0409-07/13/95-01495

FINAL

PROPOSED REMEDIAL ACTION PLAN OPERABLE UNIT NO. 7 SITES 1, 28, AND 30

MARINE CORPS BASE,
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0231

JULY 13, 1995

Prepared For:

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

Under the:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared By:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ADL	Administrative Deadline Lot
AOC	area of concern
ARAR	applicable and relevant or appropriate requirements
AST	Aboveground Storage Tank
BEHP	bis(2-ethyl hexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPC	contaminant of potential concern
DoN	Department of the Navy
EPIC	Environmental Photographic Interpretation Center
FFA	Federal Facilities Agreement
FS	Feasibility Study
GW	groundwater
HPIA	Hadnot Point Industrial Area
IAS	Initial Assessment Study
IR	Installation Restoration
MCB	Marine Corps Base
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
NC DEHNR	NC Department of Environment, Health, and Natural Resources
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPW	net present worth
O&G	oil and grease
O&M	operation and maintenance
OU	Operable Unit
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
POL	petroleum, oil, and lubricants
PRAP	Proposed Remedial Action Plan
QI	quotient index
RA	Risk Assessment
RAA	remedial action alternative
RI	Remedial Investigation

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

RI/FS	Remedial Investigation/Feasibility Study
RL	remediation level
ROD	Record of Decision
STP	sewage treatment plant
SVOCs	semivolatile organic compounds
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOCs	volatile organic compounds

PROPOSED REMEDIAL ACTION PLAN

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. 7 at MCB, Camp Lejeune. OU No. 7 consists of three sites:

- Site 1, the French Creek Liquids Disposal Area
- Site 28, the Hadnot Point Burn Dump
- Site 30, the Sneads Ferry Road Fuel Tank Sludge Area

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 alternative for OU No. 7 and explain the rationale for the preference; solicit public review of the alternative; 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) Report, the Feasibility Study (FS) Report, and other documents referenced in the RI and FS Reports prepared for OU No. 7. These documents, which will be the basis for the selection of a remedial action plan at OU No. 7, 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 Operable Unit No. 7. 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 public comment period will begin on August 8, 1995 and end on September 6, 1995. 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. 7 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 actions for OU No. 7 will be prepared based upon the results of the FS 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.

Description of Operable Unit No. 7

MCB, Camp Lejeune is a training base for the United States Marine Corps, located in Onslow County, North Carolina. 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. 7 is one of 14 operable units within MCB, Camp Lejeune. An "operable unit", as defined for the Nation Oil and Hazardous Substances Pollution Contingency Plan (NCP), is a discrete action that comprises an incremental step toward comprehensively addressing site problems. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, site-specific problems, or initial phases of an action. With respect to MCB, Camp Lejeune, operable units were developed to combine one or more individual sites where Installation Restoration (IR) Program activities are or will be implemented. The sites which are combined into an operable unit share a common element. As the case with OU No. 7, Sites 1, 28, and 30 were grouped together

because of the similar nature of the wastes that are suspected to have been disposed of at the site and the geographic proximity of the sites.

As shown on Figure 1, OU No.7 is located on the eastern portion of the Base, situated between the New River and Sneads Ferry Road, south of the Hadnot Point Industrial Area (HPIA). Brief descriptions of each of the three sites that constitute OU No. 7 are presented below.

Site 1 - Description

Site 1, the French Creek Liquids Disposal Area, is the northernmost site located within OU No. 7. As shown on Figure 1, the site is located approximately one mile east of the New River and one mile southeast of the Hadnot Point Industrial Area (HPIA). Site 1 is situated along both the north and south sides of Main Service Road near the western edge of the Gun Park Area and Force Troops Complex.

Figure 2 presents a map of Site 1 that identifies the approximate boundaries of two suspected disposal areas at the site: the northern disposal area and the southern disposal area. The site boundaries coincide with the boundaries of these disposal areas. The following subsections describe the northern and southern portions of Site 1 and the surrounding areas.

Northern Portion of Site 1

As shown on Figure 2, the northern portion of Site 1 is surrounded by a treeline and a motor-cross training area to the north, a vehicle storage area associated with Building FC-100 to the east, Main Service Road to the south, and a treeline to the west. Most of the area within this portion of the site contains fenced-in buildings and parking areas. The former northern disposal area is located in this portion of Site 1. The majority of the former northern disposal area now contains two fenced-in areas that are associated with Buildings FC-120 and FC-134.

Building FC-120 serves as a motor transport maintenance facility for the Second Landing Support Battalion. It is a two story brick structure with offices and several vehicle maintenance bays. Building FC-134, located to the north of Building FC-120, provides offices and communication

equipment storage also for the Second Battalion. It is a brick structure with offices and one garage bay.

A number of covered material storage areas are located to the north and west of Building FC-120. These smaller covered structures are used for temporary storage of paint, compressed gasses, vehicle maintenance fluids, spent or contaminated materials, and batteries. In addition to these covered storage structures, an above ground storage tank (AST) area, located adjacent to the northern side of Building FC-120, is utilized to store spent motor oil and ethylene glycol (i.e., anti-freeze). Also, a gasoline service island is located to the west of Building FC-120. The two pumps at the service island provide fuel for vehicles undergoing maintenance at Building FC-120. An underground storage tank (UST) of unknown capacity is associated with this active service island.

Two equipment wash areas are located adjacent to the northern disposal area. The first wash area is located approximately 250 feet west of Building FC-120 and the second lies approximately 100 feet east of Building FC-134. Both equipment wash areas are concrete-lined and employ an oil and water separator collection basin. A third oil and water separator is located to the northwest of Building FC-120.

There are two surface water features, a sediment retention pond and a swampy area, that influence drainage near the northern portion of the site. The retention pond, located north of Building FC-134, receives surface water runoff via a gravel drainage ditch from the parking lot, the three oil and water separators, and the surrounding areas. Surface water runoff north of Building FC-134 drains into the swampy area toward a topographic low area.

Southern Portion of Site 1

As shown on Figure 2, the southern portion of Site 1 is surrounded by Main Service Road to the north, Daly Road to the east, H. M. Smith boulevard to the south, and Gonzales Boulevard and a wooded area to the west. The area of the former southern disposal area now contains Buildings 739 and 816, a fenced-in vehicle and equipment Administrative Deadline Lot (ADL), and a fenced-in hazardous materials storage area.

The hazardous materials storage area, which is concrete-lined and bermed, is located north of Building 816. This storage area is used for the temporary storage of vehicle maintenance fluids, spent or contaminated materials, fuel, and batteries. In addition, a number of storage lockers are located throughout the southern portion of Site 1. These lockers are used to store paints and other flammable materials used by maintenance and machine shop personnel.

Several small buildings are located adjacent to the suspected southern disposal area. These buildings house a number of support offices, recreation facilities, machine shops, light-duty vehicle and equipment maintenance bays, and equipment storage areas. Heat is provided to the majority of these buildings by kerosene-fired stoves. Kerosene fuel is stored in ASTs located beside each building.

Two vehicle maintenance ramps are also located near the southern portion of Site 1. The first ramp is located immediately to the south of Building 739 and the second lies to the north of Building GP-19. Both maintenance ramps are constructed of concrete and are used for the upkeep of vehicles and equipment.

In addition, three oil and water separator collection basins are located near the southern portion of Site 1. One separator is located adjacent to the Building 739 vehicle maintenance ramp, one separator is located southeast of Building GP-19, and one separator is located approximately 100 feet south of Building 816, adjacent to an equipment wash area. Discharge from the separators and wash areas flows into a stormwater sewer and then into the drainage ditch adjacent to H. M. Smith Boulevard.

Besides receiving discharge from the separators, the drainage ditch also receives surface water runoff from the southernmost portions of the site and nearby parking lots. Although it is a site-related surface water feature, the ditch is mainly dry year round. The ditch starts within the site boundaries, flows west toward the HPIA Sewage Treatment Plant (i.e., Site 28), then empties into Cogdels Creek. Cogdels Creek eventually discharges into the New River which is located approximately one mile west of Site 1.

Site 28 - Description

Site 28, the Hadnot Point Burn Dump, is the westernmost site located within OU No. 7 (refer to Figure 1). The site is located along the eastern bank of the New River and is approximately one mile south of the HPIA on the Mainside portion of MCB, Camp Lejeune.

Figure 3 presents a map of Site 28. As shown, the site is surrounded by the Hadnot Point Sewage Treatment Plant (STP) to the north, by wooded and marshy areas to the east and south, and by the New River to the west. Cogdels Creek flows into the New River at Site 28 and forms a natural divide between the eastern and western portions of the site. Vehicle access to the site is via Julian C. Smith Boulevard near its intersection with O Street. The eastern and western portions of the site are served by an improved gravel road.

A majority of the estimated 23 acres that constitute Site 28 are used for recreation and physical training exercises. The site is predominantly comprised of two lawn and recreation areas, known collectively as the Orde Pond Recreation Area, that are separated by Cogdels Creek. Picnic pavilions, playground equipment, and a stocked fish pond (Orde Pond) are located within this recreation area. They are regularly used by base personnel and their families. In addition, field exercises and physical training activities frequently take place at the recreation area.

The Hadnot Point STP is located on and adjacent to Site 28. A portion of the STP facility (the equalization lagoon) extends across Cogdels Creek, from west to east. The STP operates a number of clarifying, settling, and aeration ponds that are located on either side of Cogdels Creek. Both operational areas of the STP are fenced with six-foot chain link. The treated water from the STP discharges into the New River via an outfall pipe approximately 400 feet from the shoreline.

Site 30 - Description

Site 30, the Sneads Ferry Road Fuel Tank Sludge Area, is the southernmost site located within OU No. 7 (refer to Figure 1). The site is situated along a tank trail which intersects Sneads Ferry Road from the west, approximately 1 mile south of the intersection with Marines Road, and roughly 4-1/2 miles south of the HPIA. The site is located adjacent to the Combat Town Training Area. The

surrounding training areas and adjacent artillery ranges are used to prepare specialized personnel for various tactical operations and to simulate amphibious assault conditions.

Figure 4 presents a map of Site 30. The site boundary depicted on Figure 4 coincides with the approximate extent of a suspected sludge disposal area. The majority of the Site 30 area is wooded containing trees of less than three inches in diameter and dense under story. Unimproved paths are found within and around the site. The tank trail that leads to the suspected disposal area is occasionally used as part of field training exercises. As shown on Figure 4, one of two streams which comprise the headwaters of Frenchs Creek lies approximately 1,500 feet west of Site 28. Surface water runoff and groundwater flow directions are generally to the west and north toward French Creek.

History of Operable Unit No. 7

The following subsections describe the history (i.e., the past land usages and waste disposal practices) of Sites 1, 28, and 30.

Site 1 - History

Site 1 had been used by several different mechanized, armored, and artillery units since the 1940s. Reportedly, liquid wastes generated from vehicle maintenance were routinely poured onto the ground surface. During motor oil changes, vehicles were driven to a disposal point and drained of used oil. In addition, acid from dead batteries was reportedly hand carried from maintenance buildings to disposal points. At times, holes were reportedly dug for waste acid disposal and then immediately backfilled. Thus, the disposal areas at Site 1 are suspected to contain petroleum, oil, and lubricants (POL) and battery acid.

The total extent of both the northern and southern disposal areas is estimated to be between seven and eight acres. The quantity of POL waste disposed at the areas is estimated to be between 5,000 and 20,000 gallons; the quantity of battery acid waste is estimated to be between 1,000 and 10,000 gallons.

Site 1 continues to serve as a vehicle and equipment maintenance/staging area.

Site 28 - History

Site 28 operated from 1946 to 1971 as a burn area for a variety of solid wastes generated on Base. Reportedly, industrial waste, trash, oil-based paint, and construction debris were burned then covered with soil. In 1971, the burn dump ceased operations, and was graded and seeded with grass.

The total volume of fill within the dump is estimated to be between 185,000 and 375,000 cubic yards. This estimate was based upon a surface area of 23 acres and a depth ranging from five to ten feet.

Site 30 - History

Site 30 was reportedly used by a private contractor as a cleaning area for emptied fuel storage tanks from other locations. The tanks were used to store leaded gasoline that contained tetraethyl lead and related compounds. Since fuel residuals remaining in the emptied tanks were reportedly washed out at Site 30, the disposal area is suspected to contain fuel sludge and wastewater from the washout of the tanks.

The suspected disposal area measures approximately 7,500 square yards. It is estimated that, at a minimum, 600 gallons of sludge were removed from tanks and drained onto the ground surface during the cleaning process. This estimate is based on the projected volume of material remaining in two 12,000 gallon tanks and the amount of material below their outflow ports. Supplemental information suggests that the site may have been used for the disposal of similar wastes from other tanks. The quantity and composition of the waste is unknown. However, it is suspected to have contained tetraethyl lead and cleansing compounds.

Previous Investigations

Previous investigations conducted at OU No. 7 include an Initial Assessment Study (IAS), a Confirmation Study, a soil assessment at Site 1, an aerial photographic investigation, an additional surface water and sediment investigation, an additional groundwater investigation, an RI, and an FS. A brief description of each of these investigations is presented below.

Initial Assessment Study

In 1983, an IAS was conducted at MCB, Camp Lejeune to evaluate potential hazards at various sites throughout the Base. The IAS was based upon a review of historical records and aerial photographs, field inspections, and personnel interviews. Conclusions from the IAS indicated that a number of sites, including Sites 1, 28, and 30, contained potential source areas of contamination and warranted further investigations.

Confirmation Study

As a result of the IAS, a Confirmation Study was conducted at MCB, Camp Lejeune between 1984 and 1987. The study consisted of two steps: a Verification Step, performed in 1984, and a Confirmation Step, performed in 1986 and 1987. The purpose of the study was to investigate potential contaminant source areas identified during the IAS. The following paragraphs summarize the results of the Confirmation Study at Sites 1, 28, and 30, and the final recommendations that were made based on these results.

Site 1 Results

At Site 1, the Confirmation Study focused on the presence of potential contaminants in groundwater, surface water, and sediment. Organic and inorganic contaminants were identified in the groundwater samples collected at the site The volatile organic compounds (VOCs), tetrachloroethene (PCE) and trichloroethene (TCE), were identified at levels exceeding present groundwater standards in a number of groundwater samples. In addition, oil and grease (O&G) was detected in groundwater, surface water, and sediment samples. The presence of the O&G was most likely due to the POL that had reportedly been disposed of at Site 1.

Site 28 Results

At Site 28, the Confirmation Study focused on the presence of potential contaminants in groundwater, surface water, sediment, and fish tissue. Overall, inorganics were the most prevalent contaminant group detected throughout both rounds of the Confirmation Study. Groundwater,

surface water, and sediment samples suggested that the inorganics, with the exception of mercury in surface water, originated from the disposal area at the site.

Concentrations of inorganics in groundwater generally decreased from one sampling round to the next, during 1984 and 1986. Inorganic concentrations in sediment, however, increased from the first to the second sampling round. Surface water samples obtained from Cogdels Creek identified cadmium and mercury at concentrations that, in certain cases, exceeded state surface water standards. Lead was detected at concentrations exceeding regulatory limits in sediment samples collected from Cogdels Creek and shallow groundwater samples collected during both the 1984 and 1986 investigations. In addition, mercury was detected in surface water and shallow groundwater samples. The distribution of mercury throughout the site suggested that the contaminant was not only present at the site, but may also have migrated from an upstream location.

In addition to the inorganics detected in the groundwater , VOCs were detected in samples collected from one monitoring well at the site. The detected concentrations exceeded regulatory limits for TCE and vinyl chloride. VOCs were not detected in groundwater samples from any of the other three existing wells.

The pesticide Alpha-BHC and polychlorinated biphenyls (PCBs) were detected in fish tissue obtained from Orde Pond in 1984. However, Alpha-BHC was detected at low concentrations and the PCBs were suspected to have bioaccumulated in the food chain. Also, PCBs were not detected elsewhere during the Confirmation Study at Site 28. Thus, neither the pesticide nor the PCBs appeared to be site related.

Site 30 Results

At Site 30, the Confirmation Study focused on the presence of potential contaminants in groundwater, surface water, and sediment. For the groundwater investigation, two monitoring wells were installed at the site. Lead was detected in the samples collected from these wells at levels exceeding state and federal drinking water standards. In the surface water, no detectable levels of target compounds were identified. During the sediment investigation, data collected suggested that O&G was present in both the suspected disposal area and stream bed sediments at Site 30. However,

it was not clear whether the presence of O&G could be attributed to heavy vehicular traffic or emergency vehicle maintenance in the Combat Town Training Area.

Recommendations of the Confirmation Study

The Confirmation Study recommended that further characterization of Sites 1, 28, and 30, including a risk assessment, be performed to complete the RI/FS process. The Confirmation Study also recommended that additional surface water and sediment investigations of Cogdels Creek, between Site 28 and the HPIA, be conducted to determine possible upstream sources of contamination.

Soil Assessment at Site 1

In 1991, a soil assessment was conducted at Site 1. The purpose of this assessment was to evaluate the soil quality at the site prior to initiating a proposed construction project near the southern disposal area. Analytical results from the soil investigation identified the presence of several inorganics. Concentrations of detected inorganics including cadmium, chromium, lead, and manganese were, in general, consistent throughout the site. Contaminants were also detected in soil samples collected from upgradient locations. The distribution and comparable nature of detected inorganics in the soil and environmental media sampled during other investigations suggested that these inorganics are found throughout adjoining areas.

Aerial Photographic Investigation

In 1992, an aerial photographic investigation was completed by the USEPA's Environmental Photographic Interpretation Center (EPIC) for several areas within MCB, Camp Lejeune. The investigation employed photographs to locate and assess potential sources of contamination, and to delineate the extent of disposal activities within the study area.

At Site 1, black-and-white aerial photographs dating from 1944, 1949, 1952, 1956, 1960, 1964, 1984, 1988, and 1990 were made available for examination of surface conditions. The photographs indicated that over time, significant clearing and construction took place within the suspected disposal areas at Site 1. Operations including the staging of equipment and vehicles also appeared to increase over time.

At Site 28, black-and-white aerial photographs dating from 1949, 1952, 1956, 1960, and 1964 were used for the visual analysis of surface conditions. Additional photographs from 1938 and 1943 were employed to establish a basis of comparison, prior to development of the Camp Lejeune Military Reservation. The aerial photographs contained visual evidence of past waste disposal activities and assisted in defining areas of concern (AOCs) at the site.

At Site 30, a black-and-white aerial photograph taken in 1964 was made available for examination of surface conditions. Although the photograph was taken prior to the reported disposal event, 1970, information from the photograph was employed to evaluate potential source areas of contamination.

Additional Surface Water and Sediment Investigation

In 1993, an additional surface water and sediment investigation of Cogdels Creek and the New River was conducted to support RI scoping activities. The most prevalent contaminants detected in the surface water and sediment samples were polycyclic aromatic hydrocarbon (PAH) compounds, pesticides, and inorganics. PAH compounds were detected in sediment samples from both Cogdels Creek and the New River. Some of the highest PAH concentrations were detected in a sediment sample from the New River, downstream of Site 28. PAH compounds were also detected upstream of the site, in sediments collected from Cogdels Creek.

Additional Groundwater Investigation

In 1993, an additional groundwater investigation was conducted at Sites 1, 28, and 30 to support RI scoping activities. This study included one round of groundwater sampling from five wells at Site 1, four wells at Site 28, and two wells at Site 30.

At Site 1, analytical results from the groundwater investigation identified the presence of inorganics. Concentrations of detected inorganics including cadmium, chromium, lead, and manganese were, in general, consistent throughout the site. Potential contaminants were also detected in groundwater samples obtained from upgradient locations. The distribution and comparable nature of detected inorganics in the groundwater and environmental media sampled during other investigations suggests that these inorganics are found throughout adjoining areas.

At Site 28, the most prevalent contaminants detected in the groundwater samples collected under this investigation were PAHs and inorganics. Total inorganics were frequently detected at concentrations in excess of state and federal groundwater standards.

At Site 30, groundwater samples were collected from both existing monitoring wells. Inorganics were detected in both wells with the detections at the easternmost well being generally greater than the detections at the westernmost well. Cadmium, chromium, and lead were all detected at levels exceeding federal and state standards at the easternmost well.

Remedial Investigation

In 1994, Baker Environmental, Inc. conducted an RI for OU No. 7. The following investigations were conducted at each site:

- Site 1
  - Soil Investigation (128 samples)
  - Groundwater Investigation (19 samples; two rounds of samples)
- Site 28
  - Soil Investigation (94 samples)
  - Groundwater Investigation (13 samples; two rounds of samples)
  - Surface Water and Sediment Investigations (14 surface water and 27 sediment samples)
  - Benthic and Aquatic Investigations (6 benthic and 19 aquatic samples)
- Site 30
  - Soil Investigation (25 samples)
  - Groundwater Investigation (3 samples; two rounds of samples)
  - Surface Water and Sediment Investigations (3 surface water and 6 sediment samples)

Note that surface water and sediment samples were initially proposed at the drainage ditch located along the southern portion of Site 1. However, due to a lack of surface water, the ditch did not represent a classifiable surface water body used for human consumption or recreation, nor did it represent an ecological habitat.

The following briefly summarizes the results of the RI conducted at each site.

Site 1 RI Results

Soil:

VOCs were not found in surface soils, but were detected in four out of 110 subsurface samples. TCE and toluene were detected at very low concentrations in samples from the northern central portion of the study area.

SVOCs were not encountered in surface soils, but were detected in a number of subsurface soil samples. Most notable among the SVOCs detected were three PAH compounds, di-n-butylphthalate, and bis (2-ethyl hexyl)phthalate (BEHP).

The pesticides dieldrin, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, endrin aldehyde, alpha-chlordane, and gamma-chlordane were detected in the soil at Site 1. Each of these pesticides was detected, at low concentrations, in at least two of the 124 soil samples. The pesticide 4,4'-DDT was the most prevalent, with 10 positive detections ranging from 1.6 to 18 micrograms per kilogram (µg/Kg), and the highest pesticide concentration was that of 4,4'-DDE at 120 µg/Kg.

The PCBs Aroclor 1254 and Aroclor 1260 were each detected once within the subsurface soil. Aroclor 1254 was detected on the southern portion of the site at a concentration of 18 µg/Kg. Aroclor 1260 was detected near the center of the northern disposal area at a concentration of 1300 µg/Kg.

Several inorganics were also detected in the surface and subsurface soil at Site 1. However, the detected concentrations of these inorganics did not significantly differ from Base-specific background concentrations. Therefore, the positive detections of inorganics in soil did not appear to be the result of past disposal practices.

Groundwater:

Positive detections of VOCs in groundwater were limited to the northern portion of the study area. TCE was detected in three samples obtained from the shallow aquifer. The maximum TCE concentration, 27 micrograms per liter (µg/L), was detected in the central northern portion of the study area. This detected concentration slightly exceeds the federal standard for TCE, 2.8 µg/L. Figure 5 shows a possible plume of TCE that was delineated based on positive detections of this contaminant and the direction of groundwater flow, northwest. Two other VOCs, 1,2-dichloroethene and 1,1-dichloroethene, were observed at maximum concentrations of 21 µg/L and 2 µg/L, respectively. Neither contaminant level exceeded federal or state standards. The maximum 1,2-dichloroethene and 1,1-dichloroethene concentrations were detected in a well located to the west of the suspected northern disposal area. Vinyl chloride was also detected at a maximum concentration of 4 µg/L which exceeds its state and federal drinking water standards.

Like VOCs, the positive detections of SVOCs were limited to the northern portion of the study area. Phenol and diethylphthalate were detected during the first sampling round only in the deep aquifer at concentrations of 6 µg/L and 1 µg/L, respectively.

Inorganics were the most prevalent among contaminants detected in the groundwater at Site 1. However, the positive detections of inorganics were distributed sporadically throughout the site and did not appear to be related to the groundwater flow direction. As a result, most of the inorganics did not appear to be site related. Iron and manganese, in particular, were detected at maximum concentrations of 29,200 µg/L and 1,200 µg/L. These levels exceeded state drinking water standards. However, positive detections of iron and manganese were distributed sporadically throughout the site, indicative of natural site conditions rather than disposal activities. In addition, iron and manganese concentrations in groundwater throughout MCB, Camp Lejeune often exceed state and federal standards. During past studies, manganese concentrations at a nearby potable water supply well and at several Site 1 wells exceeded the standards, but fell within the range of concentrations for samples collected elsewhere at MCB, Camp Lejeune.

Site 28 RI Results

Soil:

VOCs were found in one surface soil sample and two subsurface soil samples at very low concentrations. The VOCs benzene, PCE, and 1,1,1-trichloroethane were each detected once within the 72 soil samples collected at Site 28. Based upon their wide dispersion, infrequent detection, and low concentration, the occurrence of VOCs in soils at Site 28 did not appear to be a significant problem resulting from previous disposal practices.

SVOCs, among the other organic compounds within soil at Site 28, appeared to be the most directly linked to past disposal practices. Several SVOCs were identified in both surface and subsurface soil samples, primarily from the western disposal area. A majority of SVOCs detected in soil samples were PAH compounds, most probably resulting from past burning of waste material or refuse.

The pesticides dieldrin, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, alpha-chlordane, and gamma-chlordane appeared to be the most widely scattered contaminants within soils at Site 28. Each of the five pesticides was detected in at least 15 of the 72 soil samples. The pesticide 4,4'-DDE was the most prevalent, with 44 positive detections ranging from 3.1 to 1,600 µg/Kg. The highest pesticide concentration was that of 4,4'-DDT at 7,300 µg/Kg. In general, higher concentrations of those pesticides more frequently detected were limited to the western portion of the site around the picnic area.

Three PCBs, Aroclor 1242, Aroclor 1254, and Aroclor 1260, were detected in subsurface soil samples. The maximum PCB concentration was 140 µg/Kg from a location in the center of the site on the northern side of the fence surrounding the treatment plant.

Inorganics were detected in both surface and subsurface soil samples from the western portion of the study area at concentrations greater than one order of magnitude above base-specific background levels. In general, elevated inorganics concentrations were limited to soils obtained from the western portion of the study area. The inorganics copper, lead, manganese, and zinc were observed at maximum concentrations greater than two orders of

magnitude above Base-specific background levels. The same three inorganics had several positive detections in excess of the one order of magnitude level.

Groundwater:

Positive detections of VOCs in groundwater were limited to the central western portion of the study area. Chloroform, ethylbenzene, and xylene were detected in a single shallow groundwater sample obtained from a temporary well located there.

SVOCs were detected in five of ten shallow groundwater samples obtained during the first sampling round from the western portion of the study area. These SVOCs included fluorene, phenanthrene, fluoranthene, pyrene, and chrysene. The maximum SVOC concentration, 99 µg/L, was detected within the sample from a temporary monitoring well located in the central western portion of the study area. SVOC analyses of groundwater samples were not performed as part of the second sampling round.

The pesticides 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, and gamma-chlordane were each detected at least once within samples obtained from six shallow monitoring wells located on the western portion of Site 28, during the first sampling round. The pesticides 4,4'-DDE and 4,4'-DDD were detected within five and six shallow groundwater samples, respectively. The highest pesticide concentration detected was 9 µg/L, within the sample obtained from a monitoring well in the center of the site. A second round of groundwater samples was obtained from those monitoring wells that presented evidence of pesticide contamination during the first sampling round. However, groundwater samples obtained during the second sampling round did not exhibit pesticides.

Inorganics were the most prevalent and widely distributed contaminants in groundwater at Site 28 and were found distributed throughout the site. Concentrations of inorganics, in samples obtained during both sampling rounds, were generally higher in shallow groundwater samples than in samples collected from the deeper aquifer. Lead was detected, and confirmed by the second sampling round in only 1 of the 12 shallow and deep groundwater samples. Lead levels exceeded the state and federal drinking water standard from a well located in the north-central portion of the site. Iron and manganese were the

most prevalent inorganic elements detected during both sampling rounds. Concentrations of iron and manganese were confirmed by the second sampling round to have exceeded either federal or state standards within 7 groundwater samples.

Surface Water:

In New River surface water, copper exceeded aquatic reference values but at levels that were indicative of a low potential risk. Lead and zinc only exceeded the acceptable limit slightly at a single station. Aluminum exceeded the acceptable limit slightly in Orde Pond.

Sediment:

In the sediments, lead exceeded aquatic reference values only once in Cogdels Creek at a low level but exceeded reference values significantly in the New River at one station. Antimony exceeded its sediment aquatic reference values moderately at the same station in the New River. This station may be associated with runoff from the active firing range. Pesticides exceeded the sediment aquatic reference values throughout Cogdels Creek with the highest exceedances in the lower reach of the creek near the confluence with the New River. However, these exceedances represent a moderate potential for risk to aquatic receptors. The levels of pesticides detected in the sediments may be a result of routine application in the vicinity of Site 28, especially near the sewage treatment plant and recreation area.

Benthic and Aquatic:

Results of the analysis of benthic macroinvertebrates and fish populations indicate that Cogdels Creek and this reach of the New River supports an aquatic community that is representative of a tidally-influenced freshwater and estuarine ecosystem with both freshwater and marine species. The absence of pathologies observed in the fish sampled from Cogdels Creek and the New River indicates that the surface water and sediment quality does not appear to adversely impact the fish community. The benthic community demonstrated the typical tidal/freshwater species trend of primarily chironmids and oligochaetes in the upper reaches of Cogdels Creek and polychaetes and amphipods in the

lower reaches of Cogdels Creek and in the New River. Species representative of both tolerant and intolerant taxa were present and the overall community composition did not indicate a benthic community adversely impacted by surface water and sediment quality.

Site 30 RI Results

Soil:

The VOC 1,1,1-trichloroethane was the only organic compound detected in surface soil samples at Site 30. 1,1,1-trichloroethane was detected at concentrations of 2 and 3 µg/kg from two sampling locations situated along the tank trail on the northeastern edge of the site boundary. No other positive detections of VOCs or SVOCs were observed among surface soil samples.

Inorganics were detected in the surface soil samples retained from Site 30. However, none of the positive detections of priority pollutant inorganics exceeded Base-specific background levels for surface soil.

The VOC 1,1,1-trichloroethane was the only organic compound detected in subsurface soil samples at Site 30. It was detected at a concentration of 2 µg/kg in a sample located near the center of the suspected disposal area. No other positive detections of VOCs or SVOCs were observed among subsurface soil samples.

Chromium was the only inorganic detected in subsurface soil at concentrations greater than Base-specific background levels. The maximum chromium concentration among subsurface soil samples was 13.2 µg/kg. Four of the 12 chromium detections slightly exceeded the maximum Base-specific background concentration. The four detections were scattered throughout the study area.

Groundwater:

Chloroform, an SVOC, was the only organic compound detected in the surficial aquifer during the first sampling round. Chloroform was detected at a concentration of 9 µg/L. During the second sampling round, chloroform was once again detected in a groundwater sample obtained from the monitoring well located in the center of the site boundary. It was detected at a concentration of 3 µg/L. No other VOCs were detected.

Inorganics, both total and dissolved fractions, were detected in samples obtained from each of the three monitoring wells at Site 30. Chromium, iron, lead, and manganese were each detected among the three groundwater samples at concentrations which exceeded either federal or state drinking water standards for total inorganics. Chromium, iron, lead, and manganese were detected at maximum concentrations of 111 J, 41,400 J, 59.1, and 181 µg/L, respectively. None of these positive detections, in excess of either federal or state standards, were above Base-specific background levels. During the second sampling round, iron was detected at a concentration of 692 µg/L (based on total metal analyses) in a sample from the monitoring well, located approximately 300 yards upgradient of the site. This detected concentration exceeds the state standard of 300 µg/L.

Surface Water:

Three surface water samples from Frenchs Creek were submitted for laboratory analysis. Lead and mercury were the only inorganics identified at concentrations in excess of screening values. Both lead and mercury detections were observed in a sample located upgradient of the study area. Lead and mercury were detected at concentrations of 2.3 and 0.15 µg/L, respectively. No other total metal concentrations were in excess of screening values. Further, VOCs and SVOCs were not detected in any of the three surface water samples.

Sediment:

VOCs were not detected among the six sediment samples retained for analysis from Frenchs Creek. The SVOC BEHP was detected in two Frenchs Creek sediment samples. The

concentrations of BEHP at the upstream and downstream locations were 3,900 and 2,600 µg/kg, respectively. No inorganics concentrations among the six sediment samples exceeded screening values.

Based on the analytical results from the sampling of environmental media, contaminants of potential concern (COPCs) were identified. A human health risk assessment (RA) and an ecological RA were conducted to evaluate the potential risks associated with these COPCs. The results of the RAs are summarized in a later section of this PRAP.

Feasibility Study

As a result of the RI, Baker initiated an FS in 1995 to develop and evaluate remedial action alternatives (RAAs) for the contaminated environmental media at OU No. 7. The FS addressed areas of concern (AOCs) in the groundwater at Site 1 and Site 28. Based on the results of the human health and ecological RAs, conditions at Site 30 appeared to be protective of human health and the environment. Therefore, the FS did not address Site 30. The RAAs developed in the FS, and the justification for not conducting an FS at Site 30, are presented later in this PRAP.

Summary of Site Risks

As part of the RI, a human health RA and an ecological RA were conducted to evaluate potential risks to human health and the environment resulting from the presence of COPCs at Sites 1, 28, and 30. The following subsections describe the results of these RAs for each site.

Human Health Risk Assessment - Site 1

The human health RA investigated three environmental media at Site 1: surface soils, subsurface soils, and groundwater. Surface water and sediment samples were collected from a drainage ditch at Site 1. However, this ditch did not represent a classifiable surface water body used for human consumption or recreation nor did it represent an ecological habitat. Consequently, the surface water and sediment samples were removed from the risk evaluation.

Under the current exposure scenario, on-site military personnel were assumed to be the potential receptors. Under the future exposure scenario, future residents (both children and adults) and future construction workers were assumed to be the potential receptors. Exposure to soil via ingestion, dermal contact, and inhalation was analyzed for military personnel; exposure to soil via ingestion, dermal contact, and inhalation was analyzed for future construction workers; and exposure to soil and groundwater via ingestion, dermal contact, and inhalation was analyzed for future residents.

The human health RA indicated that potential risks (neither carcinogenic nor noncarcinogenic) associated with exposure to the surface soil and subsurface soil COPCs were within acceptable limits. Therefore, soil was not determined to be a media of concern at Site 1. However, there were some potential future risks associated with ingestion of the groundwater COPCs that exceeded acceptable limits. As a result, groundwater was considered a media of concern at the site. The potential noncarcinogenic risks from groundwater were calculated to be 17.3 and 7.6 for the child and adult receptors, respectively. These values exceeded the acceptable level of "unity" or "1.0". In addition, the potential carcinogenic risk from groundwater was calculated to be $1.7x10^{-4}$ for the adult receptor. This risk exceeded the acceptable range of "$1x10^{-4}$ to $1x10^{6}$." Arsenic and manganese were the primary COPCs contributing to these risks.

Although arsenic and manganese in the groundwater created some potential risk if ingested by future residents, it is important to keep in perspective the way in which this risk was determined. The approach used in the human health RA was highly conservative. At Site 1, it was the future residential scenario that created risk. However, this scenario is unlikely to occur in the foreseeable future because Site 1 is actively being used as vehicle maintenance and equipment storage area. In addition, ingestion of groundwater by future residents is unlikely to occur because the groundwater at Site 1 is not used as a potable water source.

In addition, upon comparison of arsenic and manganese levels in the groundwater to state and federal regulatory standards, only manganese exceeded its standard. Thus, although both arsenic and manganese contributed to the site risks, arsenic did not exceed regulatory standards. This indicates the highly conservative nature of the human health RA.

Another fact to consider is that the levels of arsenic and manganese used to calculate groundwater exposure risks were primarily taken from off-site wells. Also, concentrations at these off-site wells either did not exceed regulatory standards or exceeded the standards infrequently. Consequently, it is reasonable to assume that the risks associated with arsenic and manganese are over-estimations of the risk that actually exists and the contaminants are not site related.

Ecological Risk Assessment - Site 1

In addition to the human health RA, an ecological RA was conducted for Site 1 during the RI. The purpose of the ecological RA was to determine if COPCs were adversely impacting the ecological integrity of aquatic and terrestrial communities on or adjacent to the site. The ecological RA also evaluated the potential effects of COPCs on sensitive environments including wetlands, protected species, and fish nursery areas. The following paragraphs describe the state of aquatic and terrestrial communities at Site 1 as determined in the ecological RA.

Within the boundaries of Site 1, there were no aquatic communities identified that would be exposed to site related COPCs. The only surface water feature in which aquatic communities could exist is the southern drainage ditch, but this ditch is dry most of the time. As a result, the assessment concluded that there is no ecological risk associated with aquatic communities.

The only site related COPCs that could potentially affect terrestrial communities were inorganics. In particular, the presence of cadmium and chromium in surface soil indicated a slight potential for affecting terrestrial invertebrates and plants at the site. However, because the concentrations of these metals only slightly exceeded the literature values used to determine risk, cadmium and chromium were not expected to present a significant ecological risk. (Cadmium concentrations ranged from 0.62 to 2.0 mg/Kg which only slightly exceeds the literature value of 0.5 mg/Kg; chromium concentrations ranged from 1.5 to 13.1 mg/Kg which only slightly exceeds the literature value of 10 mg/Kg.)

Based on the terrestrial food chain model, there appeared to be a slight risk for deer, rabbit, fox, and quail receptors. However, this risk was expected to be insignificant because of the low levels by which terrestrial reference values were exceeded. The quotient index (QI), a value which must be less than "1" if site conditions are considered protective of the ecology, was calculated to be less

than "1" for all COPCs except manganese. The QI for manganese was 1.32 for the rabbit and 1.57 for the quail. However, because these QIs were less than "2", there is most likely only a small potential that the animals at Site 1 are being adversely affected by site conditions.

Human Health Risk Assessment - Site 28

As part of the RI, a human health RA was conducted to assess potential risks associated with contaminants at Site 28. The results indicated that inorganics in groundwater, subsurface soil, and sediment were driving the potential noncarcinogenic and carcinogenic risks at the site. These metals were manganese in groundwater, antimony, arsenic, copper, and zinc in subsurface soil, and antimony in the sediment of the New River.

In the current case, potential noncarcinogenic and carcinogenic risks to the military personnel, recreational adult, and fisherman were within acceptable risk levels. For the current recreational child receptor, there was a potential noncarcinogenic risk from New River sediment. The noncarcinogenic risk from the ingestion pathway was 1.2, which is slightly greater than the acceptable risk level of one. The COPC driving this noncarcinogenic risk was antimony.

In the future case, the total potential noncarcinogenic risk to the child receptor, 23, exceeded the acceptable risk level of one. This risk was attributed to exposure to groundwater, subsurface soil, and sediment from the New River. For the adult receptor, there were noncarcinogenic and carcinogenic risks from exposure to groundwater. The risks to the construction worker were within acceptable risk levels.

It is important to note that due to the segregation of the soil noncarcinogenic risks based on the effects on different target organs, the soil noncarcinogenic risk may be an overestimate. It also is important to note that the future exposure scenario was based on potential residential development of Site 28. At present, the site is a recreational/picnic area located within training areas on the base. It is highly unlikely that a residence will be implemented on-site in the foreseeable future. Consequently, exposure to subsurface soil and groundwater under a residential scenario is highly conservative and unlikely given the present site conditions. It follows that the potential risks associated with this exposure scenario are conservative and may be overestimated values.

In terms of lead health impacts, use of the lead uptake biokinetic model indicated that exposure to surface soil, subsurface soil and groundwater at this site generated blood lead levels in children that were within acceptable levels.

Ecological Risk Assessment - Site 28

In addition to the human health RA, an ecological RA was conducted for Site 28 to assess potential ecological impacts associated with contaminants. Inorganics and pesticides appeared to be the most significant site related COPCs that could have the potential to affect the integrity of the aquatic receptors at Site 28. For the terrestrial receptors at Site 28, metals appeared to be the most significant site related COPC that could have the potential to affect their integrity. Although the American Alligator had been observed at Site 28, potential adverse impacts to this threatened or endangered species was low due to the low levels of most contaminants in its critical habitat.

In the New River surface water, copper exceeded aquatic reference values but at levels that were indicative of a low potential for risk. Lead and zinc only exceeded unity (1.0) slightly at a single station. Copper exceeded the surface water reference values in Cogdels Creek, and aluminum exceeded the surface water reference values in Orde Pond. However, these exceedences were only slightly above the reference values.

In the sediment, lead exceeded the sediment aquatic reference values only once in Cogdels Creek at a low level but exceeded its sediment aquatic reference values significantly in the New River at one station. Antimony exceeded its sediment aquatic reference values moderately at the same station in the New River. This station may be associated with runoff from the nearby active firing range. Pesticides exceeded the sediment aquatic reference values throughout Cogdels Creek with the highest exceedences in the lower reach of the creek near the confluence with the New River. These exceedences represent a moderate potential for risk to aquatic receptors. The levels detected in the sediment may be a result of routine pesticide application in the general vicinity of Site 28, especially near the sewage treatment plant and recreational area.

Results of the analysis of benthic macroinvertebrates and fish populations indicated that Cogdels Creek and this reach of the New River support an aquatic community that is representative of a tidally-influenced freshwater and estuarine ecosystem with both freshwater and marine species. The

absence of pathologies observed in the fish sampled from Cogdels Creek and the New River indicated that the surface water and sediment quality does not adversely impact the fish community. The benthic community demonstrated the typical tidal/freshwater species trend of primarily chironomids and oligochaetes in the upper reaches of Cogdels Creek and polychaetes and amphipods in the lower reaches of Cogdels Creek and in the New River. Species representative of both tolerant and intolerant taxa were present, and the overall community composition did not indicate a benthic community adversely impacted by surface water and sediment quality.

During the habitat evaluation, no areas of vegetation stress or gross impacts from site contaminants were noted. Based on the soil toxicity data for several inorganics (cadmium, chromium, copper, manganese, nickel, and zinc), these contaminants at Site 28 may decrease the integrity of terrestrial invertebrates or plants at the site. Based on the evaluation of the deer, rabbit, fox, raccoon, and quail receptors, there did appear to be an ecological risk to terrestrial vertebrate receptors. This risk is expected to be significant if greater exposure to these contaminants results.

Human Health Risk Assessment - Site 30

At Site 30, the environmental media of concern were surface soil, subsurface soil, groundwater, surface water, and sediment. No COPCs were identified for surface soil or groundwater. However, COPCs for subsurface soil, surface water, and sediment were identified and evaluated. The COPCs included aluminum, arsenic, chromium, cobalt, copper, manganese, mercury, nickel, and vanadium in the soil; aluminum, lead, manganese, and mercury in the surface water; and aluminum, chromium, copper, lead, manganese, nickel, vanadium, and zinc in the sediment.

None of the noncarcinogenic risk values generated for Site 30 exceeded the acceptable level of 1.0. Similarly, none of the carcinogenic risk values for Site 30 exceeded the acceptable level of 1.0 10^{-4}. As a result, unacceptable carcinogenic and noncarcinogenic risks do not appear to exist at Site 30, and the site conditions appear to be protective of human health and the environment. When carcinogenic and noncarcinogenic values do not exceed the acceptable levels, a "no action" plan (i.e., leaving the site as is; taking no further remedial actions) may be justifiable. Based on the carcinogenic and noncarcinogenic risk values for Site 30, no remedial actions are required.

Ecological Risk Assessment - Site 30

The media of concern that were evaluated during the ecological RA include surface water, sediment, and surface soil.

At Site 30, inorganics in surface water appeared to be the only site related COPCs that had the potential to impact aquatic communities. These inorganics included aluminum, lead, and mercury. However, the concentrations of these surface water inorganics were higher in the upstream sampling locations than in the downstream sampling locations. As a result, these inorganics did not appear to be site related and did not warrant a remedial action at Site 30. In sediment, COPCs were not detected at concentrations that could potentially impact aquatic communities.

COPCs in surface soil were not retained for the ecological RA evaluation, so surface soil did not appear to impact terrestrial communities. Based on the terrestrial food chain model, one COPC, manganese, had a very small potential to affect raccoons. However, the model indicated that no other terrestrial species were being adversely impacted by COPCs at the site. Therefore, there did not appear to be a significant risk to terrestrial communities from site related COPCs. Furthermore, remedial actions did not appear to be necessary in order to protect the integrity of terrestrial communities.

Several threatened and/or endangered species are known to inhabit MCB, Camp Lejeune. The red-cockaded woodpecker, in particular, is known to inhabit Site 30. However, the ecological RA conducted for terrestrial communities did not identify any significant risks within the habitats that these protected species are likely to exist. Therefore, the "no action" plan may be justifiable with respect to ecological concerns.

<u>Scope and Role of Action</u>

Because the three sites that constitute OU No. 7 are geographically separated, separate remedial action alternatives were developed for each site. The following subsections describe the scope and role of the separate remedial actions for Sites 1, 28, and 30.

Site 1

Based on the risk assessments, groundwater was determined to be the only environmental medium of concern at Site 1. As a result, the remedial action alternatives for Site 1 were developed to address groundwater. More specifically, the alternatives were developed to address areas where TCE exceeded remediation levels (Rls). Based on these areas, the interpreted extent of a plume containing low levels of TCE was delineated as shown on Figure 5. This plume, is considered the AOC at Site 1.

Site 28

Based on the risk assessments, groundwater was determined to be the only environmental medium of concern at Site 28. As a result, the remedial action alternatives for Site 28 were developed to address groundwater. More specifically, the alternatives were developed to address the AOCs identified on Figure 6. These AOCs are the monitoring well locations where manganese and lead exceeded their RLs.

Site 30

Conditions at Site 30 appear to be protective of human health and the environment. As a result, the only remedial action alternative identified for Site 30 was the "no action" plan. The "no action" plan involves taking no further remedial actions (this includes conducting no further environmental investigations or sampling) at the site. The site and all of the environmental media located within the site will remain as they currently are.

Summary of Alternatives

Various remedial technologies and process options were identified, screened, and evaluated during the FS. Ultimately, remedial action alternatives (RAAs) were developed for the contaminated media at each site. Five RAAs were developed for groundwater at Site 1:

- RAA No. 1 - No Action
- RAA No. 2 - Institutional Controls

- RAA No. 3 - Extraction and On-Site Treatment
- RAA No. 4 - In-Well Aeration and Off-Gas Carbon Adsorption
- RAA No. 5 - Extraction and Off-Site Treatment

Two RAAs were developed for groundwater at Site 28:

- RAA No. 1 - No Action
- RAA No. 2 - Institutional Controls

Alternatives employing active treatment of the groundwater COPCs were not developed for Site 28 due to the nature of the COPCs, manganese and lead. Manganese appears to naturally occur at high levels in the region, and lead was only detected at concentrations above state and federal standards in one of nine samples (in the unfiltered sample, not the filtered sample). This is strong evidence that manganese and lead are not site related contaminants. Based on this evidence, the decision was made not to develop active treatment alternatives. However, because Site 28 is used as a recreational area, a no action alternative and an institutional controls alternative were developed to ensure adequate protection of human health.

For Site 30, one RAA, the no action alternative, was developed.

The following subsections briefly describe the RAAs developed for each site.

Site 1 - Summary of Alternatives

- *Site 1: RAA No. 1 - No Action*

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

  Under the no action RAA, no additional remedial actions will be performed to reduce the toxicity, mobility, or volume of the groundwater AOC. The no action alternative is required

by the NCP to provide a baseline for comparison with other remedial action alternatives that provide a greater level of response.

Although this RAA does not involve active remediation, passive remediation of the groundwater will occur via natural attenuation processes. These processes include naturally occurring biodegradation, volatilization, dilution, photolysis, leaching, adsorption, and chemical reactions between subsurface materials.

Since contaminants will remain at the site under this RAA, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

- *Site 1: RAA No. 2 - Institutional Controls*

Capital Cost: $0
Annual O&M Costs: $40,000
NPW: $600,000
Years to Implement: Estimated 30

Under RAA No. 2, no remedial actions will be performed to reduce the toxicity, mobility, or volume of the groundwater AOC at Site 1. Instead, the following institutional controls will be implemented: continued groundwater monitoring, aquifer-use restrictions, and deed restrictions. Under the groundwater monitoring plan, samples will be collected semiannually from eight existing monitoring wells and analyzed for VOCs. This continued groundwater monitoring will detect any improvement or deterioration in groundwater quality at the site. The aquifer-use restrictions will prohibit the groundwater from being used as a potable water source, and the deed restrictions will limit the future use of land at Site 1, including placement of wells.

Although this RAA does not involve active remediation, passive remediation of the groundwater will occur via natural attenuation processes. These processes include naturally occurring biodegradation, volatilization, dilution, photolysis, leaching, adsorption, and chemical reactions between subsurface materials.

Because contaminants will remain on site under RAA No. 2, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

- *Site 1: RAA No. 3 - Extraction and On-Site Treatment*

Capital Cost: $990,000
Annual O&M Costs: $70,000
NPW: $2,100,000
Years to Implement: Estimated 30

RAA No. 3 is a source collection and treatment alternative. Under RAA No. 3, three extraction wells will be installed to pump groundwater from the surficial aquifer to the ground surface. The radii of influence of these wells will intercept the AOC and provide a hydraulic barrier if the AOC migrates in the direction of groundwater flow (northwest). After being extracted, the groundwater will receive treatment at an on-site treatment plant. Treatment will include air stripping for VOC (i.e., TCE) removal, precipitation, flocculation, sedimentation, and filtration as suspended solids/metals pretreatment. The treated groundwater will be discharged off site to Cogdels Creek.

In addition to extraction, treatment, and discharge, RAA No. 3 incorporates a long-term groundwater monitoring plan to measure the effects of the remedial action alternative. Wells included under this plan will be monitored semiannually for VOCs. Also, deed restrictions and aquifer-use restrictions will be implemented under this RAA.

Until the remediation levels are met, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

- *Site 1: RAA No. 4 - In Well Aeration and Off-Gas Carbon Adsorption*

Capital Cost: $640,000
Annual Groundwater Montioring O&M Costs: $40,000
Annual System O&M Costs: $20,000
NPW: $1,300,000
Years to Implement: Estimated 30

In-well aeration is a type of air sparging in which air is injected into a well creating an in-well air-lift pump effect. This pump effect causes the groundwater to flow in a circulation pattern: into the bottom of the well and out of the top of the well. As the groundwater circulates through the well, the injected air stream strips volatiles. (As a result, in-well aeration is often referred to as in-well air stripping.) The volatiles are captured at the top of the well and treated via a carbon adsorption unit.

Under RAA No. 4, four in-well aeration wells will be installed along the lengthwise extent of the plume. The radius of influence of each well is expected to be approximately 120 to 160 feet. Thus, the wells will intercept the contaminated plume as it travels in the direction of groundwater flow.

A separate vacuum pump, knockout tank, and carbon adsorption unit will be located near the opening of each aeration well. The knockout tank will remove any liquids that have traveled up the well and the carbon adsorption unit will treat off-gases that were stripped within the well. Treated vapors from the carbon adsorption unit will be discharged to the atmosphere.

Because in-well aeration is a relatively new and innovative technology, a field pilot test is recommended prior to initiating the system design. The pilot test will determine the loss of efficiency over time as a result of inorganics precipitation and oxidation on the well screen, the radius of influence of the aeration wells under various heads of injection air pressure, the rate of off-gas organic contaminant removal via carbon adsorption, and carbon breakthrough times.

In addition to the in-well aeration system, RAA No. 4 incorporates a long-term groundwater monitoring plan to measure the effects of the remedial action alternative. Wells included under this plan will be monitored semiannually for VOCs. Also, deed restrictions and aquifer-use restrictions will be implemented under this RAA.

Until the remediation levels are met, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

- *Site 1: RAA No. 5 - Extraction and Off-Site Treatment*

Capital Cost: $500,000
Annual Groundwater Monitoring O&M Costs: $40,000
Annual System O&M Costs: $130,000
NPW: $1,400,000
Years to Implement: Estimated 30

RAA No. 5 is another source collection and treatment alternative. Under RAA No. 5, three extraction wells will be installed to pump groundwater from the surficial aquifer to the ground surface. The radii of influence of these wells will intercept the AOC and provide a hydraulic barrier if the AOC migrates in the direction of groundwater flow. Once groundwater is extracted, it will be transported to the HPIA Treatment System, an existing treatment system that is located within Site 78 (the HPIA Operable Unit) at MCB, Camp Lejeune. Although the system is currently treating VOC contaminated groundwater from Site 78, it has the capacity to accept more. The groundwater will be transported to the system by tanker trucks. At the HPIA Treatment System, the groundwater will receive VOC and inorganics treatment via air stripping, carbon absorption, and suspended solids/metals pretreatment.

In addition, RAA No. 5 will incorporate a long-term groundwater monitoring plan to measure the effects of the remedial action alternative. Wells included under this plan will be monitored semiannually for VOCs. Also, deed restrictions and aquifer-use restrictions will be implemented under this RAA.

Until the remediation levels are met, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

Site 28 - Summary of Alternatives

- *Site 28: RAA No. 1 - No Action*

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

Under the no action RAA, no additional remedial actions will be performed to reduce the toxicity, mobility, or volume of the groundwater AOCs. The no action alternative is required by the NCP to provide a baseline for comparison with other remedial action alternatives that provide a greater level of response.

Since contaminants will remain at the site under this RAA, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

- *Site 28: RAA No. 2 - Institutional Controls*

Capital Cost: $0
Annual O&M Costs: $30,000
NPW: $500,000
Years to Implement: Estimated 30

Under RAA No. 2, no additional remedial actions will be performed to reduce the toxicity, mobility, or volume of in the groundwater AOCs. Instead, the following institutional controls will be implemented: a continued groundwater monitoring plan, aquifer-use restrictions preventing the use of the aquifer as a potable water source, and deed restrictions prohibiting the future construction of potable water supply wells. Under the groundwater

monitoring plan, samples will be collected semiannually and analyzed for lead and manganese to monitor their concentrations over time.

Since contaminants will remain at the site under this RAA, the NCP requires the lead agency to review the effects of this alternative no less often than once every five years.

Site 30 - Summary of Alternatives

- *Site 30: No Action Alternative*

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

Under the no action RAA, no additional remedial actions will be performed at Site 30. Conditions at the site appear to be protective of human health and the environment so the lead agency will not be required to review the effects of this alternative every five years.

Evaluation of Remedial Action Alternatives

This section summarizes the comparative evaluation of the Site 1 and Site 28 RAAs, and the reasons for selecting the preferred alternatives. (A comparative evaluation was not conducted for Site 30 since only one alternative was developed.) The comparative evaluation was based on seven evaluation criteria: overall protectiveness of human health and the environment; compliance with applicable and relevant or appropriate requirements (ARARs); long-term effectiveness/permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Table 1 provides definitions of these evaluation criteria, Table 2 summarizes the Site 1 RAA evaluation, and Table 3 summarizes the Site 28 RAA evaluation.

Site 1 - Evaluation of Alternatives

Overall Protection of Human Health and the Environment

RAA No. 1, the no action alternative, does not reduce potential risks to human health and the environment except through natural attenuation of the groundwater AOC. On the other hand, RAA Nos. 2, 3, 4, and 5 all provide some means, other than natural attenuation, for reducing potential risks. RAA Nos. 2, 3, 4, and 5 involve institutional controls which will reduce risks. In addition, RAA Nos. 3, 4, and 5 involve active remediation systems (groundwater extraction/on-site treatment, in-well aeration, and groundwater extraction/off-site treatment) which provide additional protection to human health and the environment. However, the additional protection that RAA Nos. 3, 4, and 5 provide through active remediation systems may not be necessary considering the minimal risks associated with the groundwater contaminants.

If the contaminated plume is left alone to passively remediate via natural attenuation, the residual risk that remains will be minimal for the following reasons:

- TCE was detected at low concentrations, 8 µg/L and 27 µg/L, that only slightly exceed the RL of 5 µg/L. These low groundwater concentrations, in addition to non-detectable levels in the soil, indicate that there is no significant source of TCE at the site. Instead, the TCE is most likely the result of random, isolated spills.

- Based on the results of an analytical model for solute transport in groundwater, VOCs at Site 1 do not currently impact the nearest receptor, the former water supply well HP-638. (This supply well is currently inactive.)

- Vinyl chloride was detected at a low concentration, 4J µg/L, which only slightly exceeds the state standard of 0.015 µg/L and the federal standard of 2 µg/L. Based on this low concentration, and the fact that vinyl chloride was detected at only one well, it does not appear that there is a significant source of vinyl chloride at the site.

Considering the minimal risks associated with the contaminated groundwater, institutional controls (RAA No. 2) will be adequate for protecting human health and the environment. Groundwater

extraction and treatment (RAA Nos. 3 and 5) and in-well aeration (RAA No. 4) will be unnecessary to provide adequate protection. No action, however, provides no protection. Therefore, RAA No. 1 may be inferior to the other four alternatives, and RAA Nos. 3, 4, and 5 may overcompensate for the minor risks that exist at the site.

Compliance with ARARs

Under all five RAAs, groundwater contaminants are expected to eventually meet federal and state chemical-specific ARARs. Under RAA Nos. 1 and 2, contaminants are expected to meet ARARs via passive remediation (or natural attenuation). Under RAA Nos. 3, 4, and 5, contaminants are expected to meet ARARs via active remediation (extraction/treatment or in-well aeration).

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

Long-Term Effectiveness and Permanence

Because all five RAAs involve some form of remediation, whether it is active or passive, they are all expected to be effective at decreasing contaminant levels in the long run. In addition, the results of all RAAs are expected to be permanent.

Although residual risks associated with untreated contaminants will be minimal, RAA No. 1 is the only alternative that will allow residual risk to remain uncontrolled at the site. RAA Nos. 2, 3, 4, and 5 involve continued groundwater monitoring, aquifer-use restrictions, and deed restrictions, which are all adequate and reliable controls; RAA No. 1 involves no controls. As a result, RAA Nos. 2, 3, 4, and 5 can mitigate the potential for human health exposure through the use of institutional controls, but RAA No. 1 cannot. Also, the effectiveness of RAA Nos. 2, 3, 4, and 5 can be determined more often than the effectiveness of RAA No. 1 can be determined.

Under all five RAAs, untreated contaminants will remain at the site indefinitely. As a result, all five RAAs require 5-year reviews to ensure that adequate protection of human health and the environment is maintained. Under RAA Nos. 3, 4, and 5, however, this review will not be necessary once the RLs are achieved.

Reduction of Toxicity, Mobility, or Volume Through Treatment

RAA Nos. 1 and 2 do not involve active treatment processes so these alternatives will only reduce toxicity, mobility, or volume of the contaminants via passive remediation. RAA Nos. 3, 4, and 5, however, involve extraction/treatment and in-well aeration so they will reduce the toxicity, mobility, and volume of contaminants via active remediation. (RAA Nos. 3, 4, and 5 satisfy the statutory preference for treatment.) Under all five RAAs, however, the majority of the groundwater contaminants are expected to eventually be treated.

There are no treatment residuals associated with RAA Nos. 1 and 2. Under RAA Nos. 3, 4, and 5, however, active treatment processes will create residuals like metals sludge, spent carbon, and contaminated condensed vapor. These additional residuals will require proper disposal.

Short-Term Effectiveness

All five RAAs will reduce contaminant levels. However, RAA Nos. 3, 4, and 5 will create the most risk during implementation. Risks to the community and workers will be increased during extraction well, aeration well, piping, and treatment plant installation and operation. RAA No. 2 creates some minor risks associated with groundwater sampling, but these are insignificant compared to the risks associated with RAA Nos. 3, 4, and 5. Implementation of RAA No. 1 will create no risks.

The time in which RAA Nos. 3 and 5 will achieve the remedial action objectives (approximately 30 years) is relatively large compared to RAA No. 4 (approximately 3 years). However, all RAAs, with the exception of the no action alternative, involve continued groundwater monitoring for 30 years. The amount of time required for natural attenuation to restore the aquifer (i.e., RAA Nos. 1 and 2) is unknown.

Implementability

RAA No. 1 is the most implementable, if not the most effective, alternative. RAA Nos. 2, 3, and 5 use conventional, well-demonstrated, and commercially available technologies so these RAAs are proven to be implementable and reliable. RAA No. 4 (in-well aeration), however, involves an

emerging technology that does not have an extensive commercial track record. A field pilot test is necessary to determine this alternative's implementability. Regardless, RAA Nos. 3, 4, and 5 create more risk than RAA No. 2 during implementation.

Despite its high level of implementability, RAA No. 1 does not include adequate monitoring to determine its effectiveness. As a result, failure to detect increases in contaminant levels could result in potential ingestion of groundwater. RAA Nos. 2, 3, 4, and 5 do involve monitoring plans so there will be notice of contaminant increases before significant exposure occurs.

Cost

In terms of NPW, the no action alternative (RAA No. 1) would be the least expensive RAA to implement, followed by RAA No. 2, RAA No. 4, RAA No. 5, and then RAA No. 3. The estimated NPW values in increasing order are $0 (RAA No. 1), $600,000 (RAA No. 2), $1,300,000 (RAA No. 4), $1,400,000 (RAA No. 4), and $2,100,000 (RAA No. 3).

Site 28 - Evaluation of Alternatives

Overall Protection of Human Health and the Environment

RAA No. 1, the no action alternative, does not reduce potential risks to human health and the environment. On the other hand, RAA No. 2 does reduce potential risks because it involves institutional controls that can prevent future exposure to the groundwater.

Regardless, the magnitude of residual risks is considered to be minimal. The groundwater contaminants exceeding RLs , lead and manganese, do not pose substantial risks to human health or the environment for the following reasons:

- Manganese concentrations (from both unfiltered and filtered samples) in groundwater at MCB, Camp Lejeune often exceed the state and federal secondary standard of 50 µg/L. Elevated manganese levels, at concentrations above the state standard, were reported in samples collected from a number of Base potable water supply wells. Manganese concentrations at several Site 28 wells exceeded the state

standard, and all but one sample fell within the range of concentrations for samples collected elsewhere at MCB, Camp Lejeune.

- Lead was detected above its RLs at only one well, 28-GW08. This well, which is situated in an area of loosely compacted fill material, exhibited high turbidity (above 10 turbidity units) and total suspended solids (111 mg/L). In addition, lead was only detected in the total metals sample, not the dissolved metals sample, taken at this well. All of this information suggests that the high lead concentration detected may be the result of suspended solids, and the total metals analysis is indicative of lead in the soil and groundwater, not just the amount of lead that is dissolved in the groundwater.

Considering the minimal risks associated with lead and manganese in the groundwater, institutional controls (RAA No.2) will be adequate for protecting human health and the environment. No action, however, provides no protection.

Compliance with ARARs

Under RAA Nos. 1 and 2, manganese levels are expected to exceed their chemical-specific ARARs. However, this is not a great concern because manganese at the Base appears to naturally occur at levels exceeding ARARs. Lead, however, is not expected to exceed ARARs because the high lead detection is believed to be the result of suspended solids in the total metals sample.

No location- or action-specific ARARs apply to RAA Nos. 1 and 2.

Long-Term Effectiveness and Permanence

RAA No. 1 allows the most residual risk, and RAA No. 2 allows less residual risk. Regardless, the magnitude of any residual risk will be minimal for the three reasons stated earlier.

RAA No. 2 involves monitoring, aquifer-use restrictions, and deed restrictions, which are all adequate and reliable controls; RAA No. 1 involves no controls. As a result, RAA No. 2 can

mitigate the potential for groundwater exposure, but RAA No. 1 cannot. Also, the effectiveness of RAA No. 2 can be determined more often than the effectiveness of RAA No. 1.

Both RAAs require 5-year reviews to ensure that adequate protection of human health and the environment is maintained.

Reduction of Toxicity, Mobility, or Volume Through Treatment

RAA Nos. 1 and 2 do not involve active treatment processes so these alternatives will not reduce toxicity, mobility, or volume of the groundwater AOC. Additionally, neither RAA satisfies the statutory preference for treatment.

Short-Term Effectiveness

Implementation of RAA Nos. 1 and 2 will not increase risks to the community. RAA No. 1 will not increase risks to workers, but RAA No. 2 will. RAA No. 2, however, will not significantly increase worker risks because worker protection will be utilized during groundwater sampling. In addition, groundwater sampling has been successfully implemented in the past with minimal worker risks.

No additional environmental impacts are expected under RAA Nos. 1 and 2.

Implementability

RAA No. 1 is the most implementable, if not the most effective, alternative. RAA No. 2 is not as implementable as RAA No. 1, but it is still easily implementable. RAA No. 2 involves conventional, well-demonstrated, and commercially available technologies, and it has been easily implemented in the past.

Despite its implementability, RAA No. 1 does not have adequate monitoring to determine its effectiveness. As a result, failure to detect increases in COC levels could result in potential ingestion of groundwater. RAA No. 2 involves a monitoring plan so there will be notice of contaminant increases before significant groundwater exposure can occur.

Unlike RAA No. 1, RAA No. 2 requires the submission of semiannual sampling reports. RAA No. 1 requires no coordination with agencies.

Cost

In terms of NPW, the no action alternative (RAA No. 1) would be the least expensive RAA to implement, followed by RAA No. 2. The estimated NPW values in increasing order are $0 (RAA No. 1) and $500,000 (RAA No. 2).

The Preferred Remedial Action Alternatives

Based on the results of the alternative evaluations, preferred remedial action alternatives were selected for groundwater at Sites 1 and 28. Based on the results of the human health and ecological RAs, a no action plan was selected as the preferred alternative for Site 30. The complete PRAP for OU No. 7 will be a combination of the separate remedial action alternatives developed and proposed for Sites 1, 28, and 30. The following subsections describe these preferred alternatives.

Site 1 - The Preferred Alternative

The preferred alternative, or the Proposed Plan, for groundwater at Site 1 is RAA No. 2: Institutional Controls. Under this alternative, a long-term groundwater monitoring plan, aquifer-use restrictions, and deed restrictions will be implemented as institutional controls. Figure 7 illustrates the long-term groundwater monitoring plan. Under RAA No. 2, natural attenuation processes are expected to remediate the groundwater AOC.

Instiutional Controls were selected as the preferred alternative because it provides the most appropriate level of protection for the groundwater at Site 1. An active treatment alternative would overcompensate for the minimal risks associated with the groundwater and a no action alternative would provide no protection at all.

Site 28 - The Preferred Alternative

The preferred alternative, or the Proposed Plan, for groundwater at Site 28 is RAA No. 2: Institutional Controls. Under this alternative, a long-term groundwater monitoring plan, aquifer-use restrictions, and deed restrictions will be implemented as institutional controls. Figure 8 illustrates the long-term groundwater monitoring plan.

Institutional Controls were selected as the preferred alternative to ensure adequate protection of human health. The risks associated with the COPCs, lead and manganese, are minimal. In fact, the COPCs do not appear to be site related. However, Site 28 is frequently used as a recreation/physical training area. As such, Institutional Controls are preferred, as opposed to no action, to ensure that site conditions remain protective of human health.

Site 30 - The Preferred Alternative

Because conditions at Site 30 are protective of human health and the environment, the only remedial action alternative identified for the site was the no action plan. Therefore, it is the preferred alternative, or the Proposed Plan, for Site 30.

The no action plan involves taking no further remedial actions (this includes conducting no further environmental investigations or sampling) at the site. The site and all the environmnetal media located within the site will remain as they currently are.

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. 7 (Sites 1, 28, and 30).

Public Comment Period

The 30-day public comment period for the Proposed Plans at OU No. 7 will begin on August 8, 1995 and end on September 6, 1995. 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 1823

A public meeting will be held at the Onslow County Library in Jacksonville, NC on August 8, 1995. Representatives of the Navy, and their consultant, will be available at the meeting to answer questions and accept public comments on the Proposed Plan or remedy for OU No. 7. 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. In addition, the summary will include the responses to each issue/question raised at the public meeting. After the Record of Decision (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 located 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. 7,
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 1823
(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. 7 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
GLOSSARY OF EVALUATION CRITERIA

- **Overall Protection of Human Health and Environmental** - addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduce, or controlled through treatment engineering or institutional controls
- **Compliance with ARARs/TBCs** - addressed whether or no tan alternative will meet all of the applicable or relevant and appropriate requirements (ARARs), other criteria to be considered (TBCs), or other Federal and state environmental statues 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 environmental over time once cleanup goals have been met.
- **Reduction of Toxicity, Mobility, or Volume through Treatment** - is the anticipated performance of the treatment options that may be employed in 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 result during the construction and implementation period.
- **Implementability** - is the technical and administrative feasibility of an alternative, including the availability of material sand services needed to implement the chosen solution.
- **Cost** - includes capital and operation and maintenance costs. For comparative purposes, presents present worth values.

TABLE 2

SUMMARY OF THE RAA EVALUATION - SITE 1
SITE 1, FRENCH CREEK LIQUIDS DISPOSAL AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA No. 1 No Action	RAA No. 2 Institutional Controls	RAA No. 3 Extraction and On-Site Treatment	RAA No. 4 In-Well Aeration and Off-Gas Carbon Adsorption	RAA No. 5 Extraction and Off-Site Treatment
OVERALL PROTECTIVENESS • Human Health	No reduction in potential human health risks, except through natural attenuation of the contaminated groundwater.	Institutional controls and natural attenuation will reduce potential human health risks.	Institutional controls, natural attenuation, and the groundwater extraction/ treatment system will reduce potential human health risks.	Institutional controls, natural attenuation, and in-well aeration will reduce potential human health risks.	Institutional controls, natural attenuation, and the groundwater extraction/ treatment system will reduce potential human health risks.
• Environmental Protection	No reduction in potential risks to ecological receptors, except through natural attenuation of the contaminated groundwater.	Institutional controls and natural attenuation will reduce potential risks to ecological receptors.	Institutional controls, natural attenuation, and the groundwater extraction/ treatment system will reduce potential risks to ecological receptors.	Institutional controls, natural attenuation, and in-well aeration will reduce potential risks to ecological receptors.	Institutional controls, natural attenuation, and the groundwater extraction/ treatment system will reduce potential risks to ecological receptors.
COMPLIANCE WITH ARARS • Chemical-Specific ARARs	No active effort made to reduce contaminant levels to below federal or state ARARs. However, contaminants are expected to meet ARARs via natural attenuation processes.	No active effort made to reduce contaminant levels to below federal or state ARARs. However, contaminants are expected to meet ARARs via natural attenuation processes.	Contaminants within the wells' radii of influence are expected to meet chemical-specific ARARs.	Contaminants within the wells' radii of influence are expected to meet chemical-specific ARARs.	Contaminants within the wells' radii of influence are expected to meet chemical-specific ARARs.
• Location-Specific ARARs	Not applicable.	Not applicable.	Can be designed to meet location-specific ARARs.	Can be designed to meet location-specific ARARs.	Can be designed to meet location-specific ARARs.
• Action-Specific ARARs	Not applicable.	Not applicable.	Can be designed to meet action-specific ARARs.	Can be designed to meet action-specific ARARs.	Can be designed to meet action-specific ARARs.
LONG-TERM EFFECTIVENESS AND PERMANENCE • Magnitude of Residual Risk	The residual risk from untreated contaminants will be minimal; natural attenuation will mitigate any residual risk that may exist.	The residual risk from untreated contaminants will be minimal; institutional controls and natural attenuation will mitigate any residual risk that may exist.	The residual risk from untreated contaminants will be minimal; institutional controls and the extraction/ treatment system will mitigate any residual risk that may exist.	The residual risk from untreated contaminants will be minimal; institutional controls and in-well aeration will mitigate any residual risk that may exist.	The residual risk from untreated contaminants will be minimal; institutional controls and the extraction/ treatment system will mitigate any residual risk that may exist.

TABLE 2 (Continued)

SUMMARY OF THE RAA EVALUATION - SITE 1
SITE 1, FRENCH CREEK LIQUIDS DISPOSAL AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA No. 1 No Action	RAA No. 2 Institutional Controls	RAA No. 3 Extraction and On-Site Treatment	RAA No. 4 In-Well Aeration and Off-Gas Carbon Adsorption	RAA No. 5 Extraction and Off-Site Treatment
• Adequacy and Reliability of Controls	No controls	The proposed monitoring plan is adequate and reliable for determining the alternative's effectiveness; aquifer-use and deed restrictions are adequate and reliable for preventing human health exposure.	The proposed monitoring plan is adequate and reliable for determining the alternative's effectiveness; aquifer-use and deed restrictions are adequate and reliable for preventing human health exposure until remediation levels are met.	The proposed monitoring plan is adequate and reliable for determining the alternative's effectiveness; aquifer-use and deed restrictions are adequate and reliable for preventing human health exposure until remediation levels are met.	The proposed monitoring plan is adequate and reliable for determining the alternative's effectiveness; aquifer-use and deed restrictions are adequate and reliable for preventing human health exposure until remediation levels are met.
• Need for 5-year Review	Review will be required to ensure adequate protection of human health and the environment.	Review will be required to ensure adequate protection of human health and the environment.	Until remediation levels are met, review will be required to ensure adequate protection of human health and the environment.	Until remediation levels are met, review will be required to ensure adequate protection of human health and the environment.	Until remediation levels are met, review will be required to ensure adequate protection of human health and the environment.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT • Treatment Process Used	No active treatment process applied.	No active treatment process applied.	The treatment process includes air stripping for VOC removal and neutralization, precipitation, flocculation, sedimentation, and filtration as pretreatment for the air stripper.	The treatment process includes in-well air stripping and off-gas carbon adsorption for VOC removal.	The treatment processes, include air stripping and carbon adsorption for VOC removal; also, flocculation and sedimentation for metals removal.
• Amount Destroyed or Treated	Eventually, the majority of the contaminants are expected to be treated by natural attenuation.	Eventually, the majority of the contaminants are expected to be treated by natural attenuation.	Eventually, the majority of the contaminants are expected to be treated by the extraction/treatment system.	The majority of the contaminants are expected to be treated by the in-well aeration system.	Eventually, the majority of the contaminants are expected to be treated by the extraction/treatment system.
• Reduction of Toxicity, Mobility, or Volume	No COC reduction except by natural attenuation.	No COC reduction except by natural attenuation.	Nearly 100% reduction in contaminant toxicity, mobility, and volume is expected.	Nearly 100% reduction in contaminant toxicity, mobility, and volume is expected.	Nearly 100% reduction in contaminant toxicity, mobility, and volume is expected.

TABLE 2 (Continued)

SUMMARY OF THE RAA EVALUATION - SITE 1
SITE 1, FRENCH CREEK LIQUIDS DISPOSAL AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA No. 1 No Action	RAA No. 2 Institutional Controls	RAA No. 3 Extraction and On-Site Treatment	RAA No. 4 In-Well Aeration and Off-Gas Carbon Adsorption	RAA No. 5 Extraction and Off-Site Treatment
• Residuals Remaining After Treatment	No active treatment process applied.	No active treatment process applied.	Treatment residuals will include sludge, off-gases from the air stripper, and treated groundwater. The sludge should be non-hazardous, the off-gases will be within acceptable air discharge limits, and the treated groundwater will be within acceptable groundwater discharge limits.	Treatment residuals will include the small amount of liquid left in the knockout tank (most likely less than 5 gallons) and spent carbon. The liquid should be non-hazardous, but the spent carbon will contain adsorbed contaminants.	Treatment residuals will include spent carbon, sludge, off-gases from the air stripper, and treated groundwater. The sludge should be non-hazardous, the off-gases will be within acceptable air discharge limits, and the treated groundwater will be within acceptable groundwater discharge limits.
• Statutory Preference for Treatment	Not satisfied.	Not satisfied.	Satisfied.	Satisfied.	Satisfied.
SHORT-TERM EFFECTIVENESS • Community Protection	Potential risks to the community will not be increased.	Potential risks to the community will not be increased.	Potential risks to the community will be increased during system installation and operation.	Potential risks to the community will be increased during system installation and operation.	Potential risks to the community will be increased during system installation and operation.
• Worker Protection	No risks to workers.	No significant risks to workers.	Potential risks to workers will be increased; worker protection is required.	Potential risks to workers will be increased; worker protection is required.	Potential risks to workers will be increased; worker protection is required.
• Environmental Impact	No additional environmental impacts.	No additional environmental impacts.	No additional environmental impacts if aquifer drawdown does not affect surrounding water bodies.	No additional environmental impacts.	No additional environmental impacts if aquifer drawdown does not affect surrounding water bodies.
• Time Until Action is Complete	Unknown.	Thirty years was used to estimate NPW costs. The exact time for completion of remediation is unknown.	Thirty years was used to estimate NPW costs. The exact time for completion of remediation is unknown.	Three years was used to estimate in-well aeration costs; 30 years was used to estimate monitoring costs. The exact time for completion of remediation is unknown.	Three years was used to estimate trucking costs; 30 years was used to estimate monitoring costs. The exact time for completion of remediation is unknown.

TABLE 2 (Continued)

SUMMARY OF THE RAA EVALUATION - SITE 1
SITE 1, FRENCH CREEK LIQUIDS DISPOSAL AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA No. 1 No Action	RAA No. 2 Institutional Controls	RAA No. 3 Extraction and On-Site Treatment	RAA No. 4 In-Well Aeration and Off-Gas Carbon Adsorption	RAA No. 5 Extraction and Off-Site Treatment
IMPLEMENTABILITY • Ability to Construct and Operate	No construction or operation activities.	No construction or operation activities; institutional controls have been easily implemented in the past.	The infrastructure within a developed area like Site 1 poses some minor construction problems. O&M may be difficult because groundwater must be lifted above ground surface for treatment, and metals precipitation could clog well screens.	The technology has been commercially applied, but it is still relatively new. The infrastructure within a developed area like Site 1 poses some minor construction problems. also, metals precipitation could clog well screens.	The infrastructure within a developed area like Site 1 poses some minor construction problems. Also, metals precipitation could clog well screens.
• Ability to Monitor Effectiveness	No proposed monitoring plan; failure to detect contamination could result in potential ingestion of groundwater.	Proposed monitoring plan will detect contaminants before significant exposure can occur.	Proposed monitoring plan will detect contaminants before significant exposure can occur; O&M checks will provide notice of a system failure.	Proposed monitoring plan will detect contaminants before significant exposure can occur; O&M checks will provide notice of a system failure.	Proposed monitoring plan will detect contaminants before significant exposure can occur; O&M checks will provide notice of a system failure.
• Availability of Services and Capacities; Equipment	No services or equipment required.	No special services or equipment required.	Services and equipment are readily available.	The patented technology is exclusively licensed to a single vendor.	Services and equipment are readily available.
• Requirements for Agency Coordination	None required.	Must submit semiannual reports to document sampling.	The substantive requirements of air and water discharge permits must be met.	The substantive requirements of air and water discharge permits must be met.	Air and water discharge permits may be required if existing permits are not adequate for the additional groundwater load.
COST (Net Present Worth)	$0	$600,000	$2,100,000	$1,300,000	$1,400,000

TABLE 3

SUMMARY OF THE RAA EVALUATION - SITE 28
SITE 28, HADNOT POINT BURN DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA No. 1 No Action	RAA No. 2 Institutional Controls
OVERALL PROTECTIVENESS • Human Health	No reduction in potential human health risks.	Institutional controls reduce potential human health risks.
• Environmental Protection	No reduction in potential risks to ecological receptors.	Institutional controls reduce potential risks to ecological receptors.
COMPLIANCE WITH ARARS • Chemical-Specific ARARs	Manganese is expected to exceed chemical-specific ARARs, but it exceeds ARARs in groundwater throughout MCB, Camp Lejeune. Lead is believed to be the result of suspended solids so it is not expected to exceed ARARs.	Manganese is expected to exceed chemical-specific ARARs, but it exceeds federal and/or state ARARs in groundwater throughout MCB, Camp Lejeune. Lead is believed to be the result of suspended solids so it is not expected to exceed ARARs.
• Location-Specific ARARs	Not applicable.	Not applicable.
• Action-Specific ARARs	Not applicable.	Not applicable.
LONG-TERM EFFECTIVENESS AND PERMANENCE • Magnitude of Residual Risk	The residual risk from untreated lead and manganese will be minimal.	The residual risk from untreated lead and manganese will be minimal; institutional controls will mitigate any residual risk that may exist.
• Adequacy and Reliability of Controls	Not applicable-no controls.	The monitoring plan is adequate and reliable for determining effectiveness; aquifer-use and deed restrictions are adequate and reliable for preventing human health exposure.
• Need for 5-year Review	Review will be required to ensure adequate protection of human health and the environment.	Review will be required to ensure adequate protection of human health and the environment.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT • Treatment Process Used	No treatment process.	No treatment process.
• Amount Destroyed or Treated	None.	None.
• Reduction of Toxicity, Mobility, or Volume	None.	None.
• Residuals Remaining After Treatment	Not applicable-no treatment.	Not applicable-no treatment.
• Statutory Preference for Treatment	Not satisfied.	Not satisfied.
SHORT-TERM EFFECTIVENESS • Community Protection	Potential risks to the community will not be increased.	Potential risks to the community will not be increased.
• Worker Protection	No risks to workers.	No significant risks to workers.
• Environmental Impact	No additional environmental impacts; current impacts will continue.	No additional environmental impacts; current impacts will continue.

TABLE 3 (Continued)

SUMMARY OF THE RAA EVALUATION - SITE 28
SITE 28, HADNOT POINT BURN DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Evaluation Criteria	RAA No. 1 No Action	RAA No. 2 Institutional Controls
• Environmental Impact	No additional environmental impacts; current impacts will continue.	No additional environmental impacts; current impacts will continue.
• Time Until Action is Complete	Not applicable.	Estimated 30 years.
IMPLEMENTABILITY • Ability to Construct and Operate	No construction or operation activities.	No construction or operation activities; institutional controls have been easily implemented in the past.
• Ability to Monitor Effectiveness	No monitoring plan; failure to detect contamination could result in potential ingestion of groundwater.	Proposed monitoring plan will detect contaminants before significant exposure can occur.
• Availability of Services and Capacities; Equipment	No services or equipment required.	No special services or equipment required.
• Requirements for Agency Coordinations	None required.	Must submit semiannual reports to document sampling.
COST (Net Present Worth)	$0	$500,000

FIGURES

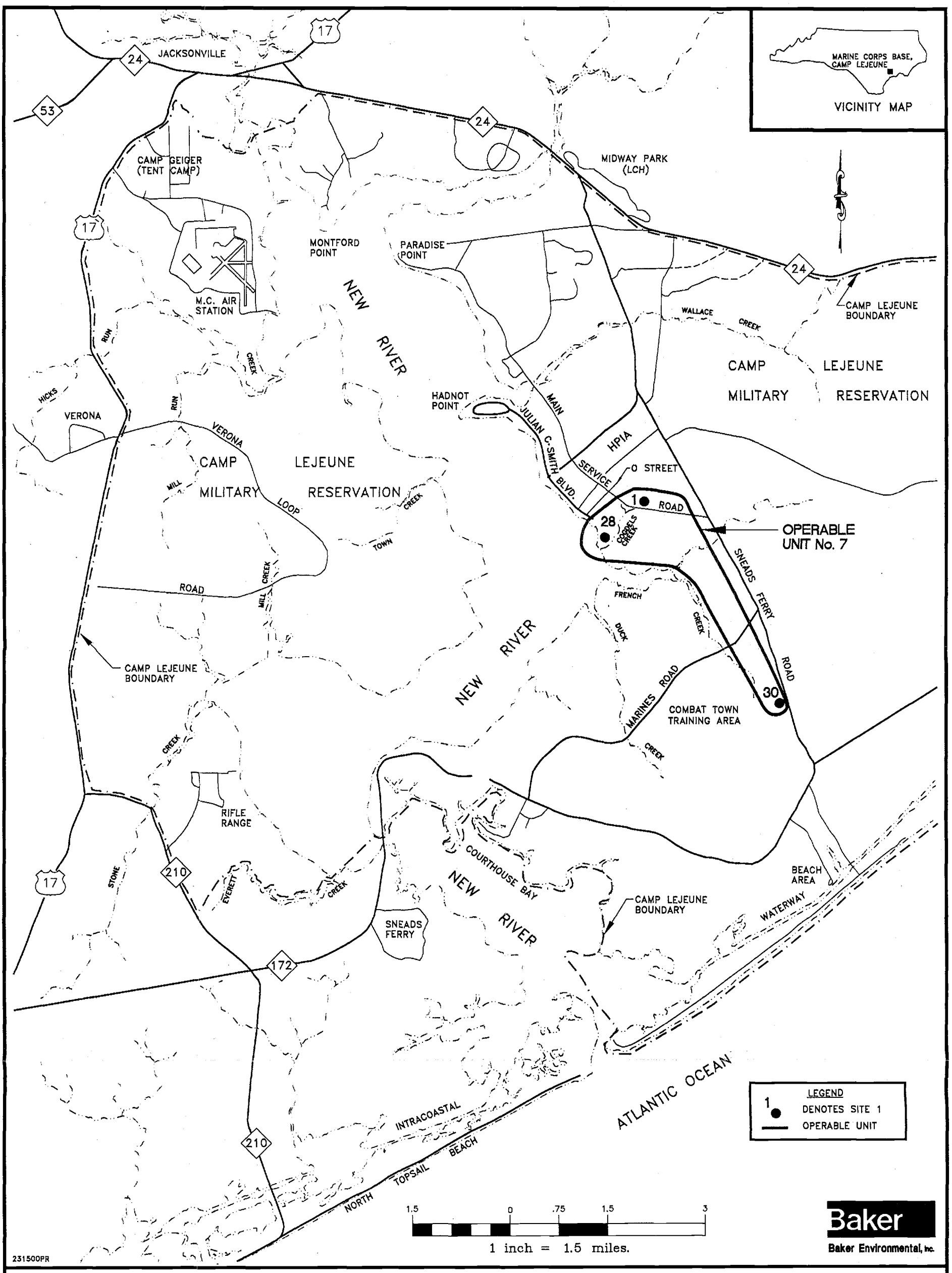


FIGURE 1
OPERABLE UNIT No. 7 – SITES 1, 28, AND 30
MARINE CORPS BASE, CAMP LEJEUNE

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01495DD012

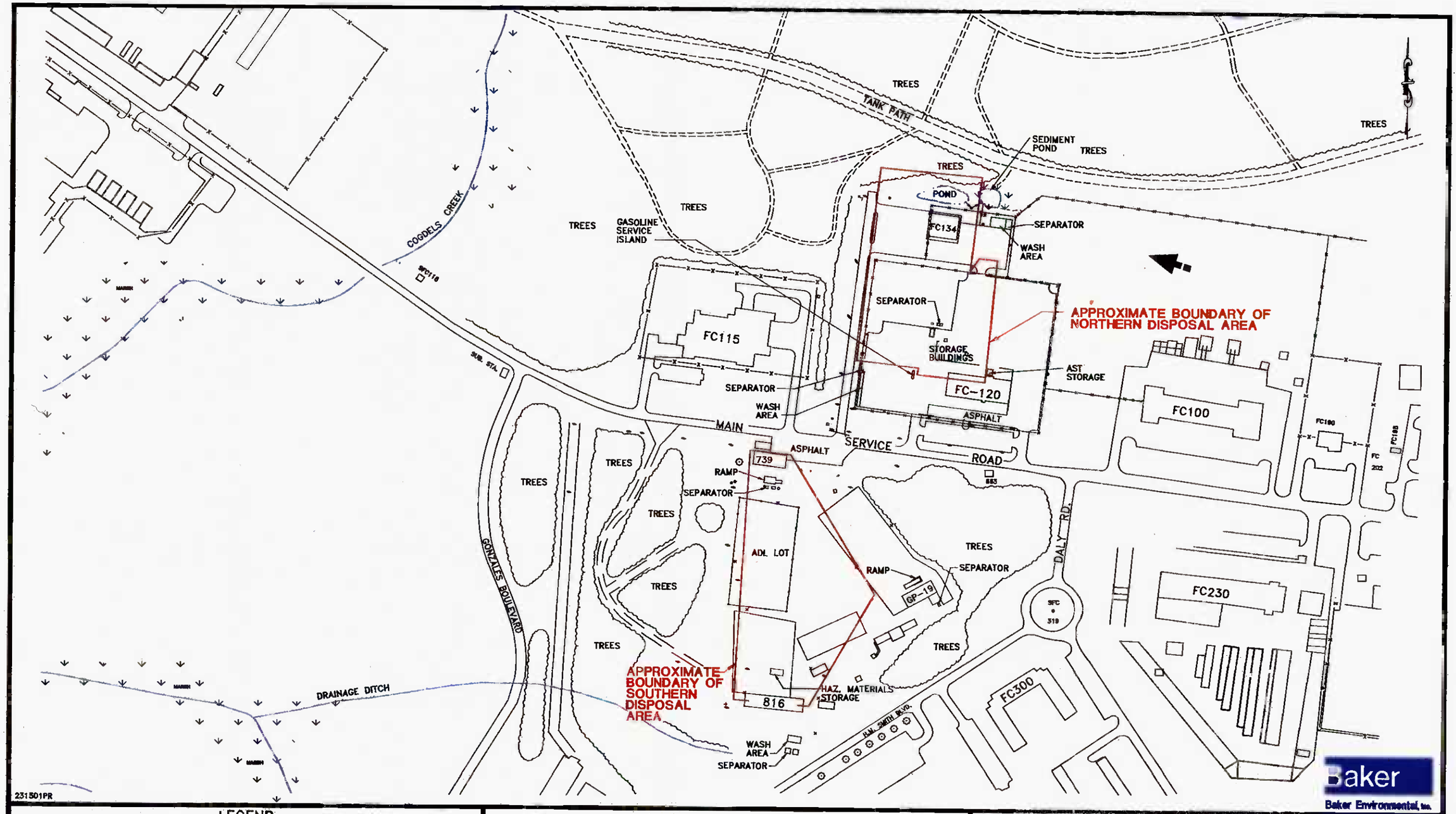
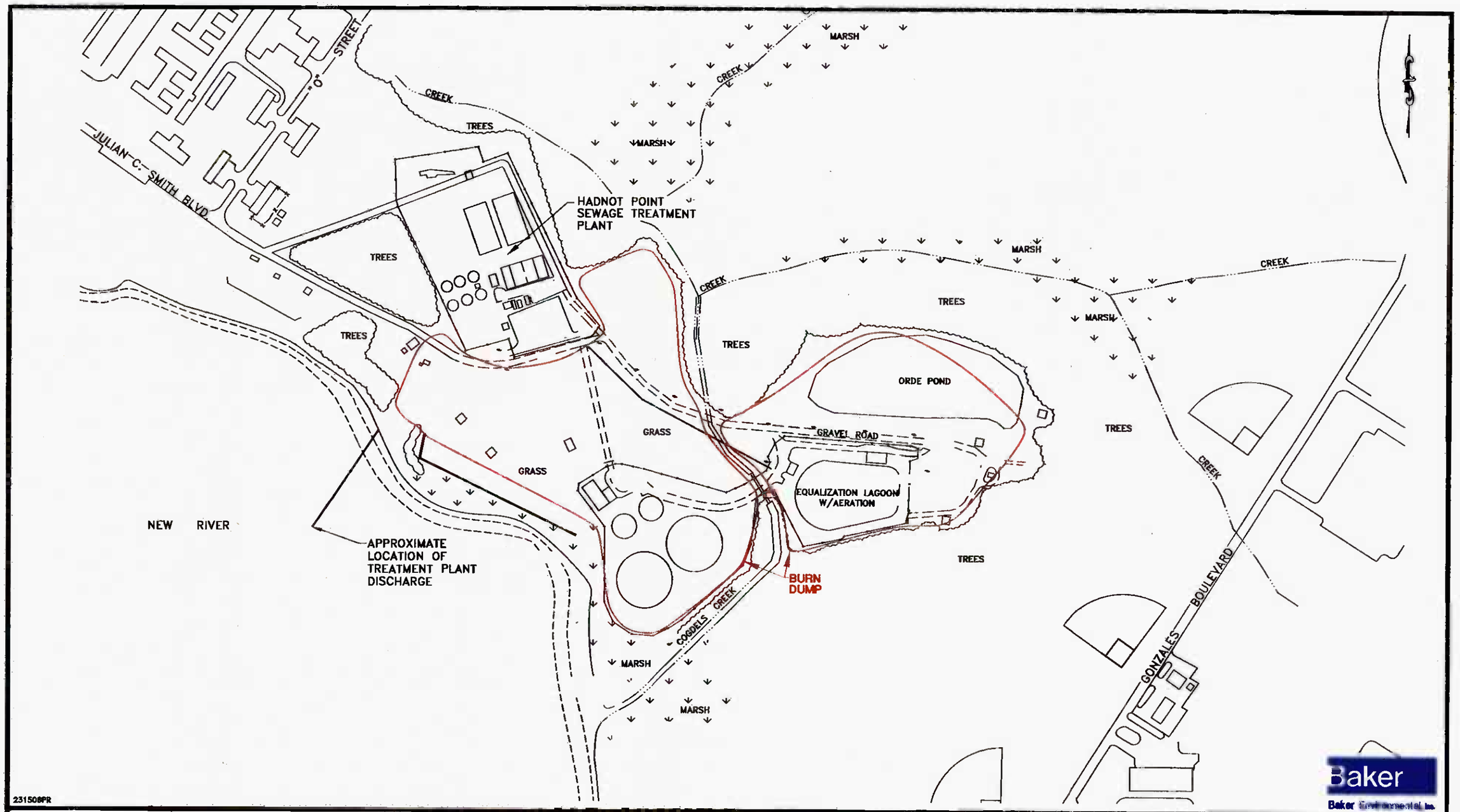


FIGURE 2
SITE 1 – FRENCH CREEK LIQUIDS DISPOSAL AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01495 DD B1Y



LEGEND

- VEGETATION
- FENCE
- CREEK/DRAINAGE
- MARSH

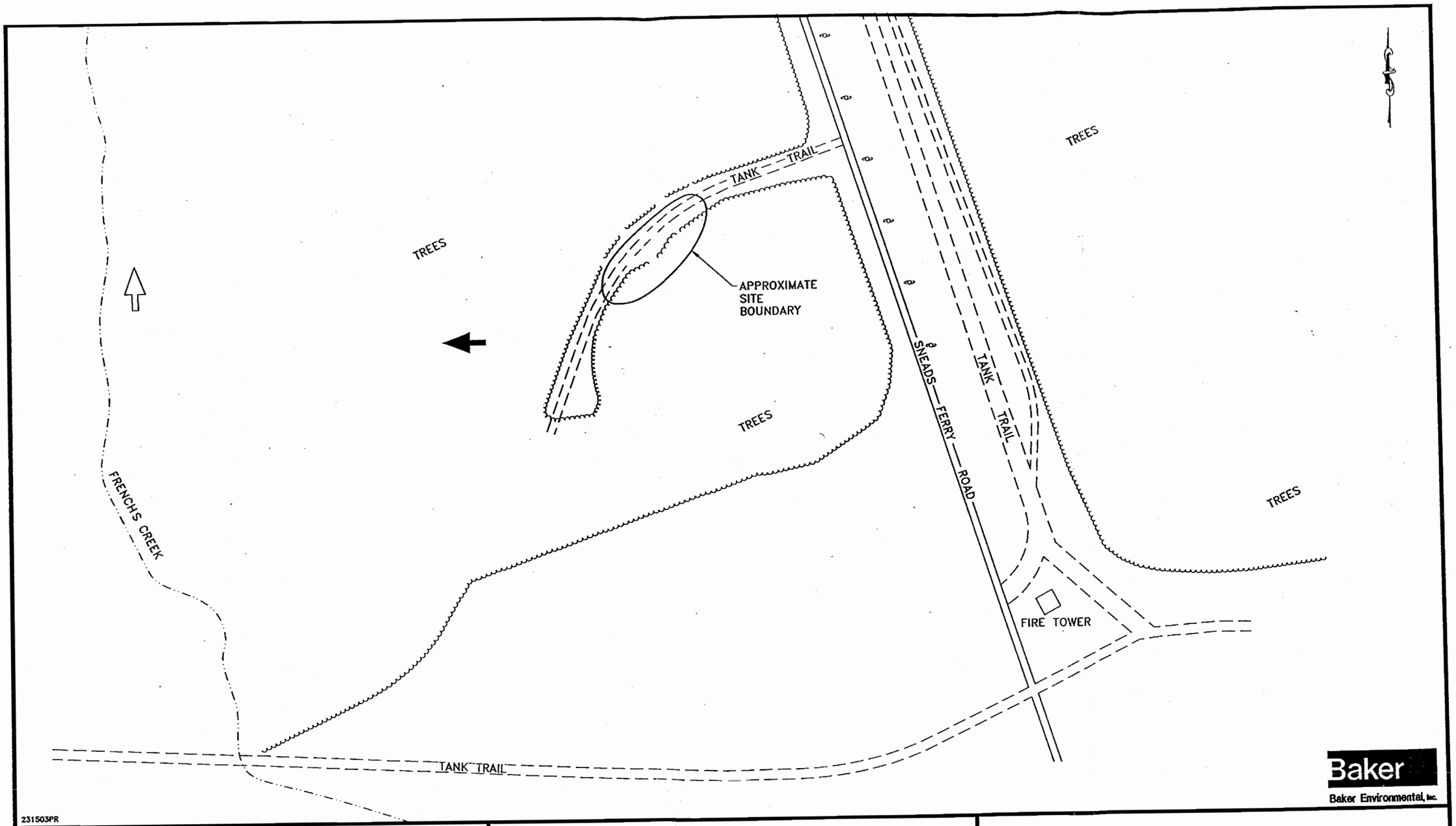
SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON, JUNE 1994

300 0 150 300 600

1 inch = 300 ft.

FIGURE 3
SITE 28 – HADNOT POINT BURN DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



231503PR

LEGEND

- ASPHALT ROAD
- UNIMPROVED ROAD (TANK TRAIL)
- UTILITY POLE
- CREEK
- VEGETATION
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- APPROXIMATE SURFACE WATER FLOW DIRECTION

SOURCE: LANTDIV, FEB. 1992 AND W.K. DICKSON, JUNE 1994

300 0 150 300 600

1 inch = 300 ft.

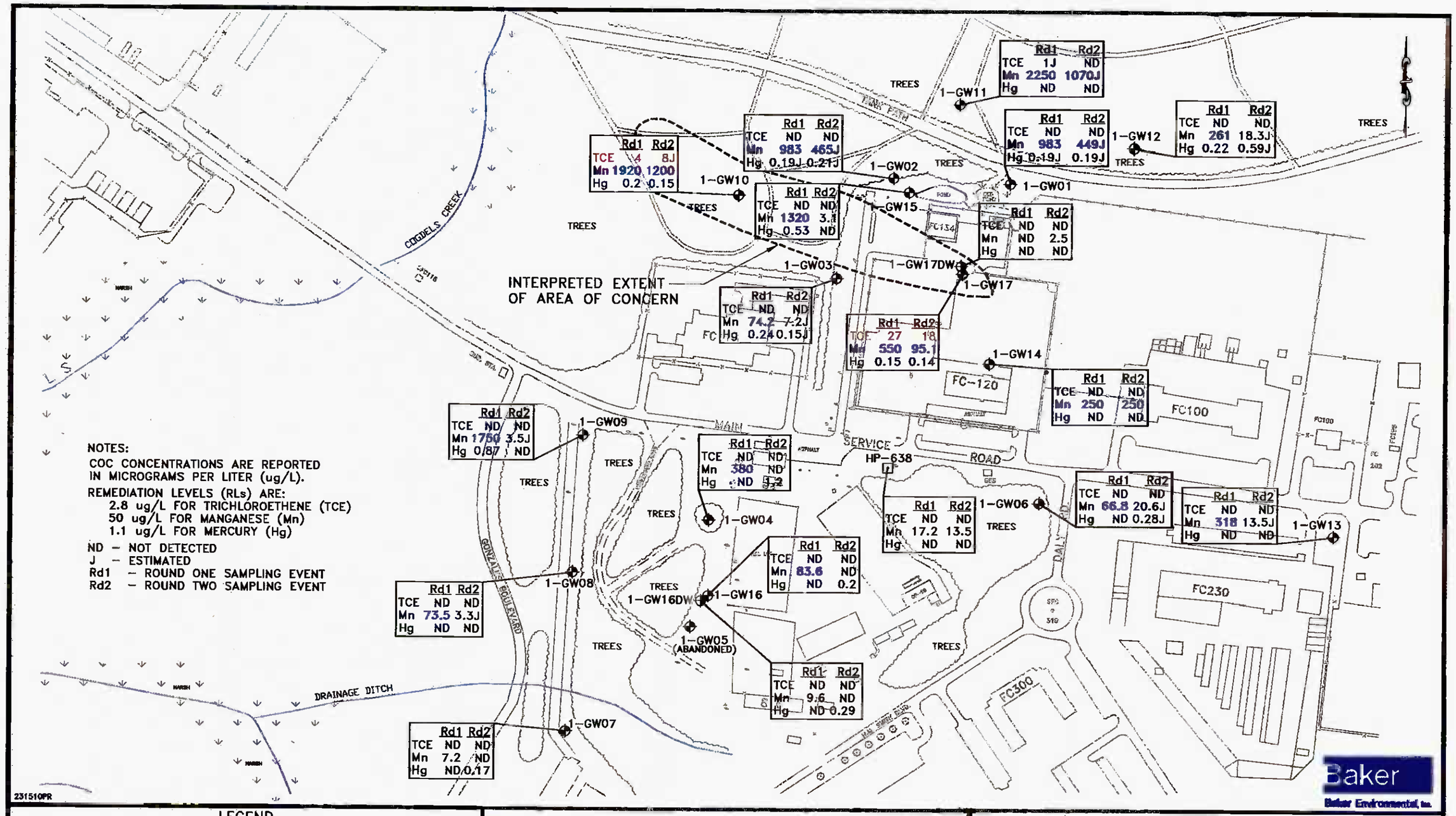
Baker

Baker Environmental, Inc.

FIGURE 4
SITE 30 – SNEADS FERRY ROAD FUEL TANK SLUDGE AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01495DD02Z



NOTES:

COC CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (ug/L).

REMEDIATION LEVELS (RLs) ARE:
- 2.8 ug/L FOR TRICHLOROETHENE (TCE)
- 50 ug/L FOR MANGANESE (Mn)
- 1.1 ug/L FOR MERCURY (Hg)

ND – NOT DETECTED
J – ESTIMATED
Rd1 – ROUND ONE SAMPLING EVENT
Rd2 – ROUND TWO SAMPLING EVENT

LEGEND

- 1-GW07 — SHALLOW MONITORING WELL
- 1-GW16DW — DEEP MONITORING WELL
- HP-638 — EXISTING WATER SUPPLY WELL

TCE 8J CONCENTRATION EXCEEDING THE TCE RL
Mn 1200 CONCENTRATION EXCEEDING THE MANGANESE RL
Hg 1.2 CONCENTRATION EXCEEDING THE MERCURY RL

SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON & ASSOC., JUNE 1994

300 0 150 300 600

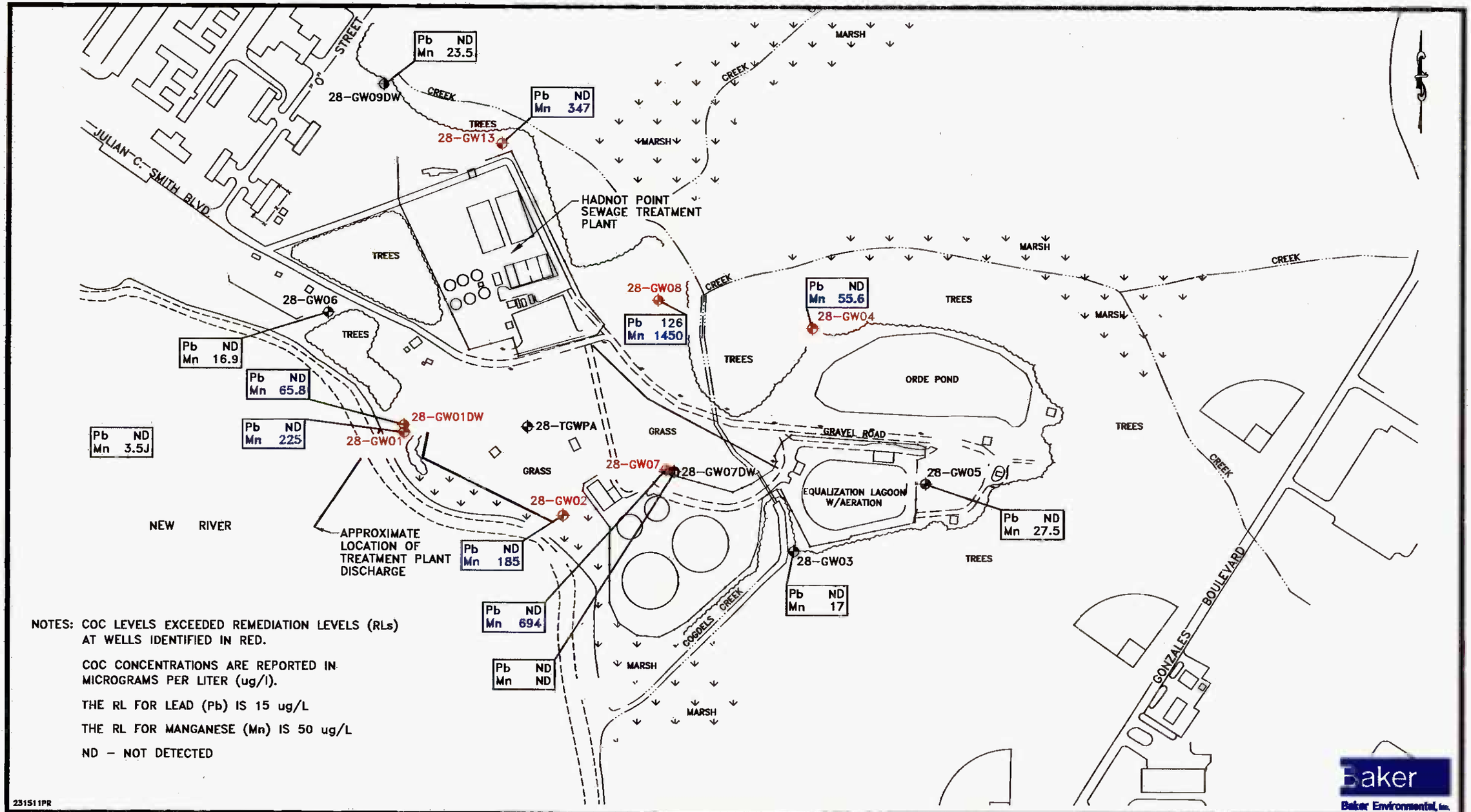
1 inch = 300 ft.

FIGURE 5
GROUNDWATER AREA OF CONCERN
SITE 1 – FRENCH CREEK LIQUIDS DISPOSAL AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker
Baker Environmental, Inc.

01495 DDB2Y



NOTES: COC LEVELS EXCEEDED REMEDIATION LEVELS (RLs) AT WELLS IDENTIFIED IN RED.

COC CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (ug/l).

THE RL FOR LEAD (Pb) IS 15 ug/L

THE RL FOR MANGANESE (Mn) IS 50 ug/L

ND – NOT DETECTED

231511PR

LEGEND

28-GW01	SHALLOW MONITORING WELL
28-GW01DW	DEEP MONITORING WELL
Pb 126	CONCENTRATION EXCEEDING THE LEAD RL
Mn 1450	CONCENTRATION EXCEEDING THE MANGANESE RL

SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON, JUNE 1994

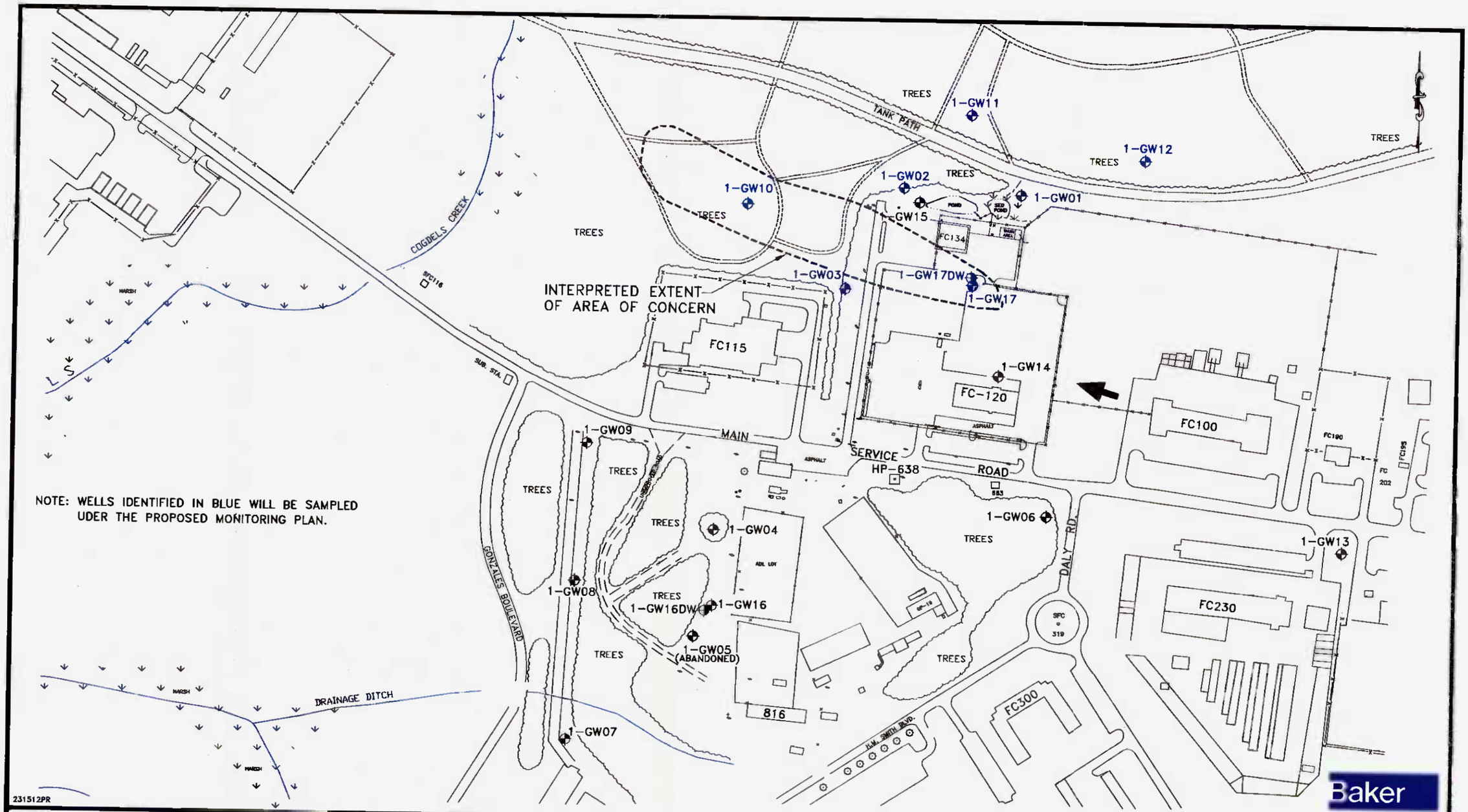
300 0 150 300 600

1 inch = 300 ft.

FIGURE 6
GROUNDWATER AREAS OF CONCERN
SITE 28 – HADNOT POINT BURN DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker
Baker Environmental, Inc.



LEGEND

- 1-GW07 — SHALLOW MONITORING WELL
- 1-GW16DW — DEEP MONITORING WELL
- HP-638 — WATER SUPPLY WELL THAT IS NOT IN SERVICE
- APPROXIMATE GROUNDWATER FLOW DIRECTION

SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON & ASSOC., JUNE 1994

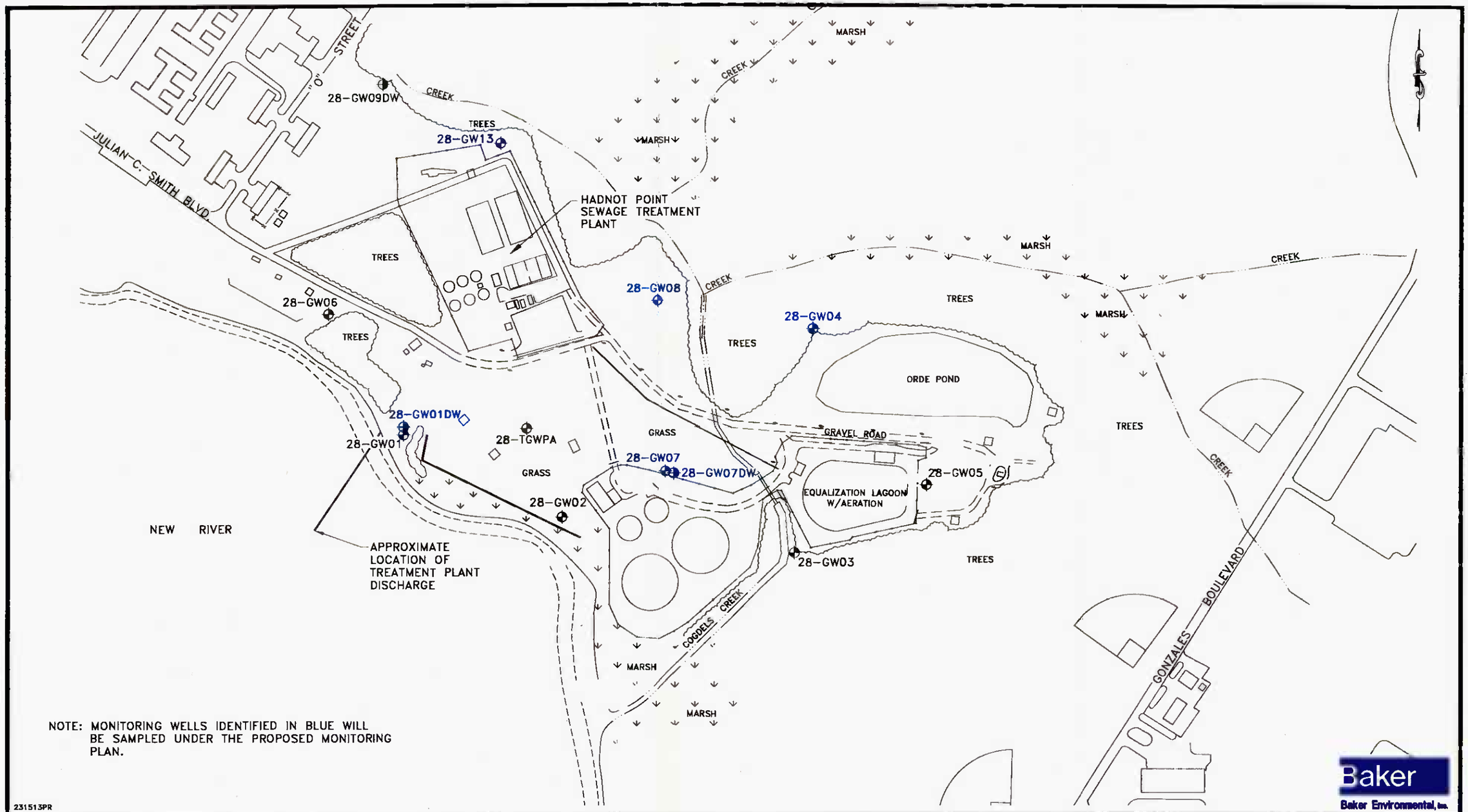
300 0 150 300 600

1 inch = 300 ft.

FIGURE 7
PREFERRED ALTERNATIVE – RAA NO. 2:
INSTITUTIONAL CONTROLS–MONITORING PLAN
SITE 1 – FRENCH CREEK LIQUIDS DISPOSAL AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker
Baker Environmental, Inc.



LEGEND

28-GW01 SHALLOW MONITORING WELL

28-GW01DW DEEP MONITORING WELL

SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON, JUNE 1994

300 0 150 300 600

1 inch = 300 ft.

FIGURE 8
PREFFERRED ALTERNATIVE – RAA No. 2:
INSTITUTIONAL CONTROLS – MONITORING PLAN
SITE 28 – HADNOT POINT BURN DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA