

02132DD01Z




## LEGEND

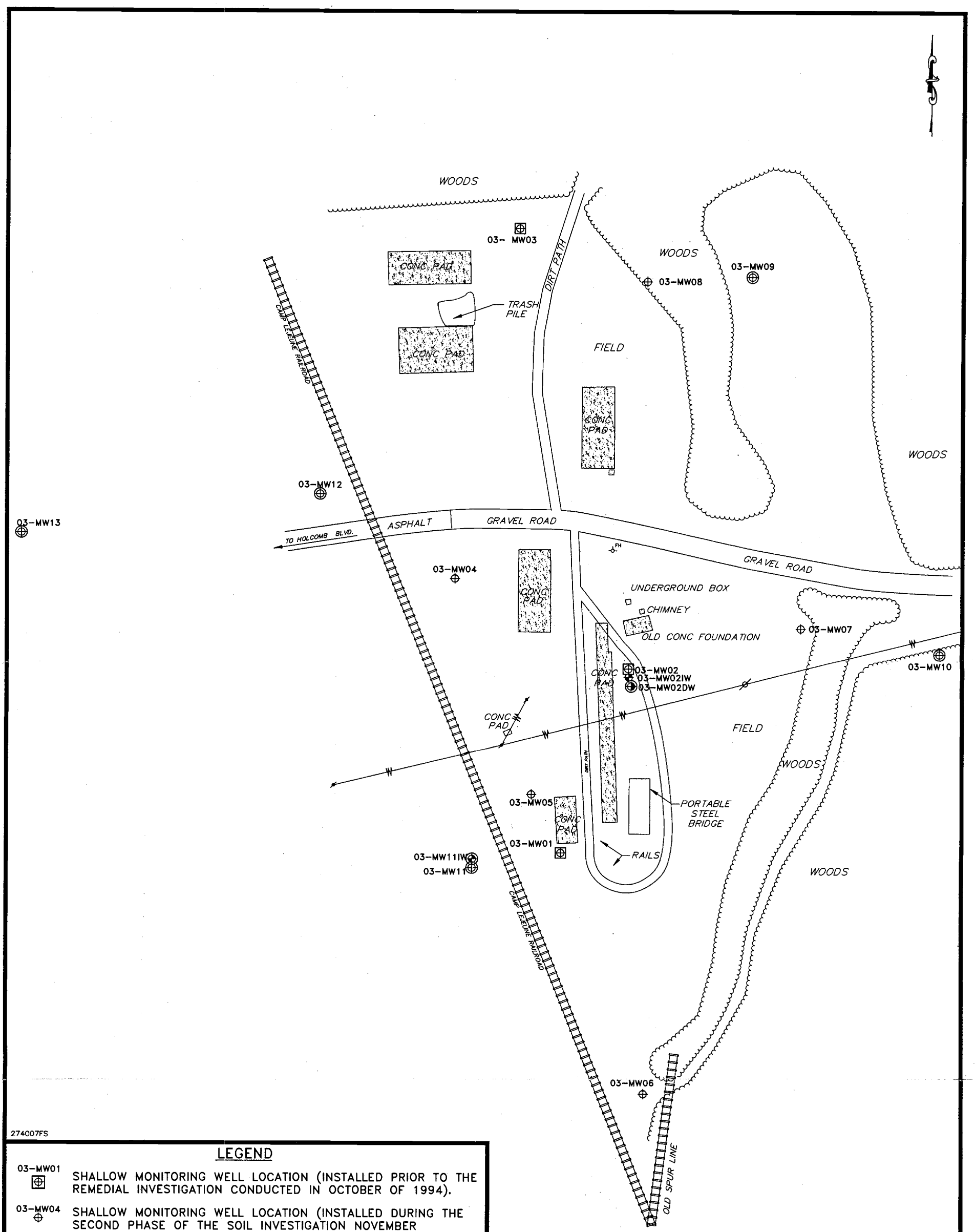
| | |
|---|---|
| 03-MW06 ⊕ | SHALLOW MONITORING WELL LOCATION (INSTALLED DURING THE SECOND PHASE OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994). |
| 03-RS-SB01 ◉ | SOIL BORING LOCATION (INSTALLED DURING THE SECOND PHASE OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994). |
| 03-RS-SB03 ● | ENSYS SURFACE SOIL BORING (INSTALLED DURING THE FIRST PHASE OF THE SOIL INVESTIGATION SEPTEMBER 19 THROUGH SEPTEMBER 22, 1994). |

SOURCE: W.K. DICKSON & CO., INC., JANUARY 1995

# FIGURE 6

## SOIL SAMPLING LOCATIONS REMEDIAL INVESTIGATION, 1994-95 SITE 3 - OLD CREOSOTE PLANT (RAIL SPUR AREA)

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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## LEGEND

| | |
|---|---|
| 03-MW01 | SHALLOW MONITORING WELL LOCATION (INSTALLED PRIOR TO THE REMEDIAL INVESTIGATION CONDUCTED IN OCTOBER OF 1994). |
| 03-MW04 | SHALLOW MONITORING WELL LOCATION (INSTALLED DURING THE SECOND PHASE OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994). |
| 03-MW02IW | INTERMEDIATE MONITORING WELL LOCATION (INSTALLED DURING THE SECOND PHASE OF THE SOIL INVESTIGATION NOVEMBER 15 THROUGH NOVEMBER 22, 1994). |
| 03-MW09 | SHALLOW MONITORING WELL LOCATION (INSTALLED DURING THE THIRD PHASE OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995). |
| 03-MW11IW | INTERMEDIATE MONITORING WELL LOCATION (INSTALLED DURING THE THIRD PHASE OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995). |
| 03-MW02DW | DEEP MONITORING WELL LOCATION (INSTALLED DURING THE THE THIRD PHASE OF THE SOIL INVESTIGATION JUNE 12 THROUGH JUNE 29, 1995). |

