

Final

No Further Remedial Action Plan
Decision Document
Site 68
MCB, Camp Lejeune, North Carolina



Prepared For
Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

Contract No. N62470-95-D-6007
CTO-0120

April 6, 2000

Prepared by

CH2M HILL

Federal Group, Ltd.

Baker
Environmental, Inc.

CDM
Federal Programs Corp.

TABLE OF CONTENTS

	<u>Page</u>
ACRONYMS AND ABBREVIATIONS	iv
DECLARATION	vi
DECISION SUMMARY	1-1
1.0 INTRODUCTION	1-1
1.1 Site Location and Description	1-2
1.1.1 MCB, Camp Lejeune	1-2
1.1.2 Site 68.....	1-3
1.2 Site History and Enforcement Activities	1-3
1.2.1 Investigative Activities	1-4
1.2.2 Regulatory Agency/Public Involvement.....	1-8
1.3 Community Participation	1-8
2.0 SUMMARY OF SITE CHARACTERISTICS	2-1
2.1 Climatology.....	2-1
2.2 Physiography, Geology and Soils	2-1
2.3 Hydrogeology.....	2-1
2.4 Surface Water.....	2-2
2.5 Land Use	2-2
2.6 Receptors.....	2-3
3.0 DATA ANALYSIS/RISK ASSESSMENT	3-1
4.0 DESCRIPTION OF THE NFRAP ALTERNATIVE.....	4-1
5.0 RESPONSIVE SUMMARY	5-1

LIST OF TABLES

- 1-1 Organic and Inorganic Data

LIST OF FIGURES

- 1-1 Site Location Map
1-2 Site Map and Sample Locations, Site 68 Rifle Range Area (small scale)
1-3 Site Map and Sample Locations, Site 68 Rifle Range Area (large scale)

ATTACHMENTS

- A Land Use Control Implementation Plan
B State of North Carolina Approval Letter

- NEED TO REVIEW APPENDIX A.

ACRONYMS AND ABBREVIATIONS

Baker	Baker Environmental, Inc.
BEHP	bis(2-ethylhexyl)phthalate
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COC	Contaminant of Concern
DD	Decision Document
DoD	Department of Defense
DoN	Department of Navy
F	Fahrenheit
FFA	Federal Facilities Agreement
FS	Feasibility Study
HI	Hazard Index
HQ	Hazard Quotient
LANTDIV	Atlantic Division Naval Facilities Engineering Command
LUCIP	Land Use Control Implementation Plan
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
msl	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NC DENR	North Carolina Department of Environment and Natural Resources
NCWQS	North Carolina Water Quality Standards
NFRAP	No Further Response Action Plan
NPL	National Priorities List
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyls
Pre-RI	Pre-Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RA	Removal Action or Remedial Action
RBC	Risk-Based Concentrations
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
TAL	Target Analyte List
TCL	Target Compound List

ACRONYMS AND ABBREVIATIONS

USEPA	United States Environmental Protection Agency
USGS	United States Geologic Society
VOC	Volatile Organic Compound

DECLARATION

SITE NAME AND LOCATION

Site 68
Rifle Range Dump
Marine Corps Base, Camp Lejeune, North Carolina

STATEMENT OF BASIS

This No Further Remedial Action Plan (NFRAP) decision is based on the results of a Pre-Remedial Investigation (Pre-RI) Screening Study conducted at Site 68 in October 1995. The Pre-RI Screening Study included a review of previous investigations, completion of a geophysical survey, installation of groundwater monitoring wells, and associated soil and groundwater sampling.

DESCRIPTION OF THE SELECTED REMEDY

Based on the current conditions at Site 68, it has been determined that no threat to public health exists. Therefore, no further action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), is warranted.

DECLARATION STATEMENT

This NFRAP Decision Document represents the selected action for Site 68, developed in accordance with CERCLA, as amended by SARA, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Because contaminant levels at the site have been determined to present no known significant threat to human health, it has been determined that no further action is protective of human health, attains Federal and state requirements that are applicable or relevant and appropriate, and is cost-effective. The statutory preference for treatment is not satisfied because treatment was not found to be necessary. Even though it has been determined that there are no potential human health risks at Site 68, land use and aquifer use will be controlled because of the reported, but unverified, disposal of 2,000 gallons of solvents. These land and aquifer use controls are presented in the Land Use Control Implementation Plan (LUCIP) in Attachment A. A copy of the NC DENR approval letter is presented in Attachment B. These controls will be enforced until it is determined, through the five year review process, that no potential human health risks are posed by the potential solvent contamination.

WHAT ABOUT Ecological?

Signature
Major General R. G. Richard
Commanding General
Marine Corps Base, Camp Lejeune

Date

DECISION SUMMARY

1.0 INTRODUCTION

Marine Corps Base (MCB), Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List (NPL) on October 4, 1989 (54 Federal Register 41015, October 5, 1989). Subsequent to this listing, the United States Environmental Protection Agency (USEPA) Region IV; the North Carolina Department of Environment and Natural Resources (NC DENR); and the United States Department of the Navy (DoN) entered into a Federal Facilities Agreement (FFA) on December 6, 1989 for MCB, Camp Lejeune. The objectives of the FFA are:

- To ensure that the environmental impacts with past and present activities at MCB, Camp Lejeune are thoroughly investigated and appropriate CERCLA response actions are developed and implemented as necessary to protect the public health, welfare and the environment;
- To establish a procedural framework and schedule for developing, implementing and monitoring appropriate response actions at MCB, Camp Lejeune in accordance with CERCLA, the NCP, and USEPA policy relevant to remediation at MCB, Camp Lejeune; and
- To facilitate cooperation, exchange of information and participation of the parties in such action.

The Fiscal Year 2000 Site Management Plan for MCB, Camp Lejeune, the primary document referenced in the FFA, accounts for each of the sites at the base and provides detailed strategic planning. Many of the sites listed in the FFA have been investigated through the completion of Remedial Investigation/Feasibility Studies (RI/FS). However, several sites, (Site 68 included) did not warrant a full scale RI/FS. As such, these sites were investigated by completing Pre-Remedial Investigation (Pre-RI) Screening Studies. The goal of these investigations was to determine if a full RI study was necessary or if a decision of no further action was appropriate.

This NFRAP Decision Document (DD) supports no further action for Site 68 at the Rifle Range Dump, Camp Lejeune. The purpose of this NFRAP DD is to summarize the existing data for the site and to describe the Marine Corps' rationale for no further action. Even though it has been determined that there are no potential human health risks at Site 68, land use and aquifer use will be controlled because of the reported, but unverified, disposal of 2,000 gallons of solvents. These land and aquifer use controls are presented in the LUCIP in Attachment A. These controls will be enforced until it is determined, through the five year review process, that no potential human health risks are posed by ~~the~~ potential solvent contamination.

Decision Documents of this type can fall into four categories. The category into which a site is placed is determined by the investigation(s) that have been conducted at the site. They are divided as follows: Category I - NFRAP decision is based on the results of a Preliminary Assessment (PA), a PA supplement, or an equivalent effort; Category II - NFRAP decision based on the results of a Site Inspection (SI), a SI supplement, or an equivalent effort; Category III - NFRAP decision based on the results of a Remedial Investigation (RI) and, if required, a Feasibility Study (FS), or an equivalent effort; Category IV - NFRAP decision based on the completion of a removal action or remedial action (RA) (including interim actions), or an equivalent effort.

DELETE

equivalent effort; Category IV - NFRAP decision based on the completion of a removal action or remedial action (RA) (including interim actions), or an equivalent effort.

Site 68 is a Category II designation. The Pre-RI Screening Study was completed to determine if further investigations were warranted; this effort is equivalent to a SI. The Pre-RI Screening Study completed at Site 68 provides sufficient information about the history, nature of the site and the lack of contamination. Therefore, a Category II - NFRAP DD is herein presented in accordance with all Category II requirements.

The objectives of this NFRAP DD for Site 68 are:

- To briefly describe the location, history and environmental setting of Site 68 and its relationship to MCB, Camp Lejeune;
- To describe the current status of the site based on the results of the related investigations; and
- To assess the potential risks to human health at the site.

Data from the Pre-RI Screening Study were used to derive and support no further action for Site 68. The Pre-RI Screening Study was initiated to detect and characterize potential impacts to human health and to determine if the site required further investigative work. The investigation included a review of previous studies, soil sampling, permanent monitoring well installation, groundwater sampling, surface water sampling, sediment sampling, and a site survey.

1.1 Site Location and Description

To provide the reader with the entire framework of Site 68, the following subsections discussing site locations and descriptions for both MCB, Camp Lejeune and Site 68.

1.1.1 MCB, Camp Lejeune

MCB, Camp Lejeune is located on the coastal plain of North Carolina in Onslow County. The facility encompasses approximately 236 square miles and is bisected by the New River. The New River flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The southeastern border of MCB, Camp Lejeune is the Atlantic Ocean shoreline. The western and northeastern boundaries of the facility are U.S. Route 17 and State Route 24, respectively. The city of Jacksonville borders MCB, Camp Lejeune to the north.

Construction of MCB, Camp Lejeune began in April 1941 at the Hadnot Point Industrial Area, where major functions of the base are centered today. The facility was designed to be the "World's Most Complete Amphibious Training Base." The MCB, Camp Lejeune complex consists of six geographical locations under the jurisdiction of the Base Command. These areas include Camp Geiger, Montford Point, Courthouse Bay, Mainside, the Rifle Range Area and the Greater Sandy Run Area. Another area also overseen by MCB, Camp Lejeune is Camp Johnson which is located among the six geographical areas of Camp Lejeune.

Site 68 is located near the Rifle Range Area. Stone Bay Rifle Range was constructed in 1941 and was used for training Marine Corps Personnel.

1.1.2 Site 68

As shown on Figure 1-1, Site 68 is located near the Rifle Range Area in the southwest portion of the MCB, Camp Lejeune.

Figures 1-2 and 1-3 are site maps which show the boundary and features of the surrounding area. Site 68 is located to the west of Range Road, approximately 200 feet west of the Rifle Range Water Treatment Plant, and about 800 feet east of Stone Creek. The entire suspected disposal area is reported to be less than five acres in size.

Site 68 is accessed from the east, along the northern edge of the Rifle Range parking area. An improved dirt road leads into the center of the suspected disposal area. With the exception of the main road (Loop Road) which loops through the center of the site, the majority of the site is densely wooded. Evidence of clearing and ground disturbance was noted to the south and west of Loop Road on historical aerial photographs of the area. During the 1993 site visit, excavated trenches which contained construction debris and road asphalt, were observed west of Loop Road.

Currently, Loop Road is used as a fitness trail with exercise stations along the way. Evidence of military personnel activity and maneuvers are present throughout the suspected disposal area.

The flat topography of MCB, Camp Lejeune is typical of seaward portions of the North Carolina coastal plain. Elevations on the base vary from sea level to 72 feet above mean sea level (msl); however, most of the base is between 20 and 40 feet above msl. At Site 68, the site topography is variable with elevations ranging from 50 feet msl to the east to 5 feet msl to the northwest. Soil in this area is primarily sandy and favors rapid infiltration of surface precipitation. There is evidence that surface water runoff does occur in a northwest direction toward Stone Creek (ESE, 1990).

1.2 Site History and Enforcement Activities

Site 68 was reportedly used as a disposal facility for a period of 30 years from 1942 to 1973. Although not documented, an estimated 2,000 gallons of waste solvents were reportedly disposed in this area. In addition, it has been reported that approximately 100,000 cubic yards of various types of waste material (i.e., garbage, building debris and waste treatment sludge) were also disposed here. The suspected disposal area, less than 5-acres in size, lies within a 30 to 40-acre area. Signs of activity (i.e. deforested areas), were identified in historical aerial photographs (ESE, 1990).

Two investigations have been conducted at Site 68. They are detailed in the following subsections. No enforcement activities have occurred at Site 68.

The NCP states that sites which the USEPA determines to need no additional evaluation are given a "NFRAP" designation within the CERCLA Information System (CERCLIS). Through this designation, no supplemental investigation or remediation work will be performed at the site unless new information is presented indicating that the initial decision was not appropriate. This NFRAP DD presents the pertinent information that supports the conclusion that Site 68 poses little or no potential threat to human health.

1.2.1 Investigative Activities

The conditions at Site 68 have been evaluated through several separate investigative activities. The following subsections provide a summary of the previous studies completed at the site along with the results of the Pre-RI Screening Study.

1.2.1.1 Previous Investigations

In 1984 shallow monitoring wells 68-GW01, 68-GW02, and 68-GW03 were installed for the purpose of groundwater sampling (Figure 1-2) around the Rifle Range Dump. Both monitoring wells were comprised of 15 feet of screen and set at depths of 25 feet below ground surface (bgs). Groundwater samples were collected from the three newly installed monitoring wells and the existing supply wells, RR-45 and RR-97. The groundwater samples were analyzed for volatile organic compounds (VOCs). No detections of VOCs were reported in the groundwater sample set. No soil samples were collected during the investigation.

In 1986, the three monitoring wells were resampled and analyzed for VOCs. Again, no VOCs were detected in the groundwater samples collected from these wells.

1.2.1.2 Pre-RI Screening Study

The field work for a Pre-RI Screening Study was completed by Baker Environmental, Inc. (Baker) in October 1995 with additional groundwater sampling in March 1998 and the final report completed in November 1998. The investigation included researching the previous studies and completing additional investigative tasks. The field activities included surface and subsurface soil sampling, groundwater sampling, surface water sampling, and sediment sampling.

WHICH??
EVENT → Surface soil, subsurface soil, groundwater, surface water and sediment samples were collected at Site 68. The soil samples were analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) Metals. Groundwater, surface water, and sediment samples were analyzed for the same parameters. In addition, water quality parameters including temperature, pH, dissolved oxygen, conductivity, salinity, and turbidity were recorded for surface water sample locations. Table 1-1 contains criteria against which the sample results were compared. These criteria included Residential Contaminant of Concern (COC) Screening Values based on the Risk Based Concentration (RBC) values, USEPA Soil Screening Levels for transfer from soil to groundwater, and twice the average base specific background concentrations for inorganic analytes. RBCs are promulgated by the USEPA Region III as a tool to determine potential risk to human health from contaminants in soil and groundwater.

Surface Soil

A total of 24 surface soil samples were obtained at Site 68 and submitted for TCL organic and TAL metal analyses. Table 1-1 provides a summary of positive detections of the organic compounds and metals.

As indicated on Table 1-1, one VOC (acetone) was detected in three samples. No other VOCs were detected in surface soil samples at Site 68. None of the detections exceeded respective screening standards.

Detections of three SVOCs were limited to six of the surface soil samples. Phenol was detected in one sample while di-n-butylphthalate and bis(2-ethylhexyl)phthalate (BEHP) was detected in four samples. The maximum concentration of BEHP was detected at boring location 68-SB09. None of the SVOCs exceeded their respective screening standards as noted on Table 1-1.

Pesticide compounds were detected in 22 of the 24 surface soil samples. The pesticide concentrations appear to be widely scattered across the site. The pesticides 4,4'-DDE and 4,4'-DDT were the most common pesticides detected. Pesticide concentrations ranged from 170J $\mu\text{g}/\text{kg}$ of 4,4'-DDE to 2.3J $\mu\text{g}/\text{kg}$ of 4,4'-DDT. Methoxychlor was detected at an estimated concentration of 18J $\mu\text{g}/\text{kg}$.

One surface soil sample had a positive detection of a PCB compound. Aroclor-1260 was detected at a concentration of 290 $\mu\text{g}/\text{kg}$ at soil boring location 68-SB05. This concentration did not exceed the residential COC screening value of 320 $\mu\text{g}/\text{kg}$. No other PCB compounds were detected among any of the 24 surface soil samples obtained from Site 68.

Twenty-one of 23 TAL metals were detected among the 24 surface soil samples obtained from Site 68 (silver and thallium were not detected). Table 1-1 provides a summary of the metals detected within soil samples from Site 68. Eight metals including aluminum, barium, beryllium, copper, lead, manganese, nickel, and zinc were detected at concentrations greater than twice the average base-specific (i.e., MCB, Camp Lejeune) background levels (refer to Table 1-1 for twice the average base specific background concentrations). Inorganic analytes which exceeded residential COC screening values included antimony, arsenic, iron, and manganese. Those analytes which exceeded the USEPA Soil Screening Levels were iron, manganese, mercury, and selenium.

Subsurface Soil

A total of 25 subsurface (i.e., greater than one-foot bgs) soil samples were obtained at Site 68 and submitted for TCL organic and TAL metal analyses. Three volatile compounds were detected in subsurface soil samples (refer to Table 1-1). None of the detections of acetone, carbon disulfide, or 2-butanone exceeded residential COC screening values or the USEPA Soil Screening Levels.

Two semivolatile compounds, pyrene and bis(2-ethylhexyl)phthalate, were detected at concentrations below their corresponding residential COC screening values and USEPA Soil Screening Levels.

Two other organic compounds were detected in the subsurface soil samples at Site 68, one pesticide and one PCB. The pesticide compound, 4,4'-DDT was detected in one of the 25 subsurface soil samples obtained from Site 68 while the PCB, aroclor-1260, was detected at three of the 25 locations. None of the detected compounds exceeded their corresponding COC screening values or the USEPA Soil Screening Levels. It should be noted that Soil Screening Level does not exist for the detected PCB compounds.

Nineteen of the 23 TAL metals were detected among the 25 subsurface soil samples collected at Site 68. As seen on Table 1-1 only selenium was detected at a level below twice the average base specific background concentrations. Those analytes above residential COC screening values were aluminum, arsenic, iron, and manganese. While analytes detected in excess of the USEPA Soil Screening Levels were iron, manganese, and selenium.

Groundwater

The groundwater investigation at Site 68 entailed the collection of samples from three existing wells (68-GW01, 68-GW02, and 68-GW03) and six newly installed wells (68-GW01DW, 68-GW04, 68-GW04DW, 68-GW05DW, 68-GW06, and 68-GW06DW). The groundwater quality at Site 68 was evaluated by sampling both the upper portion of the surficial aquifer and below the Castle Hayne confining unit which was present over most of the site. Three existing wells and two new wells provided samples from the upper portion of the surficial aquifer and the four newly installed deep wells provided samples from the upper portion of the Castle Hayne aquifer. Two rounds of groundwater samples were collected at Site 68. The first round of samples were obtained in January 1996. The first round of groundwater samples collected were analyzed for full TCL organics, TAL metals using CLP protocols. Based upon the results of the draft Pre-RI Screening Study, a second round of groundwater sampling was conducted in March 1998. During this sampling event, samples were only analyzed for TAL inorganics. Analytical results from the groundwater investigation at Site 68 are provided in the following paragraphs. A positive detection summary of organic compounds and metals are provided in Table 1-1.

Only two VOCs were detected as part of the organic analyses of groundwater. Carbon disulfide was detected at shallow monitoring wells 68-GW06 and 68-GW04, both at concentrations of 4J $\mu\text{g/L}$. The compound 2-hexanone was detected at deep monitoring well 68-GW04DW at a concentration of 6J $\mu\text{g/L}$. There were no other organic compounds detected in the groundwater at Site 68.

SVOCs, PCB, and pesticide compounds were not detected in any of the groundwater samples collected from Site 68.

TAL metals were detected in each of the monitoring wells at Site 68. Nineteen of the 23 TAL total metals were detected within at least one groundwater sample at Site 68 (beryllium, mercury, silver and thallium were not detected). Of the positive detections, aluminum, antimony, iron, and manganese exceeded its respective North Carolina Water Quality Standards (NC WQS) or Federal Maximum Contaminant Levels (MCLs). Tapwater COC screening values were exceeded by antimony, arsenic, cadmium, iron, manganese, and thallium; while iron and manganese exceeded USEPA Soil Screening Levels.

Surface Water

A total of ten surface water samples were collected at Site 68. Five of the surface water samples were collected from Stone Creek and five samples were collected from an unnamed tributary which flows north into Stone Creek. The samples were collected from the segments of the streams which border the site from the northeast to the southwest. Each surface water sample was analyzed for full TCL organics and TAL inorganics using CLP protocol.

Analytical results from the surface water investigation are presented below as well as in Table 1-1. The screening values for the surface water samples were based upon NC WQS and USEPA Region IV Water Quality Standards.

Of the organic analyses, only one SVOC was detected in the surface water samples. Di-n-butylphthalate was detected at an estimated concentration of 1J $\mu\text{g/L}$ at surface water sample station 68-SW01 located approximately southwest of the site in Stone Creek. This concentration is well below the respective screening standard of 2,700 $\mu\text{g/L}$. No other organic compounds were detected among the 10 surface water samples.

Thirteen of the 23 TAL total metals were positively detected among the surface water samples (antimony, beryllium, chromium, cobalt, copper, nickel, silver, and thallium were not detected). None of the detections of inorganic analytes in the surface water samples exceeded their respective screening standard.

Sediment

Sediment samples were collected from the same stations as the surface water samples. A total of ten samples were collected: five from Stone Creek and five from the unnamed tributary which flows north into Stone Creek. The sediment samples were obtained from zero to six inches into the sediment. Each of the ten sediment samples were analyzed for full TCL organics and TAL inorganics using CLP protocol.

Analytical results from the sediment investigation are provided in the following paragraphs and included on Table 1-1. Volatile and PCB compounds were not detected in any of the ten sediment samples.

Semivolatile organic compounds were detected in three of the ten sediment samples. At station 68-SD03, only one SVOC was detected, 250J $\mu\text{g/kg}$ BEHP. Benzo(a)pyrene was detected at a concentration of 380 $\mu\text{g/kg}$ at sampling station 68-SD05. The majority of SVOCs were detected at sampling point 68-SD07. The detections ranged from 420J $\mu\text{g/kg}$ of fluoranthene to 62J $\mu\text{g/kg}$ of anthracene. None of the detections exceeded the associated screening standards.

The pesticides 4,4'-DDD and 4,4'-DDE were detected in each of the ten sediment samples with the exception of sample point 68-SD02. 4,4'-DDT was detected in each of the sampling points with the exception of 68-SD01 and 68-SD04. Two other pesticide compounds, alpha-chlordane and gamma-chlordane, were detected at sample station 68-SD06 at concentrations of 13J $\mu\text{g/kg}$ and 14NJ $\mu\text{g/kg}$. 4,4'-DDT detections ranged from 6.3 $\mu\text{g/kg}$ to the maximum concentration at 4,500 $\mu\text{g/kg}$. The maximum 4,4'-DDT detection was detected in the sample obtained from station 68-SD07. The pesticide 4,4'-DDE was detected at concentrations ranging from 6.7 $\mu\text{g/kg}$ at station 68-SD06 to 550 $\mu\text{g/kg}$ at 68-SD10. 4,4'-DDD detections ranged from 2.5J $\mu\text{g/kg}$ at station 68-SD03 to 2,900 $\mu\text{g/kg}$ at station 68-SD03. Each of the pesticide compounds were detected above their respective screening standards. Alpha-chlordane and gamma-chlordane were only detected in the tributary to Stone Creek to the east of the site. These contaminants were not detected in Stone Creek sediments. 4,4'-DDT, 4,4'-DDD and 4,4'-DDE were found in Stone Creek and tributary (to the east) sediments. The maximum 4,4'-DDD concentration occurs in the portions of Stone Creek that is to the west of the site. The maximum 4,4'-DDE and 4,4'-DDT concentrations occur in the tributary to the east of the site. There is an increasing trend of 4,4'-DDE, 4,4'-DDD and 4,4'-DDT concentrations (from the upstream direction) in the tributary to the east of the site. The pesticide concentrations in sediment to the west of the site were highest in the sample collected just downstream from the unnamed tributary to Stone Creek that flows from the western portion of the site.

Eighteen of the 23 TAL total metals were positively detected among the ten sediment samples (antimony, beryllium, potassium, silver, and thallium were not detected). Three inorganic analytes slightly exceeded the associated screening value including cadmium, lead, and mercury.

In summary, analytical testing of the soil samples at Site 68 detected organic compounds of each class. There were detections of two volatile organic compounds in the groundwater samples. Metals were detected in samples from all media. Pesticide compounds exceeded screening values in sediment samples. Inorganic analytes in each media, except surface water, exceeded either State or Federal promulgated values. Table 1-1 provides a summary of the compounds and analytes detected in the soil, groundwater, surface water, and sediment at Site 68.

1.2.2 Regulatory Agency/Public Involvement

The USEPA and NC DENR have been actively involved with the investigation of this site through report review and partnering meetings. Based on the results no further remedial actions are recommended at this site. The USEPA Region IV, and the NC DENR concur with the no further remedial action decisions. Public involvement is summarized in the following section.

1.3 Community Participation

A public meeting was held at MCAS, New River on August 27, 1996 to discuss the results of the Pre-RI Screening Study. The meeting included members of the local base community, personnel from MCB, Camp Lejeune, Naval Facilities Engineering Command (LANTRDIV), and Baker Environmental, Inc. The members of the project team presented the findings of the investigation and discussed the results of the risk assessment. Members of the community were given the opportunity to ask questions and comment on the related information. These comments and questions were immediately and informally addressed at the public meeting.

2.0 SUMMARY OF SITE CHARACTERISTICS

This section summarizes information pertaining to MCB, Camp Lejeune existing background information. In addition, specific information relevant to Site 68 is presented.

2.1 Climatology

MCB, Camp Lejeune experiences hot and humid summers; however, ocean breezes frequently produce a cooling effect. The winter months tend to be mild, with occasional brief cold spells. Average daily temperatures range from 34° F to 54° Fahrenheit (F) in January, the coldest month, and 72° F to 89° F in July, the hottest month. The average relative humidity, between 78 and 89 percent, does not vary greatly from season to season. The average yearly rainfall is 52.4 inches. Measurable amounts of rainfall occur 118 days per year, on average. Observations of sky conditions indicate yearly averages of approximately 112 days clear, 105 partly cloudy, and 148 cloudy. Prevailing winds are generally from the south-southwest 10 months of the year and from the north-northwest during September and October. The average wind speed at MCAS, New River is seven miles per hour.

2.2 Physiography, Geology and Soils

MCB, Camp Lejeune is located in the Atlantic Coastal Plain physiographic province. The sediments of this province consist primarily of sand, silt, and clay. Other sediments may be present, including shell beds and gravel. Sediments may be of marine or continental origin. These sediments are found in interfingering beds and lenses that gently dip and thicken to the southeast. Sediments of this type range in age from early Cretaceous to Quaternary time and overlie igneous and metamorphic rocks of pre-Cretaceous age. United States Geological Survey (USGS) studies at MCB, Camp Lejeune indicate that the base is underlain by sand, silt, clay, calcareous clay and partially cemented limestone. The combined thickness of these sediments beneath the base is approximately 1,500 feet.

The surface soil at Site 68 consists of loosely packed fine grained silty sand which is dark brown to gray in color. The first foot of soil is very moist and contains a very high percentage of organic material such as roots and partially decaying leaves and twigs. The fine grained sand extends to an average depth of three feet bgs, but was found up to 17 feet bgs at one location. A noticeable color change from the dark brown to a light brown to yellow is obvious for this sand layer. A transitional layer of clayey silt with trace amounts of fine sand was found in between the sand layer and clay layer. An olive gray clay layer was encountered from 15 to 18 feet bgs. The clay layer can be classified as medium stiff and had an average thickness of two to six feet thick. Below the clay layer is another fine grained sand layer which was encountered until the test borings were advanced to their termination depths of 30 to 62 feet bgs. The sand's characteristics include a dark brown color with areas of orange staining, traces of silt and increasingly higher percentages of shell fragments downward, very wet, and with a hardness in the medium, dense range.

2.3 Hydrogeology

The aquifers of primary interest are the surficial aquifer and the underlying Castle Hayne Aquifer. Other aquifers that occur beneath the facility include the Beaufort, Pee Dee, Black Creek, and upper and lower Cape Fear aquifers. The following summary is a compilation of information which pertains to aquifer characteristics within MCB, Camp Lejeune area.

The surficial aquifer consists of interfingering beds of sand, clay, sandy clay, and silt that contain some peat and shells. The thickness of the surficial aquifer ranges from 0 to 73 feet and averages nearly 25 feet over MCB, Camp Lejeune. The beds are thin and discontinuous, and have limited lateral continuity. This aquifer is not used for water supply at MCB, Camp Lejeune. The Castle Hayne aquifer lies below the surficial aquifer and consists primarily of unconsolidated sand, shell fragments, and fossiliferous limestone. Between the surficial aquifer and Castle Hayne aquifer lies the Castle Hayne confining unit. In general, the Castle Hayne confining unit may be characterized as a group of less permeable beds at the top of the Castle Hayne aquifer that have been partly eroded or incised in places. The Castle Hayne aquifer is about 150 to 350 feet thick, increasing in thickness to the ocean. The top of the aquifer lies approximately 20 to 73 feet bgs. Onslow County and MCB, Camp Lejeune lie in an area where the Castle Hayne aquifer generally contains freshwater; therefore, the Castle Hayne aquifer is a viable potable water source for the region's population. Seven potable water supply wells exist within a one-mile radius of the study area.

At Site 68, static water level measurements of the surficial aquifer indicate that the groundwater flow is to the west across the site in a uniform direction. Static water level measurements of the Castle Hayne aquifer indicates that groundwater flows to the southwest, being slightly influenced by Stone Creek.

2.4 Surface Water

The dominant surface water feature at MCB, Camp Lejeune is the New River. It receives drainage from a majority of the base. The New River is short with a course of approximately 50 miles on the central Coastal Plain of North Carolina. At MCB, Camp Lejeune, the New River flows in a southerly direction into the Atlantic Ocean through the New River Inlet. Several small coastal creeks drain the area of MCB, Camp Lejeune not associated with the New River and its tributaries. These creeks flow into the Intracoastal Waterway, which is connected to the Atlantic Ocean by Bear Inlet, Brown's Inlet, and the New River Inlet. The New River, the Intracoastal Waterway, and the Atlantic Ocean converge at the New River Inlet.

The nearest stream is Stone Creek which is located to the north and east of the site. At Stone Creek's nearest point to the east of the site, it lies approximately 400 feet away. Stone Creek flows in a northwesterly direction and empties into the New River. In addition, there is an unnamed tributary which flows north into Stone Creek. The unnamed tributary lies approximately 200 feet northwest of the site boundary.

2.5 Land Use

MCB, Camp Lejeune encompasses an area of approximately 236 square miles. The installation border is approximately 70 miles, including 21 miles of ocean front and Intracoastal Waterway. Recently, MCB, Camp Lejeune acquired approximately 41,000 additional acres in the Greater Sandy Run area. Land use within the base is influenced by topography and ground cover, environmental policy, and base operational requirements. Much of the land within MCB, Camp Lejeune consists of freshwater swamps that are wooded and largely unsuitable for development. In addition, 3,000 acres of sensitive estuary and other areas set aside for the protection of threatened and endangered species are to remain undeveloped. Operational restrictions and regulations, such as explosive quantity safety distances, impact-weighted noise thresholds, and aircraft landing and clearance zones, may also greatly constrain an influence development (Master Plan, 1988). The combined military and civilian population of MCB, Camp Lejeune and Jacksonville area is approximately

112,000. Nearly 90 percent of the surrounding population resides within urbanized areas. The presence of MCB, Camp Lejeune has been the single greatest factor contributing to the rapid population growth of Jacksonville and adjacent communities, particularly during the period from 1940 to 1960.

2.6 Receptors

Site 68 is situated in a nonresidential area of MCAS that has only been used for training exercises in the past. The risk assessment recognizes this fact by preparing conceptual site models that included the following receptors:

- Current military personnel
- Future on-site residents (young child [ages 1-6 years] and adult)

The contaminants detected at the site in surface soils, subsurface soils, groundwater, surface water, and sediment can migrate from the various media in several ways, including:

- Vertical migration of contaminants from surface soil to subsurface soil.
- Leaching of contaminants from subsurface soil to water-bearing zones.
- Vertical migration from shallow water-bearing zones to deeper flow systems.
- Horizontal migration in groundwater in the direction of groundwater flow.
- Wind erosion and subsequent deposition of windblown dust.

3.0 DATA ANALYSIS/RISK ASSESSMENT

The risk assessment completed for Site 68 examined exposure pathways associated with each environmental medium and each human receptor. Pathways were evaluated both qualitatively and quantitatively, considering site conditions and associated receptors. The exposure to current military personnel and future on-site residents from soil, groundwater, surface water, and sediment was considered.

Potential exposure to surface soil may occur by incidental soil ingestion, contaminant absorption through the skin and inhalation of airborne particulates. Surface soil exposure was evaluated for current military personnel and future residential children and adults.

Subsurface soil is available for contact only during excavation activities, so potential exposure to subsurface soil is limited to current military personnel involved in training exercises and maneuvers. Potential exposure to subsurface soil may occur by incidental soil ingestion, contaminant absorption through the skin and inhalation of airborne particulates.

Future residents were evaluated for groundwater exposure at Site 68. At the present time, shallow groundwater in the vicinity of the site is not used as a potable supply for residents or base personnel. The current water supply wells are set in a deeper aquifer, the Castle Hayne. However, in the future, (albeit unlikely due to poor transmissivity and insufficient flow) shallow groundwater may be tapped for potable water. Groundwater exposure was evaluated for future residential children and adults. Potential exposure pathways are ingestion, dermal contact, and inhalation of volatile contaminants while showering. However, it should be noted, that there were no VOCs detected above screening levels in the groundwater samples. Therefore, inhalation, of VOCs while showering was not evaluated as an exposure pathway.

Potential exposure to surface water/sediment may occur by incidental ingestion and contaminant absorption through the skin. Future residents were evaluated for surface water/sediment exposure at Site 68.

Table 1-1 presents a summary of the detected compounds and analytes at the site. The table presents the range of positive detections for each contaminant of concern. These detections were compared to USEPA COC Screening Values derived from the Risk Based Concentrations for residential soils and tap water as well as values stipulated by the USEPA Soil Screening Guidance, Ambient Water Quality Criteria, Effects Range-Low and Effects Range-Medium sediment screening values. As shown on the table, only one detection of an organic compound, carbon disulfide, among the subsurface soil samples exceed the screening criteria. No detections of organic compounds in surface soil, groundwater, or surface water exceeded screening criteria. However, some metals detected in the surface and subsurface soil samples exceeded their respective screening criteria such as antimony, arsenic, iron, manganese, mercury, and selenium in surface soil and aluminum, arsenic, iron, manganese, and selenium in subsurface soil. The metals antimony, arsenic, iron, manganese, and thallium exceeded screening criteria in groundwater. In surface water, iron was the only analyte to exceed Ambient Water Quality Criteria. Concentrations of the organic compounds phenanthrene, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, alpha-chlordane, and gamma-chlordane exceeded sediment screening criteria. Inorganics in sediment which exceeded screening criteria included cadmium, lead, and mercury. Each of the detections were considered in the risk assessment completed for Site 68.

Those pathways and receptors identified for potential risks include the groundwater ingestion pathway for future residential children and adults. A noncarcinogenic risk is posed for children [hazard index (HI) = 14] and for adults (HI = 6) both exceeding the acceptable HI = 1.0. The noncarcinogenic risk for children is due primarily to the groundwater ingestion pathway with the primary risk drivers antimony contributing a hazard quotient (HQ) = 2.5 (62% of the elevated HI), and manganese contributing an HQ = 1.1 (28% of the elevated HI). Similarly, the risk posed for adults resulted from the groundwater ingestion pathway as well, with antimony contributing to a hazard quotient (HQ) = 1.1 and manganese contributing an HQ = 0.48 totaling approximately 90% of the elevated HI as the primary risk drivers. Shallow groundwater is not currently used as a potable source at these sites, and future residential development of this site is unlikely. Based on this information, the future groundwater exposure scenario evaluated in the Risk Assessment, although highly protective of human health, is unlikely to occur.

4.0 DESCRIPTION OF THE NFRAP ALTERNATIVE

No evidence exists to suggest that the soil, groundwater, surface water, or sediment are sufficiently contaminated to pose a threat to human health. Those potential risks noted for future exposure scenarios are unlikely due to the projected groundwater use at the site. Therefore, current site conditions and environmental testing data indicated that no further remedial action is warranted at Site 68. Even though there is no evidence to suggest that site media pose a potential health risk, land use and aquifer use controls will be enforced due to the reported disposal of 2,000 gallons of solvents. These controls are presented in the LUCIP which is included as part of this NFRAP in Attachment A. The LUCIP will be enforced until solvents are determined, through the five year review process, to pose no potential human health risks.

5.0 RESPONSIVENESS SUMMARY

This NFRAP was made available to the public for comment at a public meeting held on April 19, 1998. However, there was no formal comment period. No comments have been received from the public on the draft NFRAP. Comments were received from the USEPA, NCDENR and the Navy Environmental Health Center. These comments were incorporated into this final NFRAP and are presented in the following pages.

**USEPA REGION IV COMMENTS OF MARCH 22, 1999
& NAVY RESPONSES
DRAFT NO FURTHER RESPONSE ACTION PLAN - SITE 68
MCB CAMP LEJEUNE, NORTH CAROLINA**

USEPA Comment #1: "It was noted that there are several pesticide detections in sediments above the screening level (scr.). Although the levels are above scr., they appear to be in line with levels typically found at Military Installations. It is the Agency's recommendation to proceed with the no further action decision, however, the narrative should be strengthened by adding text that addresses the frequency, pattern and magnitude of the detections. The agency also suggest verifying this information with the State."

Response: The text has been strengthened to discuss the frequency, pattern and magnitude of pesticide detections in sediment. Please refer to the NC Superfund Section comments (Dave Lilley Comment #3) for North Carolina comment and response on contaminant detection exceedences of sediment criteria.

**NC SUPERFUND SECTION COMMENTS OF APRIL 22, 1999
& NAVY RESPONSES
DRAFT NO FURTHER RESPONSE ACTION PLAN - SITE 68
MCB CAMP LEJEUNE, NORTH CAROLINA**

NC Superfund Comment #1: "This site is a former open dump (in use for 30 years) and is suspected of having received 2,000 gallons of solvent. It needs institutional controls and periodic monitoring. While, at present, further remedial action may not be warranted, future users of the site should be protected through the implementation of institutional controls. Without additional investigation, any intrusive activities, such as soil excavation, should be restricted. Periodic groundwater monitoring to confirm that solvents have not mobilized is necessary."

Response: During the Pre-RI Screening Study, aerial photographs were examined, and soil, groundwater, surface water and sediment samples were collected in an attempt to locate evidence of a solvent spill or other source of solvent contamination. No source area was evident. Therefore, at the conclusion of this study in 1996, it was decided through partnering that the site warranted no further investigation. For this reason, a NFRAP seemed the appropriate follow up decision document for this site. However, a site-specific Land Use Control Implementation Plan (LUCIP) has been developed for Site 68 that includes aquifer use and land use controls due to the potential exposure to the reported disposal of solvents. The LUCIP is included as Attachment A of the NFRAP. The LUCIP will be enforced until it is determined, through the five year review process, that there is no potential human health risk due to the suspected site contamination.

NC Superfund Comment #2: "Page 1-5, the third paragraph. The significance of the NFRAP designation is overstated. While it may be fair to state that the site is not known to be impacting human health and the environment, the site is a former open dump. The statement, "the site poses no significant risk to human health and the environment," is not justified. The NCP states, "Sites that EPA decides do not warrant moving further in the site evaluation process are given a 'No Further Response Action Planned' (NFRAP) designation in CERCLIS. This means that no additional federal steps under CERCLA will be taken at the site unless future information so warrants." This is not the same as determining that there is no threat. Data collected has failed to find environmental exposure; however, the history of the site suggests that it may still have the potential to harm the environment."

Response: Agreed. The statement has been deleted from the text. The purpose of a NFRAP is to present the "no further action planned" decision. However, in this case, the decision for no further planned action was based upon the Pre-Remedial Investigation (RI) Screening Study. The data collected for this study, as well as the human health risk assessment that was based on this data, did not indicate that further action or investigation was warranted. Ecological receptors were not analyzed under the Pre-RI Screening Study. Therefore, any conclusions that there is no significant threat to the environment cannot be drawn in this NFRAP. All such conclusions have been deleted from the text.

NC Superfund Comment #1: "Attached are our comments on risk assessment in the NFRAP and the Final Pre-Remedial Investigation Screening Study for Site 68. Evaluation of the risk posed by pesticides in the sediments is probably the most pressing issue."

Response: Comments on the risk assessment in the NFRAP are addressed below.

Dave Lilley Comment #1: "Page 1-6, Section 1.2.1.2, second paragraph: The screening levels contained within the NC Risk Analysis Framework (RAF) document are DRAFT and NOT to be used or cited in Risk Assessments or cleanup level determinations. The use of the METHODOLOGIES contained within the RAF is acceptable. It is recommended the RGOs be calculated using the methodologies outlined in the Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 5, 1995."

Response: Agreed. All references to the NC Risk Analysis Framework will be removed from text and tables. However, based on discussions between Baker Environmental, Inc. and Mr. David Lown, the final clean up goals were to be chosen between the following RGOs: Region III RBCs multiplied by a factor of 0.2, base background, and Soil Screening Levels (developed from USEPA Soil Screening Guidance, 1996). Therefore, the RGOs will not be recalculated based on the methodologies outlined in Region 4 Bulletin No. 5 (USEPA, 1995).

Dave Lilley Comment #2: "Page 3-2, second paragraph: According to Tables 5-41 through 5-43, the HIs for residential adults and children are 6 and 14, respectively, not the numbers shown in this paragraph. Please make the necessary changes."

Response: Agreed. These errors have been corrected in the text.

Dave Lilley Comment #3: "Page 3-2, first paragraph: Screening criteria were exceeded for sediment, but no ecological assessment was conducted to determine what risks these contaminants pose to the environment. Therefore, it is not possible to conclude (page 4-1) that no evidence exists to suggest that the soil, groundwater, surface water, or sediment are sufficiently contaminated to pose a threat to the human health or environment. Please provide evidence to show that, although sediment screening criteria were exceeded, there are no risks to the environment. This can be accomplished by analyzing the exposure pathways as outlined in Step 1 of the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, June, 1997. In Step 1, it is recommended that only Region IV sediment screening levels be used. If no complete exposure pathways exist, the COPCs can be dropped from consideration. If COPCs pass through Step 1, Step 3 (Problem Formulation) should be completed to discuss each COPC and refine the document. In Step 3, other screening values can be used."

Response: The purpose of the Pre-RI Screening Study was "to detect and characterize potential impacts to human health and to determine if the site required further investigative work". An ecological risk assessment was not included in the scope of work for this study. Even though screening criteria were exceeded for some sediment samples, the contaminants were not believed to be related to the site. Based on this, it is believed that no further remedial or investigative activities were required. As noted in the response to NC Superfund Comment #2, all references to potential risk to the environment have been deleted from the text.

Dave Lilley Comment #4: "Page 3-2, second paragraph: The levels of iron and manganese exceeded the NC Drinking Water Standards. How will this be handled?"

Response: It is believed that iron and manganese are commonly and naturally occurring in groundwater at Camp Lejeune, and that these metals are not site related. Iron and manganese occur in drinking water wells at Camp Lejeune. Further, even though these metals are above screening levels, it is highly unlikely that the this site will be used for residential purposes. Therefore, at the conclusion of this study in 1996, it was decided through partnering that the site warranted no further

investigation. For this reason, a NFRAP seemed the appropriate follow up decision document for this site. However, because disposal of solvents has been reported, a LUCIP has been included as part of the NFRAP (Attachment A). The LUCIP defines aquifer use and land use controls that will prevent human exposure to contaminants, including iron and manganese that exceed NC Drinking Water Standards.

DEPARTMENT OF THE NAVY
NAVY AND ENVIRONMENTAL HEALTH CENTER
COMMENTS OF DECEMBER 6, 1999
DRAFT NO FURTHER REMEDIAL ACTION PLAN – SITE 68
MCB CAMP LEJEUNE, NORTH CAROLINA

Navy Comment #1: "Per reference (Baker Environmental, Inc. Letter of Transmittal dated 29 Oct 99), we have completed a medical review of the subject document. We agree with the selected remedy and have no further comments concerning this site."

Response: Baker is pleased to receive your concurrence of the No Further Response Action Plan for Site 68 at MCB Camp Lejeune.

TABLES

TABLE 1-1

**SURFACE SOIL ORGANIC DATA
SITE 68, RIFLE RANGE DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120**

Parameter	Contaminant Range/Frequency		Comparison to Criteria			
	Range of Positive Detections (µg/kg)	No. of Positive Detections/ No. of Samples	Region III Residential COC Screening Value ⁽¹⁾ (µg/kg)	Positive Detects Above Residential COC Value	Soil to Groundwater Screening Level ⁽²⁾ (µg/kg)	Detections Above Soil to Groundwater Screening Level
Volatiles						
Acetone	12-18	3/24	780,000	0	2,810	0
Semivolatiles						
Phenol	78J	1/24	4,700,000	0	1,746	0
Di-n-butylphthalate	44J	1/24	780,000	0	24,800	0
bis(2-Ethylhexyl)phthalate	49J-160J	4/24	46,000	0	--	--
Pesticide/PCBs						
Beta-BHC	1.4J	1/24	350	0	--	--
Dieldrin	6.3NJ	1/24	40	0	40	0
4,4'-DDE	4.5J-170J	10/24	1,900	0	1,900	0
4,4'-DDT	2.3J-56J	11/24	1,900	0	1,900	0
Methoxychlor	18J	1/24	39,000	0	56,140	0
Aroclor-1260	290	1/24	320	0	--	--

Notes:

Shading indicates contaminant selected as COPC for human health risk assessment.

J = Estimated value

N = Tentative identification. Consider present.

-- = Value Not Available

COC = Contaminant of Concern

⁽¹⁾ USEPA Region III Risk-Based Concentrations (RBC) Table (October 1, 1998).

⁽²⁾ USEPA Soil Screening Levels for Transfer from Soil to Groundwater (May, 1996)

TABLE 1-1 cont'd.

**SURFACE SOIL INORGANIC DATA
SITE 68, RIFLE RANGE DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120**

Analyte	Range/Frequency		Comparison to Criteria					
	Range of Positive Detections (mg/kg)	No. of Positive Detections/ No. of Samples	Twice the Average Base Specific Background ⁽¹⁾ Concentration (mg/kg)	No. of Times Exceeded Twice the Average Background Concentration	Residential COC Screening Value ⁽²⁾ (mg/kg)	Positive Detects Above Residential COC Value	Soil to Groundwater Screening Level ⁽⁵⁾ (mg/kg)	Detections Above Soil to Groundwater Screening Level
Aluminum	1,200 - 7,460	24/24	5,856.083	4	7,800	0	--	--
Antimony	4.5J	1/24	5.455	0	3.1	1	--	--
Arsenic	0.14 - 0.87	22/24	1.322	0	0.43	11	26.6	0
Barium	3 - 28.8	24/24	17.292	7	550	0	848	0
Beryllium	0.16 - 0.59	11/24	0.205	9	16	0	--	--
Cadmium	0.44	1/24	0.696	0	7.8	0	2.72	0
Calcium+	45.8 - 8,530	23/24	1,372.977	1	--	--	--	--
Chromium	0.86 - 4.1	24/24	6.607	0	23	0	27.2	0
Cobalt	0.49 - 1.3	13/24	2.046	0	470	0	--	--
Copper	0.44 - 7.2	23/24	7.104	1	310	0	704	0
Iron+	364 - 2,990	24/24	3,702.427	0	2,300	3	151.2	24
Lead	4 - 122	24/24	23.37	1	400 ⁽³⁾	0	270.06	0
Magnesium+	32.4 - 213	24/24	202.96	2	--	--	--	--
Manganese	2.1 - 162	24/24	18.51	16	160	1	65.2	8
Mercury	0.05	1/24	0.094	0	2.3 ⁽⁴⁾	0	0.0154	1
Nickel	2 - 3.8	12/24	3.455	2	160	0	56.4	0
Potassium+	199	1/24	200.06	0	--	--	--	--
Selenium	0.24	1/24	0.753	0	39	0	0.223	1
Sodium+	5.7 - 34.2	12/24	59.013	0	--	--	--	--
Vanadium	1.2 - 8.2	24/24	11.447	0	55	0	--	--
Zinc	1.8 - 21	20/24	13.763	1	2,300	0	1,100.04	0

Notes:

COC = Contaminant of Concern

Shaded areas indicate analyte selected as COPC for human health risk assessment.

+ = Essential Nutrient

-- = No criteria published

J - Estimated Value

⁽¹⁾ Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.⁽²⁾ USEPA Region III Risk Based Concentration (RBC) Table (October 1, 1998).⁽³⁾ Action Level for residential soils (USEPA, 1994b).⁽⁴⁾ Value for mercuric chloride used as a surrogate.⁽⁵⁾ USEPA Soil Screening Levels for Transfer from Soil to Groundwater (May, 1996).

TABLE 1-1 cont'd.

SUBSURFACE SOIL ORGANIC DATA
 SITE 68, RIFLE RANGE DUMP
 MCB, CAMP LEJEUNE, NORTH CAROLINA
 NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120

Parameter	Contaminant Range/Frequency		Comparison to Criteria			
	Range of Positive Detections (µg/kg)	No. of Positive Detects/ No. of Samples	Region III Residential COC Value ⁽¹⁾	Positive Detects Above Residential COC Value	Soil to Groundwater Screening Level ⁽²⁾ (µg/kg)	Detections Above Soil to Groundwater Screening Level
Volatiles						
Acetone	15 - 150	7/25	780,000	0	2,810	0
Carbon Disulfide	16	1/25	780,000	0	4940	0
2-Butanone	9J	1/25	4,700,000	0	--	--
Semivolatiles						
Pyrene	48J	1/25	230,000	0	286,440	0
bis(2-Ethylhexyl)phthalate	39J - 110J	4/25	46,000	0	46,000	0
Pesticide/PCBs						
4,4'-DDT	3.4J	1/25	1,900	0	1,900	0
Aroclor-1260	12J - 26J	3/25	320	0	--	--

Notes:

J = Estimated value

COC = Contaminant of Concern

⁽¹⁾ USEPA Region III Risk Based Concentration (RBC) Table (October 1, 1998).

⁽²⁾ USEPA Soil Screening Levels for Transfer from Soil to Groundwater (May, 1996).

TABLE 1-1 cont'd.

**SUBSURFACE SOIL INORGANIC DATA
SITE 68, RIFLE RANGE DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA
NO FURTHER RESPONSE ACTION DECISION DOCUMENT, CTO-0120**

Analyte	Range/Frequency		Comparison to Criteria					
	Range of Positive Detections (mg/kg)	No. of Positive Detections/ No. of Samples	Twice the Average Base Specific Background ⁽¹⁾ (mg/kg)	No. of Times Exceeded Twice the Average Background Concentration	Residential COC Screening Value ⁽²⁾ (mg/kg)	Positive Detections Above Residential COC Value	Soil to Groundwater Screening Level ⁽⁴⁾ (µg/kg)	Detections Above Soil to Groundwater Screening Level
Aluminum	645 - 13,200	25/25	7,413.23	20	7,800	19	--	--
Arsenic	0.27 - 7.6	23/25	1.971	20	0.43	22	26.6	0
Barium	0.59 - 80.9J	25/25	14.37	13	550	0	848	0
Beryllium	0.2 - 0.87	17/25	0.191	16	16	0	--	--
Cadmium	0.56 - 0.82	3/25	0.718	1	7.8	0	2.72	0
Calcium+	16.2 - 682	25/25	387.824	5	--	--	--	--
Chromium	2 - 25.1	25/25	12.537	20	23	0	27.2	0
Cobalt	0.79 - 10.7	16/25	1.611	3	470	0	--	--
Copper	1.1 - 11.5	22/25	2.41	19	310	0	704	0
Iron+	726 - 18,600	25/25	7,134.639	16	2,300	21	151.2	25
Lead	1.1 - 11.9J	25/25	8.264	6	400 ⁽³⁾	0	270.06	0
Magnesium+	15.3 - 1,520	25/25	263.398	20	--	--	--	--
Manganese	3.4 - 178	24/25	7.99	20	160	1	65.2	1
Nickel	2.5 - 18.9	15/25	3.725	8	160	0	56.4	0
Potassium+	465 - 1,340	20/25	344.252	20	--	--	--	--
Selenium	0.27 - 0.53	4/25	0.806	0	39	0	0.223	4
Sodium+	12.4 - 69.2	20/25	54.57	4	--	--	--	--
Vanadium	1.7 - 33.2	25/25	13.34	20	55	0	--	--
Zinc	0.84 - 92.8	24/25	6.668	21	2,300	0	1,100.04	0

Notes:

COC = Contaminant of Concern

Shaded areas indicate analyte selected as COPC for human health risk assessment.

+ = Essential Nutrient

-- = No criteria published

J - Estimated Value

⁽¹⁾ Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.⁽²⁾ USEPA Region III Risk Based Concentration Table (October 1, 1998).⁽³⁾ Action Level for residential soils (USEPA, 1994b).⁽⁴⁾ USEPA Soil Screening Levels for Soil to Groundwater (May, 1996).

TABLE 1-1 cont'd.

**GROUNDWATER ORGANIC AND INORGANIC DATA
SITE 68, RIFLE RANGE DUMP
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120
MCB, CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Groundwater Criteria					Frequency/Range		Comparison to Criteria				
	NCWQS ⁽¹⁾ (µg/L)	MCL ⁽²⁾ (µg/L)	Region III Tapwater COC Screening Value ⁽³⁾ (µg/L)	Federal Health Advisories ⁽⁴⁾ (µg/L)		No. of Positive Detects/ No. of Samples	Concentration Range (µg/L)	No. of Detects Above NCWQS	No. of Detects Above MCL	No. of Detects Above COC Value	No. of Detects Above Health Advisories	
				10 kg Child	70 kg Adult						10 kg Child	70 kg Adult
Volatiles												
Carbon Disulfide	NE	NE	100	NE	NE	2/9	4J - 4J	NA	NA	0	NA	NA
2-Hexanone	NE	NE	150	NE	NE	1/9	6J	NA	NA	0	NA	NA
Inorganics												
Aluminum	NE	50/200 ⁽⁵⁾	3,700	NE	NE	8/18	186J -3,690	NA	7/8	0	NA	NA
Antimony	NE	6	1.5	10	15	2/18	20.3 - 21	NA	2	2	2	2
Arsenic	50	50	0.045	NE	NE	1/18	0.96	0	0	1	NA	NA
Barium	2,000	2,000	260	NE	NE	18/18	3.6 - 50.9	0	0	0	NA	NA
Beryllium	NE	4	7.3	4,000	20,000	1/18	4.2J	NA	1	0	0	0
Cadmium	5	5	1.8	5	20	1/18	4.8	0	0	1	0	0
Calcium+	NE	NE	NE	NE	NE	18/18	1,890-109,000	NA	NA	NA	NA	NA
Chromium	50	100	11	200	800	3/18	3.5 - 5.9J	0	0	0	0	0
Cobalt	NE	NE	220	NE	NE	4/18	3.1 - 35.8J	NA	NA	0	NA	NA
Copper	1,000	1,300 ⁽⁶⁾	150	NE	NE	13/18	2.3 - 25.6	0	0	0	NA	NA
Iron	300	300 ⁽⁵⁾	1,100	NE	NE	17/18	16.4 - 6,170	5	5	4	NA	NA
Lead	15	15 ⁽⁶⁾	NE	NE	NE	6/18	0.84 - 2.9J	0	0	NA	NA	NA
Magnesium+	NE	NE	NE	NE	NE	18/18	334 - 8,850	NA	NA	NA	NA	NA
Manganese	50	50 ⁽⁵⁾	73	NE	NE	16/18	2.6J - 1,390	6	6	2	NA	NA
Mercury	1.1	2	1.1 ⁽⁷⁾	NE	2	2/18	0.031J - 0.035J	0	0	0	NA	0
Nickel	100	100	73	500	1,700	4/18	9.2J-65.4	0	0	0	0	0
Potassium+	NE	NE	NE	NE	NE	14/18	1,040J - 15,000	NA	NA	NA	NA	NA

TABLE 1-1 cont'd.

**GROUNDWATER ORGANIC AND INORGANIC DATA
SITE 68, RIFLE RANGE DUMP
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120
MCB, CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Groundwater Criteria					Frequency/Range		Comparison to Criteria				
	NCWQS ⁽¹⁾ (µg/L)	MCL ⁽²⁾ (µg/L)	Region III Tapwater COC Screening Value ⁽³⁾ (µg/L)	Federal Health Advisories ⁽⁴⁾ (µg/L)		No. of Positive Detects/ No. of Samples	Concentration Range (µg/L)	No. of Detects Above NCWQS	No. of Detects Above MCL	No. of Detects Above COC Value	No. of Detects Above Health Advisories	
				10 kg Child	70 kg Adult						10 kg Child	70 kg Adult
Selenium	50	50	18	NE	NE	1/18	2.1	0	0	0	NA	NA
Sodium+	NE	NE	NE	NE	NE	18/18	1,880 - 46,200	NA	NA	NA	NA	NA
Thallium	NE	2	0.26	7	20	6/18	3.6J - 6.6J	NA	6	6	0	0
Vanadium	NE	NE	26	NE	NE	6/18	2.8 - 23.1J	NA	NA	0	NA	NA
Zinc	2,100	5,000 ⁽⁵⁾	1,100	3,000	10,000	10/18	4 - 250	0	0	0	0	0

Notes:

Shaded areas indicate parameter selected as COPC.

⁽¹⁾ NC WQS = North Carolina Water Quality Standards for Groundwater (15A NCAC2L)

⁽²⁾ MCL = Safe Drinking Water Act Maximum Contaminant Level

⁽³⁾ USEPA Region III RBC Table (October 1, 1998).

⁽⁴⁾ Longer Term Health Advisories for a 10 kg Child and 70 kg Adult

⁽⁵⁾ SMCL = Secondary Maximum Contaminant Level

⁽⁶⁾ Action Level for drinking water.

⁽⁷⁾ Value for mercuric chloride used as a surrogate.

⁽⁸⁾ USEPA Soil Screening Levels for Soil To Groundwater (May 1996).

+ - Essential Nutrient

NE - No Criteria Established

NA - Not Applicable

J - Estimated Value

COC - Contaminant of Concer

TABLE 1-1 cont'd.

**SURFACE WATER DATA
ORGANICS AND INORGANICS
SITE 68, RIFLE RANGE DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120**

Contaminant	Surface Water Criteria			Contaminant Frequency/Range		Comparison to Criteria		
	NCWQS ⁽¹⁾ (µg/L)	Federal Health AWQCs ⁽²⁾				Positive Detects Above NCWQS	Positive Detects Above AWQC	
		Water & Organisms (µg/L)	Organisms Only (µg/L)	No. of Positive Detects/ No. of Samples	Contaminant Range (µg/L)		Water & Organisms	Organisms Only
Semivolatiles								
Di-n-butylphthalate	2,700	2,700	12,000	1/10	1J	0	0	0
Inorganics								
Aluminum	NE	NE	NE	10/10	141 - 422	NA	NA	NA
Barium	1,000	1,000	NE	10/10	11.3 - 18.4	0	0	NA
Cadmium	NE	NE	NE	1/10	2.9	NE	NE	NE
Calcium+	NE	NE	NE	10/10	6,530 - 27,300	NA	NA	NA
Iron	NE	300	NE	10/10	410 - 594	NA	10	NA
Lead	NE	50	NE	6/10	0.87 - 2.5	NA	0	NA
Magnesium+	NE	NE	NE	10/10	1,260 - 25,500	NA	NA	NA
Manganese	200	50	100	10/10	11.7 - 42.5	0	0	0
Potassium+	NE	NE	NE	6/10	865 - 8,030	NA	NA	NA
Selenium	NE	NE	NE	1/10	1.7	NA	NA	NA
Sodium+	NE	NE	NE	10/10	6,650 - 210,000	NA	NA	NA
Vanadium	NE	NE	NE	1/10	2.4	NA	NA	NA
Zinc	NE	NE	NE	2/10	4.1 - 4.2	NA	NA	NA

Notes:

Shaded areas indicate parameter selected as COPC for human health risk assessment.

(1) NC WQS = North Carolina Water Quality Standards for Surface Water

(2) AWQC = Ambient Water Quality Criteria

+ = Essential Nutrients

NE = Not Established

NA = Not Applicable

J = Estimated value

TABLE 1-1 cont'd.

SEDIMENT DATA
ORGANICS AND INORGANICS
SITE 68, RIFLE RANGE DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120

Parameter	Sediment Screening Values ⁽¹⁾		Range/Frequency		Comparison to Criteria	
	ER-L Concentration	ER-M Concentration	Range of Positive Detections	No. of Positive Detections/ No. of Samples	Positive Detects Above	
					ER-L	ER-M
Semivolatiles (µg/kg)						
Phenanthrene	240	1,500	280J	1/10	1	0
Anthracene	85.3	1,100	62J	1/10	0	0
Fluoranthene	600	5,100	420J	1/10	0	0
Pyrene	665	2,600	330J	1/10	0	0
Benzo(a)anthracene	261	1,600	190J	1/10	0	0
Chrysene	384	2,800	210J	1/10	0	0
Bis(2-ethylhexyl)phthalate	NE	NE	250J	1/10	NA	NA
Benzo(b)fluoranthene	NE	NE	250J	1/10	NA	NA
Benzo(k)fluoranthene	NE	NE	97J	1/10	NA	NA
Benzo(a)pyrene	430	1,600	170J - 380J	3/10	0	0
Indeno(1,2,3-cd)pyrene	NE	NE	110J	1/10	NA	NA
Benzo(g,h,i)perylene	NE	NE	98J	1/10	NA	NA
Pesticides/PCBs (µg/kg)						
4,4'-DDE	2.2	27	6.7 - 550	9/10	9	5
4,4'-DDD	1.58 ⁽²⁾	46.1 ⁽²⁾	2.5J - 2,900	9/10	9	4
4,4'-DDT	1.58 ⁽²⁾	46.1 ⁽²⁾	6.3J - 4,500	7/10	7	3
Alpha-chlordane	0.5 ⁽³⁾	6 ⁽³⁾	13J	1/10	1	1
Gamma-chlordane	0.5 ⁽³⁾	6 ⁽³⁾	14NJ	1/10	1	1
Inorganics (mg/kg)						
Aluminum	NE	NE	351 - 11,500	10/10	NA	NA
Arsenic	8.2	70	0.64J - 4.2	5/10	0	0
Barium	NE	NE	1.5 - 28.1	10/10	NA	NA
Cadmium	1.2	9.6	0.5 - 4.7	3/10	2	0
Calcium+	NE	NE	71.3 - 11,900	10/10	NA	NA
Chromium	81	370	0.79 - 12.6	10/10	0	0
Cobalt	NE	NE	0.75 - 6.3	5/10	NA	NA
Copper	34	270	0.45 - 14.9	8/10	0	0
Iron	NE	NE	296 - 16,300	10/10	NA	NA

TABLE 1-1 cont'd.

**SEDIMENT DATA
ORGANICS AND INORGANICS
SITE 68, RIFLE RANGE DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA
NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT, CTO-0120**

Parameter	Sediment Screening Values ⁽¹⁾		Range/Frequency		Comparison to Criteria	
	ER-L Concentration	ER-M Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	Positive Detects Above	
					ER-L	ER-M
Lead	46.7	218	1.8 - 73J	10/10	1	0
Magnesium+	NE	NE	23.5 - 8,330	10/10	NA	NA
Manganese	NE	NE	2.7 - 127	10/10	NA	NA
Mercury	0.15	0.71	0.4	1/10	1	0
Nickel	20.9	51.6	2.3 - 9.7	3/10	0	0
Selenium	NE	NE	0.79 - 1.2	2/10	NA	NA
Sodium+	NE	NE	55.8 - 15,400	7/10	NA	NA
Vanadium	NE	NE	0.7 - 26.6	10/10	NA	NA
Zinc	150	410	3.8 - 86.5	9/10	0	0

Notes:

Shaded areas indicate parameter selected as COPC for human health risk assessment.

ER-L - Effects Range-Low

ER-M - Effects Range-Medium

⁽¹⁾ Long et al., 1995.

⁽²⁾ Value for total DDT

⁽³⁾ Region IV National Oceanic and Atmospheric Administration (NOAA) sediment screening value

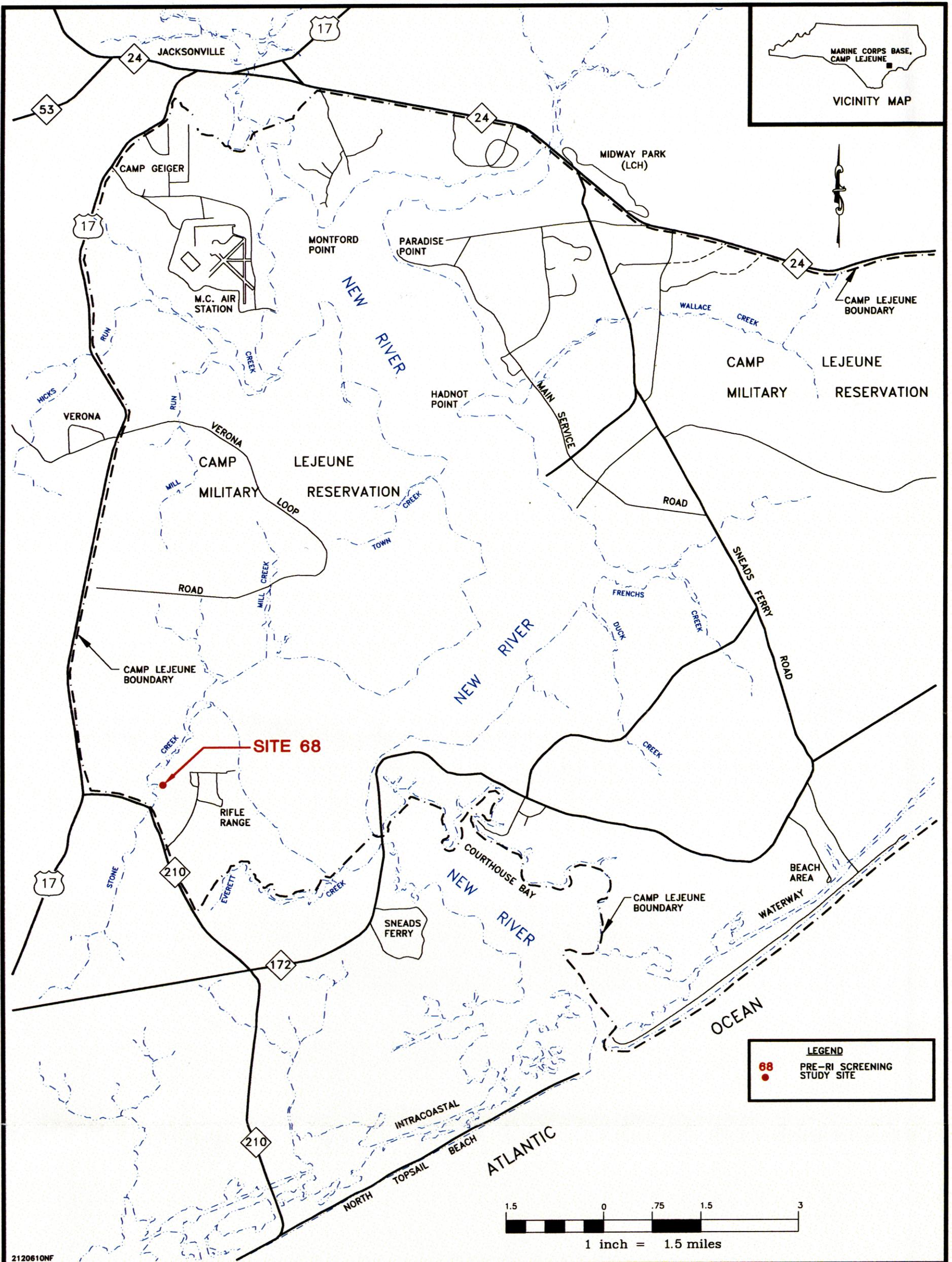
+ = Essential Nutrients

NA - Not Applicable

NE - Not Established

J - Estimated value

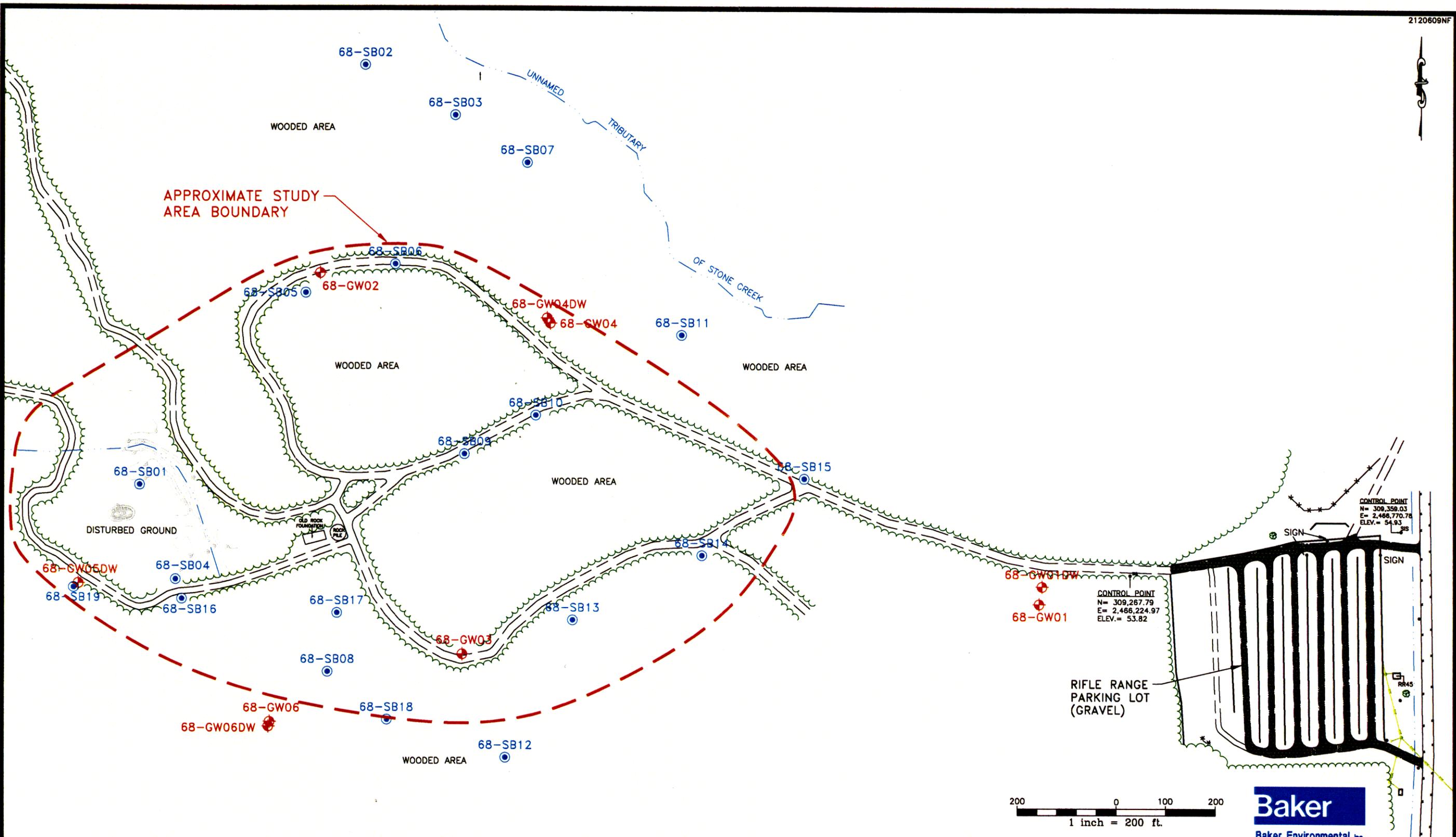
FIGURES



2120610NF

FIGURE 1-1
 SITE LOCATION MAP
 NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT
 CTO - 0120

MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

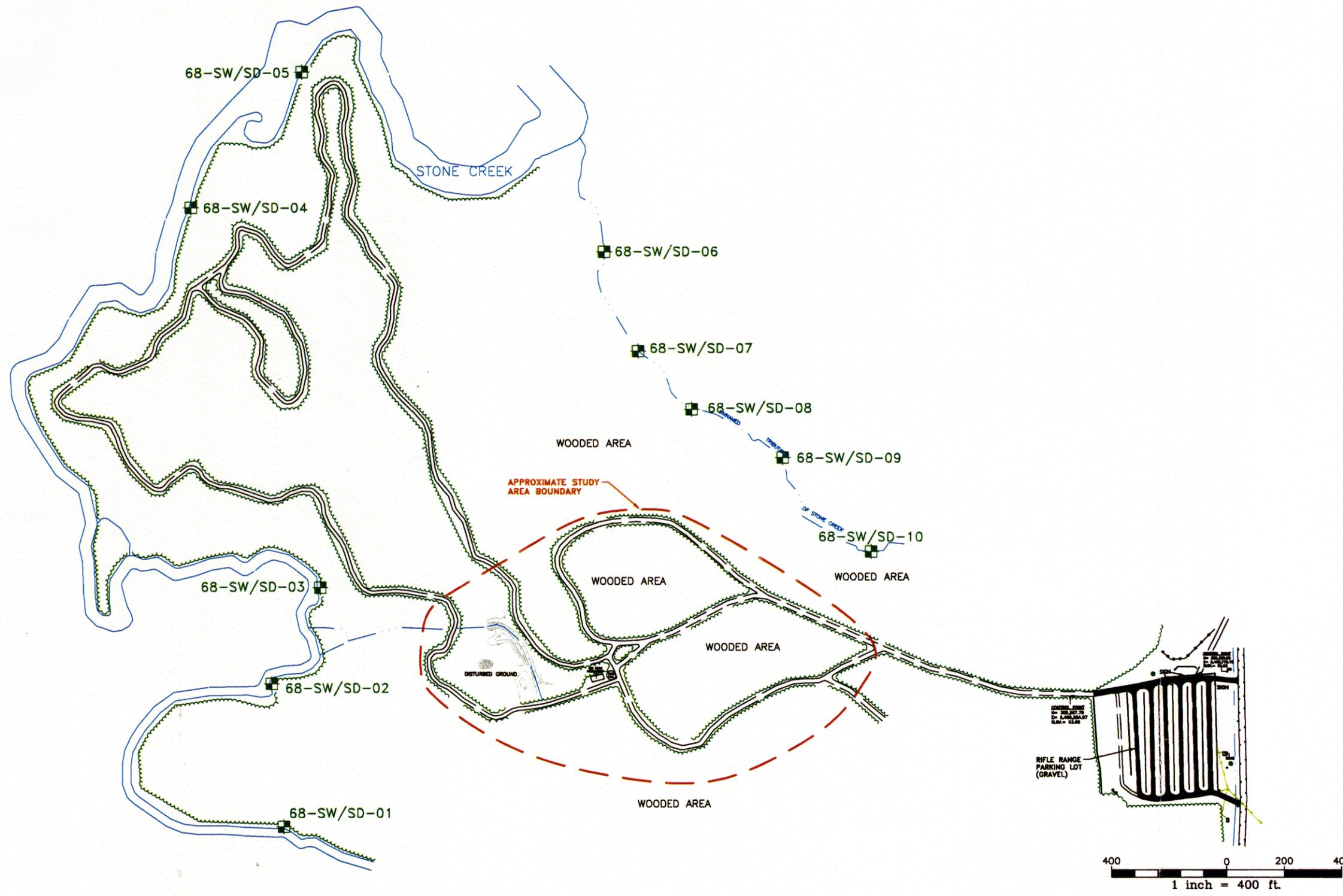


LEGEND

- 68-GW01DW - EXISTING GROUNDWATER MONITORING WELL LOCATION
- 68-SB12 - SOIL BORING LOCATION
- - TREE LINE
- - - - - INTERMITTENT STREAM
- == - DIRT OR GRAVEL ROAD

SOURCE: BRENT A. LANIER R.L.S., FEBRUARY 1996.

FIGURE 1-2
 SITE MAP AND
 SAMPLE LOCATIONS
 SITE 68 - RIFLE RANGE AREA
 NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT
 CTO - 0120
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



LEGEND	
68-SW/SD-04	- SURFACE WATER AND SEDIMENT SAMPLE STATION
	- TREE LINE
	- INTERMITTENT STREAM
	- DIRT OR GRAVEL ROAD

SOURCE: BRENT A. LANIER R.L.S., FEBRUARY 1996.

FIGURE 1-3
 SITE MAP AND
 SAMPLE LOCATIONS
 SITE 68 - RIFLE RANGE AREA
 NO FURTHER RESPONSE ACTION PLAN DECISION DOCUMENT
 CTO - 0120
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

**ATTACHMENT A
LAND USE CONTROL
IMPLEMENTATION PLAN (LUCIP)**

Original LUCIP Date: November 1999

Last Revised: November 1999

**LAND USE CONTROL IMPLEMENTATION PLAN (LUCIP)
MCB CAMP LEJEUNE (SITE 68)
RIFLE RANGE DUMP**

GENERAL

By separate Memorandum of Agreement dated May 24, 1999, hereinafter referred to as the Land Use Control Assurance Plan (LUCAP), the U.S. Environmental Protection Agency (USEPA); the North Carolina Department of Environment and Natural Resources (NCDENR); and the Department of the Navy (Navy) on behalf of U.S. Marine Corps Base, Camp Lejeune, agreed that the Navy and the United States Marine Corps (Marine Corps) shall follow certain procedures for implementing and maintaining site-specific land use controls. Those procedures are contained in the LUCAP, and, for Site 68, this Land Use Control Implementation Plan (LUCIP). The LUCAP is intended to ensure that all of the Department of the Navy's site-specific selected remedies with land use controls remain protective of human health and the environment. This LUCIP and its requirements are part of the Final No further Remedial Action Plan (NFRAP) for Site 68.

The parties to the LUCAP also agree that the efficacy/protectiveness of the land use controls within this Land Use Control Implementation Plan is contingent upon the Navy's substantial good-faith compliance with those procedures applicable to the NFRAP and the LUCIP for Site 68. Should such compliance not occur or should the LUCAP be terminated, the parties agree that the protectiveness of the LUCIP may be reconsidered by any party and remedial measures may be necessary to ensure the protection of human health and the environment. Based upon the history of Site 68, the need for remedial action would be determined and implemented through the five year review process.

This document is the LUCIP for MCB Camp Lejeune, Site 68, Rifle Range Dump. This LUCIP is an attachment to and a part of the NFRAP for the site.

The Navy and the Marine Corps will, pursuant to the LUCAP, include the land use controls set forth in this LUCIP within the Installation's Geographic Information System (GIS) and the base master planning process. Pursuant to the LUCAP paragraph IV. a), the Installation will provide written notification to the State and USEPA when the requirements of this paragraph have been met.

All proposed changes to this LUCIP will be submitted to the State and USEPA for review and concurrence prior to implementation. Changes to this LUCIP will be reflected in changes under the five year review plan.

The parties agree that the Navy's annual certification of land use control implementation is necessary for as long as the Navy retains ownership of the site. The NCDENR maintains this annual certification is part of the selected remedy. The Navy and Marine Corps maintain this annual certification is a procedure to implement the selected remedy and is not a part of the selected remedy. Nevertheless, all parties agree that a written certification is desirable. Accordingly, pursuant to the LUCAP paragraph V. b), MCB Camp Lejeune will provide certification annually to USEPA and the NCDENR that the land use controls within the NFRAP remain implemented.

SITE BOUNDARY IDENTIFICATION

The geographic boundary of the site is identified in Figure 1, Boundary of Site 68. This boundary indicates the outermost border of all controlled portions of the site (i.e., no areas subject to land use controls lie outside this boundary). The current boundary is driven by aquifer use controls.

The geographic boundary of the current potential groundwater contamination is identified in Figure A-2, Boundary of Current Potential Shallow Groundwater Contamination. The geographic boundary of the current potential deep groundwater contamination is identified in Figure A-3, Boundary of Current Potential Deep Groundwater Contamination. The geographic boundary of the current potential soil contamination is identified in Figure A-4, Boundary of Current Potential Soil Contamination. Solvents are suspected of having been dumped at the site but have not been located.

SITE USE CONTROLS

Unless specifically excepted by both NCDENR and USEPA, all residential land uses at the site are prohibited. See Figure A-5, Boundary of Land Use Controls. These controls are to remain in effect until it can be demonstrated that the suspected solvents do not pose a potential risk to human health. This would be determined through the five year review process.

AQUIFER USE CONTROLS

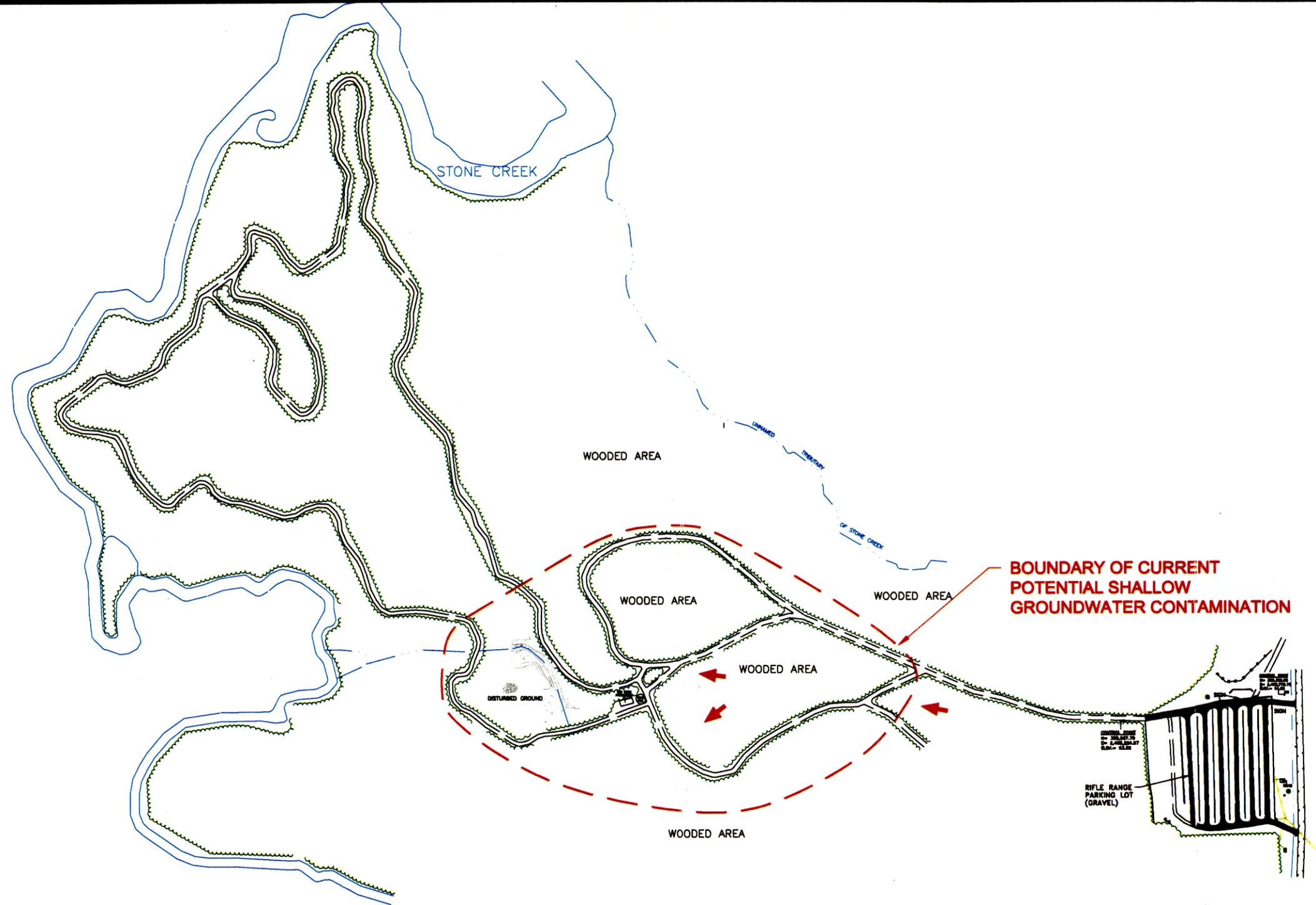
Except for monitoring purposes or as specifically excepted by NCDENR or the USEPA, all use of groundwater beneath Site 68 is prohibited. In addition, the installation of any well, other than those constructed for monitoring purposes, is prohibited except as authorized by North Carolina Administrative Code Title 15A, Chapter 2C (as amended), Well Construction. See Figure A-6, Boundary of Aquifer Use Controls. A 1,000-foot buffer around boundary of potential shallow and deep groundwater contamination is used to delineate this boundary. These controls are to remain in effect until it can be demonstrated that the suspected solvents do not pose a potential risk to human health. This would be determined through the five year review process.

SITE ACCESS CONTROLS

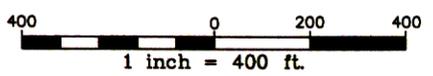
There are no controls on site access.

NOTIFICATION

Following the procedures contained within the LUCAP, MCB Camp Lejeune shall file a Notification of Inactive Hazardous Substance or Waste Disposal Site meeting the requirements of NCGS 130A-310.8.



**BOUNDARY OF CURRENT
POTENTIAL SHALLOW
GROUNDWATER CONTAMINATION**

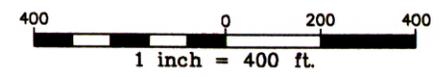
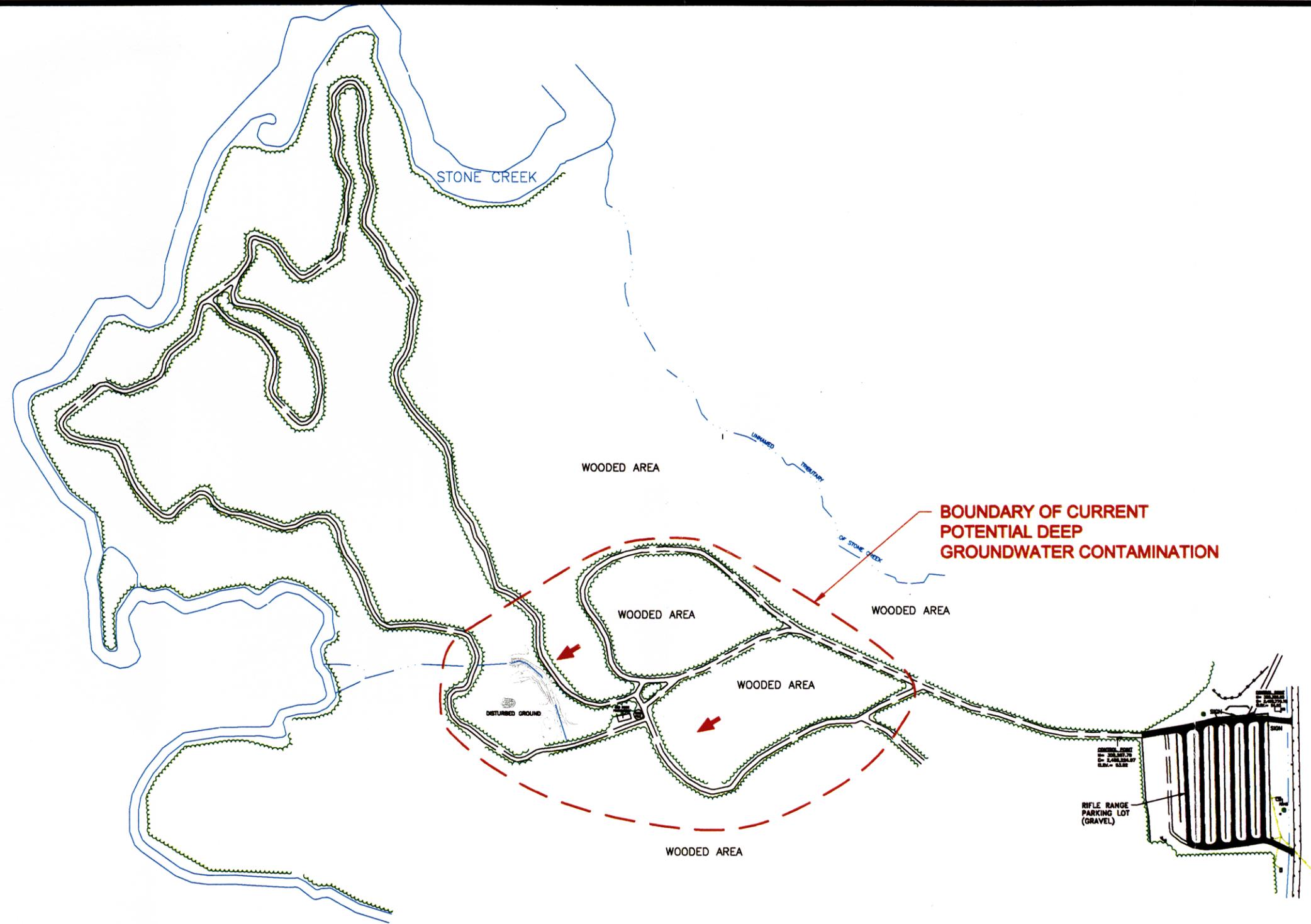


LEGEND

- TREE LINE
- INTERMITTENT STREAM
- DIRT OR GRAVEL ROAD
- BOUNDARY OF CURRENT POTENTIAL SHALLOW GROUNDWATER CONTAMINATION
- GROUNDWATER FLOW DIRECTION

SOURCE: BRENT A. LANIER R.L.S., FEBRUARY 1998.

FIGURE A-2
BOUNDARY OF CURRENT POTENTIAL
SHALLOW GROUNDWATER CONTAMINATION
SITE 68 - RIFLE RANGE AREA
APRIL 2000
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

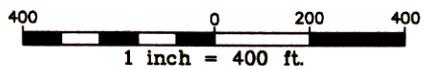
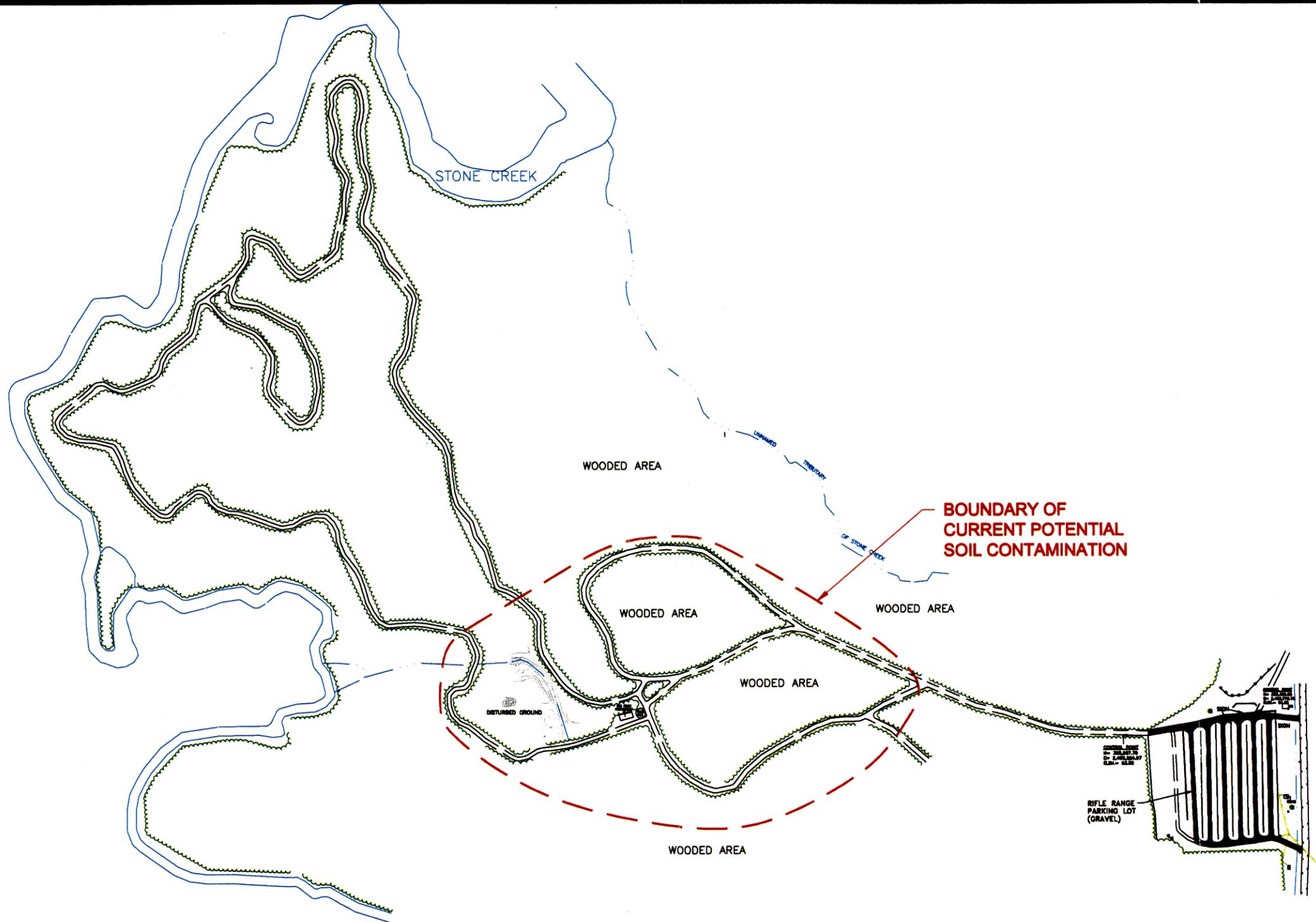


LEGEND

- TREE LINE
- INTERMITTENT STREAM
- DIRT OR GRAVEL ROAD
- BOUNDARY OF CURRENT POTENTIAL DEEP GROUNDWATER CONTAMINATION
- GROUNDWATER FLOW DIRECTION

SOURCE: BRENT A. LANIER R.L.S., FEBRUARY 1996.

FIGURE A-3
BOUNDARY OF CURRENT POTENTIAL DEEP GROUNDWATER CONTAMINATION
SITE 68 - RIFLE RANGE AREA
APRIL 2000
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

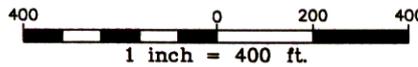
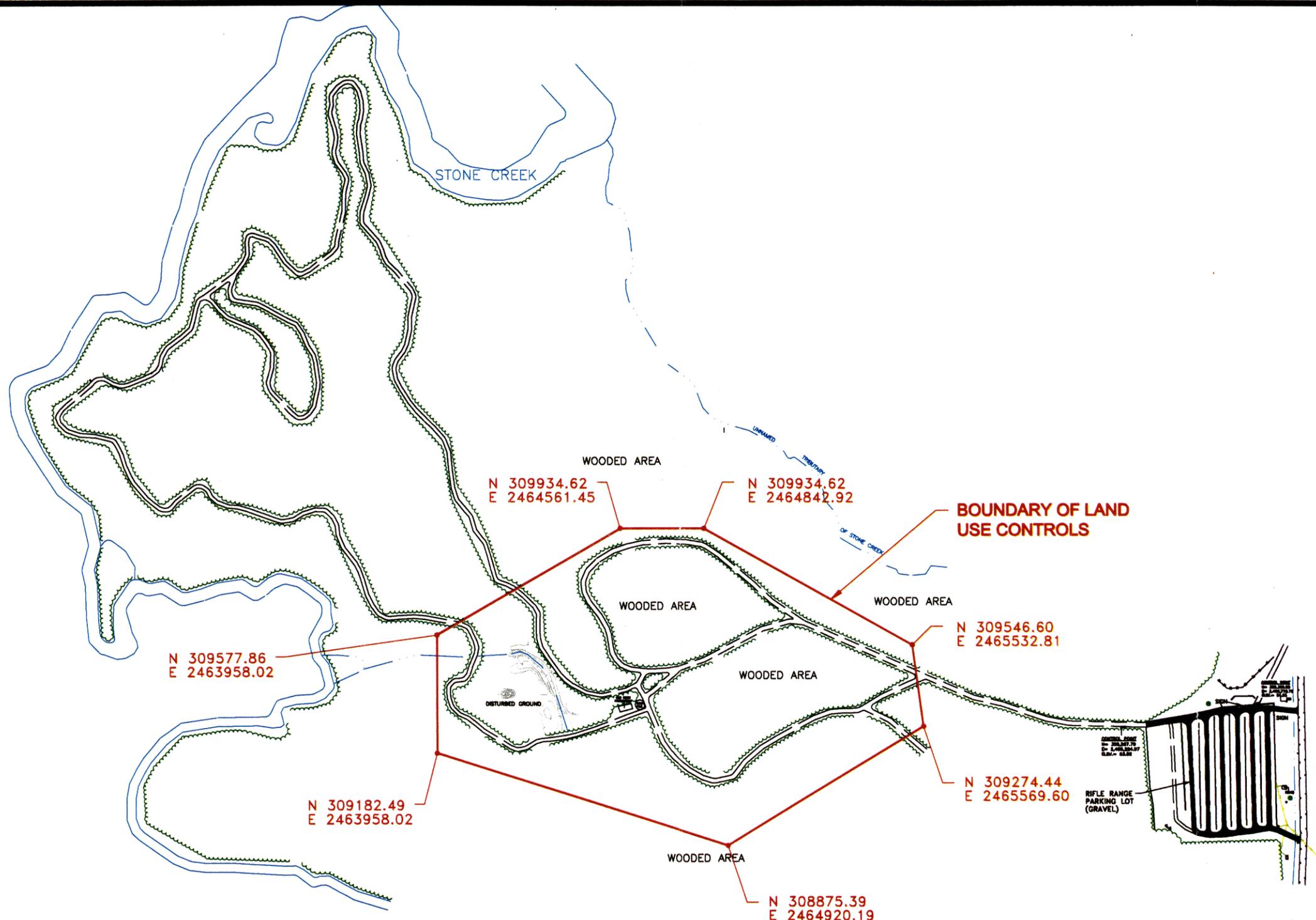


LEGEND

- TREE LINE
- INTERMITTENT STREAM
- DIRT OR GRAVEL ROAD
- BOUNDARY OF CURRENT POTENTIAL SOIL CONTAMINATION

SOURCE: BRENT A. LANIER R.L.S., FEBRUARY 1996.

FIGURE A-4
BOUNDARY OF CURRENT POTENTIAL
SOIL CONTAMINATION
SITE 68 - RIFLE RANGE AREA
APRIL 2000
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

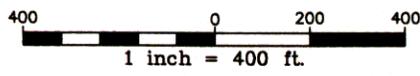
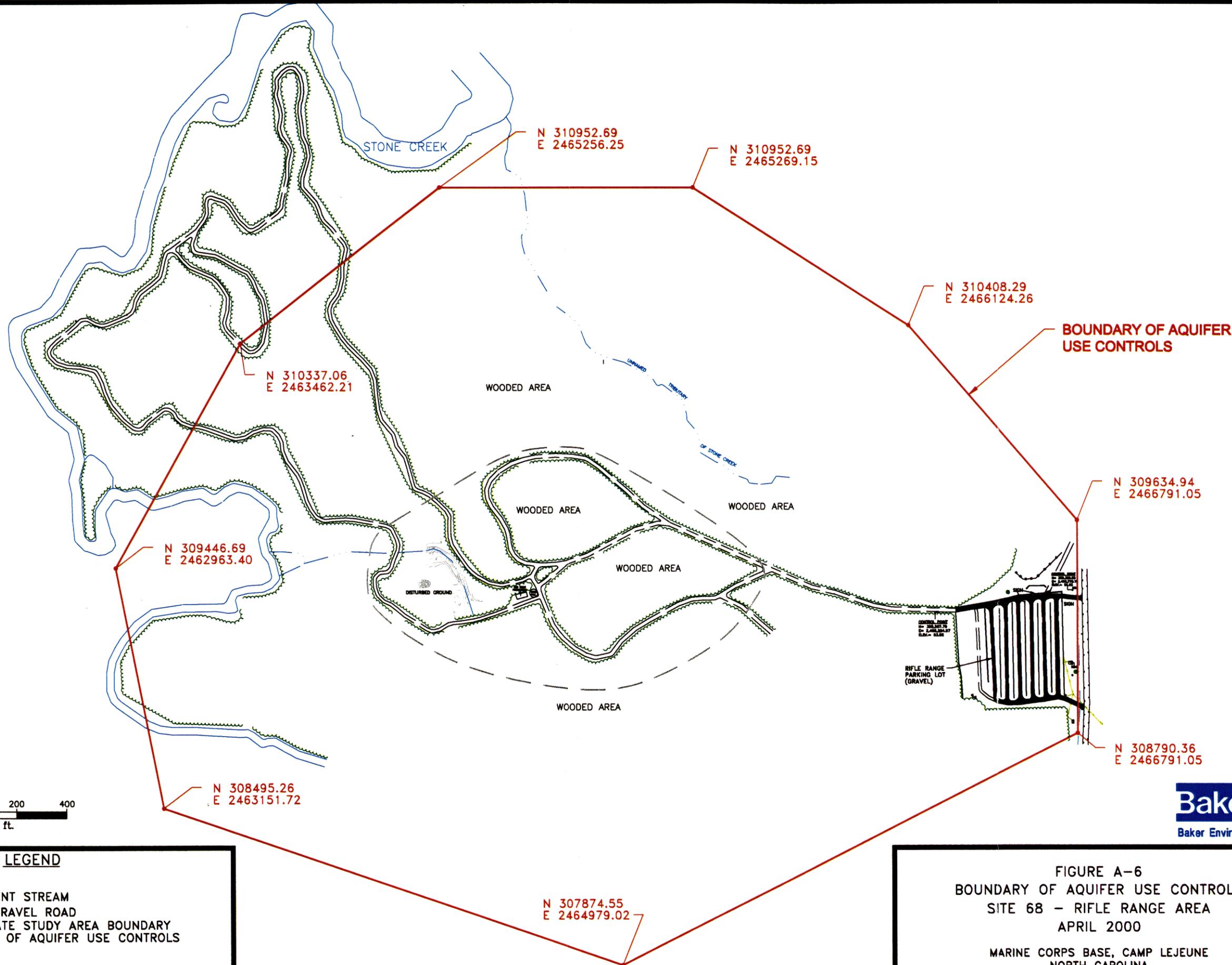


LEGEND

- TREE LINE
- INTERMITTENT STREAM
- DIRT OR GRAVEL ROAD
- BOUNDARY OF LAND USE CONTROLS

SOURCE: BRENT A. LANIER R.L.S., FEBRUARY 1998.

FIGURE A-5
 BOUNDARY OF LAND
 USE CONTROLS
 SITE 68 - RIFLE RANGE AREA
 APRIL 2000
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



LEGEND

- TREE LINE
- INTERMITTENT STREAM
- DIRT OR GRAVEL ROAD
- APPROXIMATE STUDY AREA BOUNDARY
- BOUNDARY OF AQUIFER USE CONTROLS

FIGURE A-6
BOUNDARY OF AQUIFER USE CONTROLS
SITE 68 - RIFLE RANGE AREA
APRIL 2000
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

ATTACHMENT B
STATE OF NORTH CAROLINA APPROVAL LETTER

THIS PAGE INTENTIONALLY LEFT BLANK