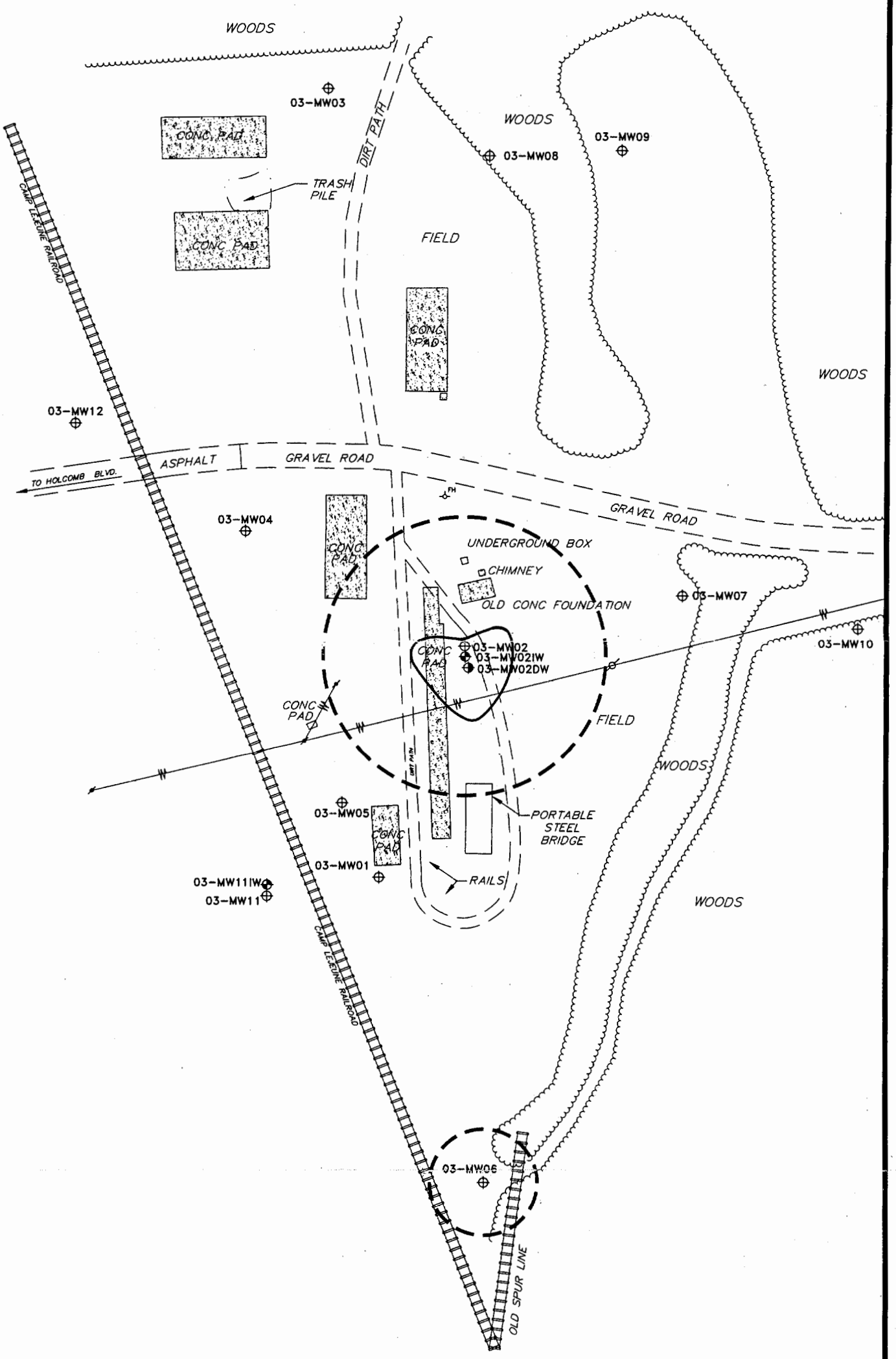
SOURCE: W.K. DICKSON & Co., INC., JANUARY 1995

# FIGURE 7

## GROUNDWATER SAMPLING LOCATIONS REMEDIAL INVESTIGATION, 1994-95 SITE 3 - OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

02132DDB/2




274009FS

Baker

Baker Environmental, Inc.

## LEGEND

- 03-MW01 ⊕ SHALLOW MONITORING WELL LOCATION
- 03-MW02IW ⊕ INTERMEDIATE MONITORING WELL LOCATION
- 03-MW02DW ⊕ DEEP MONITORING WELL LOCATION
- — — — GROUNDWATER AREA OF CONCERN (SHALLOW AQUIFER)
- ——— SUBSURFACE SOIL AREA OF CONCERN

SOURCE: W.K. DICKSON & Co., INC., JANUARY 1995

# FIGURE 8

## AREAS OF CONCERN
## SITE 3 – OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA