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RECORD OF DECISION
OPERABLE UNIT NO. 7
SITE 28 - HADNOT POINT BURN DUMP

MARINE CORPS BASE,
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0231

MARCH 30, 1995

Prepared For:

DEPARTMENT OF THE NAVY
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ARAR	Applicable or Relevant and Appropriate Requirements
Baker	Baker Environmental, Inc.
BEHP	bis (2-ethylhexyl) phthalate
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLEJ	Camp Lejeune
COPC	contaminant of potential concern
DoN	Department of the Navy
EPIC	Environmental Photographic Interpretation Center
FFA	Federal Facilities Agreement
FS	Feasibility Study
GW	groundwater
HI	Hazard Index
HPIA	Hadnot Point Industrial Area
IAS	Initial Assessment Study
ICR	Incremental Cancer Risk
IRP	Installation Restoration Program
MCB	Marine Corps Base
NC DEHNR	NC Department of the Environment, Health, and Natural Resources
NCP	National Contingency Plan
NPL	National Priorities List
OU	Operable Unit
PRAP	Proposed Remedial Action Plan
RA	Risk Assessment
RBC	Risk-Based Concentration
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SVOC	Semivolatile Organic Compound

USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

DECLARATION

Site Name and Location

Operable Unit No. 7
Site 28, Hadnot Point Burn Dump
Marine Corps Base
Camp Lejeune, North Carolina

Statement of Basis and Purpose

This decision document presents the selected remedy for Site 28 (which is part of Operable Unit (OU) No. 7), at Marine Corps Base (MCB), Camp Lejeune, North Carolina. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for the operable unit.

The Department of the Navy (DoN) and the Marine Corps have obtained concurrence from the North Carolina Department of Environment, Health and Natural Resources (NC DEHNR) and the United States Environmental Protection Agency (USEPA) Region IV on the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this operable unit, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a potential threat to public health, welfare, or the environment.

Description of Selected Remedy

The selected remedy for Site 28 addresses both the groundwater and surface soil areas of concern (AOCs). More specifically, the remedy involves institutional controls and excavation and off-site disposal of contaminated surface soil. The principal components of this remedy are:

- A long-term groundwater monitoring plan in which groundwater samples are collected semiannually and analyzed for the groundwater contaminants of potential concern (COPCs).
- Aquifer use restrictions that will prohibit the future use of the aquifer as a potable water source.
- Deed restrictions that will limit the future use of land at the site, including placement of wells.
- Excavation of the surface soil AOCs to an approximate depth of 1-foot.
- Disposal of the excavated soil at an off-site facility.

The principal threats at Site 28 are the potential for ingestion of contaminated groundwater and surface soil. The selected remedy addresses this threat because deed and aquifer use restrictions prohibit the aquifer from being used as a potable water source, the groundwater monitoring plan will detect any deterioration in groundwater quality before exposure can occur, and removal of contaminated soil from the site eliminates the potential for exposure to the soil contaminants.

Statutory Determinations

This selected remedy is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements (ARARs) and criteria to be considered (TBCs) directly associated with this action, and is cost-effective. The statutory preference for treatment is not satisfied because no treatment is necessary at Site 28 in order to maintain adequate protection. Under this remedy, five-year reviews by the lead agency will be required.

_____ _____

Signature (Commanding General, MCB, Camp Lejeune) Date

1.0 INTRODUCTION

Marine Corps Base (MCB), Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) on October 4, 1989 (54 Federal Register 41015, October 4, 1989). The United States Environmental Protection Agency (USEPA) Region IV, the North Carolina Department of Environment, Health and Natural Resources (NC DEHNR) and the United States Department of the Navy (DoN) then entered into a Federal Facilities Agreement for MCB, Camp Lejeune in February 1991. The primary purpose of the Federal Facilities Agreement was to ensure that environmental impacts associated with past and present activities at the MCB were thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives were developed and implemented as necessary to protect public health and the environment.

Site 28, the Hadnot Point Burn Dump, is one of three sites that make up Operable Unit (OU) No. 7. Therefore, Site 28 has been investigated as part of a Remedial Investigation (RI) conducted for OU No. 7. Following the RI, a Feasibility Study (FS) was conducted to develop and examine remedial action alternatives (RAAs) for Site 28. A preferred alternative was identified in a Proposed Remedial Action Plan (PRAP) document and the public will be given an opportunity to comment on the RI/FS and the PRAP for Site 28. This Record of Decision (ROD) summarizes the selected remedy for the site and the remedy selection process. The final ROD will be based on the RI/FS, public comments, and any new information that may become available.

2.0 SITE LOCATION AND DESCRIPTION

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

Figure 2 presents a site map depicting the approximate site boundary. As shown, the site is bordered to the north by the Hadnot Point Sewage Treatment Plant (STP), to the east and south by wooded and marshy areas, and to the west by the New River. 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 the site 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 and 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 within 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.

3.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

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 approximate extent of this burn dump is identified in Figure 2. 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.

Previous investigations conducted at Site 28 include an Initial Assessment Study, a Confirmation Study, some additional RI scoping investigations conducted by Baker Environmental, Inc. (Baker), an aerial photographic investigation, a Remedial Investigation/Feasibility Study (RI/FS), and confirmatory surface soil sampling.

Initial Assessment Study

In 1983, an Initial Assessment Study was conducted by Water and Air Research, Inc. The study identified a number of sites at MCB, Camp Lejeune, including Site 28, as potential sources of contamination.

Confirmation Study

From 1984 through 1987, a Confirmation Study (two rounds) was conducted by Environmental Science and Engineering, Inc. The purpose of the study was to investigate potential contaminant source areas identified in the Initial Assessment Study. At Site 28, this Confirmation Study focused on the presence of potential contaminants in groundwater, surface water, sediment, and fish tissue.

Metals were the most prevalent contaminant group encountered during both rounds of the investigation. Groundwater, surface water, and sediment samples suggested that the metals, with the exception of mercury in surface water, originated from the disposal area at the site. Concentrations of metals in groundwater generally decreased from one sampling round to the next, during 1984 and 1986. Metals 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. 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.

Volatile organic compounds (VOCs) were detected in groundwater samples collected from monitoring well 28-GW01 during both rounds of the investigation; the sample exceeded regulatory limits for trichloroethene (TCE) and vinyl chloride. (Well 28-GW01 is located on the western side of the site.) VOCs were not detected in groundwater samples from any of the other three existing wells.

The Confirmation Study recommended that further characterization of the burn dump be performed to complete the RI/FS process. Additional surface water and sediment investigations of Cogdels

Creek, between Site 28 and HPIA, were also suggested to determine possible upstream sources of contamination. Following the characterization of potentially impacted environmental media, a risk assessment was also recommended to identify unacceptable risks to human health and the environment.

Additional Investigations

In addition to the two rounds of groundwater data collected during the Confirmation Study, a third round was gathered by Baker in April 1993 to support RI scoping activities. A surface water and sediment investigation was also conducted to support RI scoping. The most prevalent contaminants found in environmental media at Site 28 were polyaromatic hydrocarbon (PAH) compounds, pesticides, and metals.

PAH compounds were detected in sediment samples from both Cogdels Creek and the New River. A number of maximum PAH concentrations were detected in a sediment sample collected from the New River, downstream of Site 28. PAH compounds were also detected upstream of the site, in sediments collected from Cogdels Creek. In addition, three PAH compounds were identified, at low concentrations, in a groundwater sample collected from well 28-GW02, adjacent to the western disposal area and the mouth of Cogdels Creek.

Pesticides were detected in both surface water and sediments from Cogdels Creek and the New River. The proportional concentrations and widespread occurrence of detected pesticides, particularly in sediments, suggested that their presence may be the result of spraying activities rather than past waste disposal. Positive detections of pesticides in sediments were not exceptionally high or concentrated in any one area. In addition, pesticide concentrations of this magnitude have historically been encountered throughout MCB, Camp Lejeune.

Metals such as cadmium, chromium, and lead were, in general, found throughout the various environmental media at Site 28. Total metals were frequently detected at concentrations in excess of state, federal, and National Oceanic Atmosphere Administration (NOAA) standards in surface water, sediment, and/or groundwater samples.

Aerial Photographic Investigation

In 1992, an interim aerial photographic investigation report was completed by the USEPA's Environmental Photographic Interpretation Center (EPIC). Black-and-white aerial photographs 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. These photographs contained visual evidence of past waste disposal activities and assisted in defining potential areas of concern (AOCs) at the site.

Remedial Investigation

Baker conducted an RI at Site 28 from late March through early May 1994. As part of the RI, additional groundwater sampling was conducted in November 1994. The purpose of the RI was to evaluate the nature and extent of the threat to public health and the environment caused by the release of hazardous substances, pollutants, or contaminants. RI data gathering activities at Site 28 included the following investigations:

- 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)

These investigations are described at length in the RI report.

As part of the RI, a human health risk assessment (RA) and an ecological RA were conducted to identify potential risks associated with the site. These risks are summarized later in this ROD.

Feasibility Study

As a result of the RI, Baker initiated an FS in January 1995 to address contaminants in the groundwater and surface soil at Site 28. Several groundwater remedial action alternatives were developed and evaluated in the FS. These alternatives are summarized later in this ROD.

Confirmatory Surface Soil Sampling

In order to more accurately delineate the extent of surface soil contamination, confirmatory surface soil sampling was conducted in March 1995. Sampling results indicated that the area of contaminated surface soil was smaller than the area that was estimated during the Draft RI/FS. Since the confirmatory sampling was conducted in between the submittal of the Draft FS and this Draft ROD, all information contained within this Draft ROD, including cost estimates, has been adjusted to account for the new surface soil AOC.

4.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS report and Proposed Remedial Action Plan (PRAP) for Site 28 will be released to the public on a date to be determined. These documents will be made available to the public in the administrative record file at information repositories maintained at the Onslow County Public Library and at the MCB, Camp Lejeune Library. Also, all addresses on the Site 28 mailing list will be sent a copy of the Final PRAP and Fact Sheet. The notice of availability of the PRAP and RI/FS documents will be published in the "Jacksonville Daily News" on a date to be determined. A public comment period will be held from July 18, 1995 to August 18, 1995. In addition, a public meeting will be held on July 18, 1995 to respond to questions and to accept public comments on the PRAP for Site 28. The public meeting minutes will be transcribed and a copy of the transcript will be made available to the public at the aforementioned libraries. A Responsiveness Summary, included as part of this ROD, has been prepared to respond to the significant comments, criticisms and new relevant information received during the comment period. Upon signing this ROD, MCB, Camp Lejeune and the DoN will publish a notice of availability of this ROD in the local newspaper, and place this ROD in the information repository located in the Onslow County and MCB, Camp Lejeune libraries.

5.0 SCOPE AND ROLE OF THE ACTION

The selected remedy (or response action) for Site 28 focuses on groundwater and surface soil. More specifically, the remedy focuses on the groundwater and surface soil AOCs identified in Figures 3 and 4, respectively. As shown, the groundwater AOCs are small areas at each well where an RL was

exceeded. The surface soil AOCs are three circular areas centered on sampling locations SB08, SB11, and SB18 that extend around a 15 foot radius at each location.

The principal threat at Site 28 is the potential for ingestion of groundwater and surface soil. The selected remedy for Site 28 was developed to address this principle threat.

Please note that this ROD was developed for Site 28, not Sites 1 and 30, which are also included in OU No. 7. Separate PRAPs will be developed for Sites 1 and 30.

6.0 SITE CHARACTERISTICS

This section briefly describes the nature and extent of the COPCs that were detected in the groundwater and soil during the RI at Site 28. Please note that although many COPCs were detected during the RI, only lead and manganese in the groundwater and copper and manganese in the surface soil were required to be evaluated in the FS.

Groundwater

VOCs, semivolatile organic compounds (SVOCs), pesticides, and metals were all detected to some extent in the groundwater at Site 28. Polychlorinated biphenyls (PCBs) were not detected in any of the groundwater samples submitted for analysis. As a result, the extent of PCB contamination in groundwater will not be addressed.

Volatile Organic Compounds: Positive detections of VOCs were limited to a shallow groundwater sample obtained from a temporary well located near the center of the western disposal area. The lack of positive VOC detections in samples obtained from surrounding shallow monitoring wells or the deep aquifer suggested that VOCs had not migrated from the western disposal area. The residual levels (i.e., less than 20 micrograms per liter [µg/L]) of chloroform, ethylbenzene, and total xylenes that were observed, were most likely the remains of accelerants once used to ignite waste material.

Semivolatile Organic Compounds: SVOCs were detected in four of the nine shallow monitoring wells and the one temporary monitoring well. Each of the monitoring wells with positive SVOC concentrations were located within or adjacent to the western disposal area. No SVOCs were detected in the three samples obtained from the deep aquifer, which suggested that contamination had not migrated to depths greater than 100 feet below ground surface.

A total of six SVOCs were detected in samples obtained from four permanent monitoring wells. Five of the six SVOCs were detected at concentrations of less than 2 µg/L, 4-methylphenol was detected at a concentration of 29 µg/L. Twelve SVOCs were identified in the groundwater sample from the temporary well. The highest detection of an SVOC was 99 µg/L of naphthalene. In general, subsurface soil analytical results from monitoring well test borings and nearby soil borings corresponded to the results from the groundwater investigation and the presence of fill and burn material.

Pesticides: During the first sampling round, organic pesticide compounds were detected in five of the nine shallow monitoring wells and the one temporary monitoring well. No pesticides were observed in the three groundwater samples collected from the deep aquifer. Each of the six groundwater samples with pesticide detections were obtained from wells located on the western portion of the study area. The five shallow monitoring wells which exhibited concentrations during

the first round were resampled for pesticides as part of the second sampling round. The absence of pesticide compounds in those five samples suggested that the reduction of suspended colloids, through use of the low-flow sampling technique, correlated with the elimination of pesticides. Subsurface soil analytical results throughout the western portion of the study area indicated the presence of pesticides. Suspended soil particles, colloids, in groundwater samples collected during the first sampling round are likely to have introduced pesticide contaminants into the sample set; pesticides tend to adhere to soil material. As a result of the second round groundwater sampling results, the extent of groundwater pesticide contamination was not considered further.

Metals: Metals were detected in each of the 13 groundwater samples submitted for analysis. Iron, manganese, and lead were the only metals detected, among samples obtained from the 12 permanent monitoring wells, at levels in excess of either federal or state standards. Positive detections of both iron and manganese were distributed throughout the site, indicative of natural site conditions rather than disposal activities. Lead was detected within one sample at a concentration which exceeded the state standard. Lead was detected at a concentration (126 µg/L) in a sample from monitoring well 28-GW08, located within the western disposal area. During the installation of well 28-GW08 several buried metallic objects, including steel cable material, were brought to the surface. Generally, concentrations of metals in shallow groundwater at Site 28 appeared to be higher in samples obtained from the western portion of the study area.

The decrease of metals concentrations between the first and second sampling rounds was most likely the result of modified sample acquisition procedures. Elevated metals observations have been recorded at other MCB, Camp Lejeune sites and are likely the consequence of loose surficial soils. During the resampling, a low flow purge method was utilized to minimize the presence of suspended solids or colloids in samples that are associated with the surficial soils. The resulting data set yielded a more accurate assessment of existing conditions. The DoN is currently evaluating the presence and distribution of metals in groundwater throughout the facility. Studies conducted at the base support the opinion that metals concentrations in groundwater are due more to geologic conditions (i.e., naturally occurring concentrations and unconsolidated soils) and sample acquisition methods than to actual metals concentrations in the surficial aquifer.

Soil

VOCs, SVOCs, pesticides, PCBs, and metals were detected to some extent in soil at Site 28. The following paragraphs describe the extent of soil contamination.

Volatile Organic Compounds: VOCs within soils at Site 28 did not appear to be the result of widespread disposal activities. VOCs were positively detected in only three of the 72 soil samples collected throughout Site 28. The positive detections were identified in samples retained from both the eastern and western portions of Site 28. The VOCs benzene, tetrachloroethene, and 1,1,1-trichloroethane were each detected once at low concentrations (i.e., less than 5 micrograms per kilogram [µg/Kg]). Given the limited extent and low concentration of VOCs at Site 28, their presence was most likely the result of previous burning operations.

Semivolatile Organic Compounds: The presence and dispersion of SVOCs in soil, particularly polynuclear aromatic hydrocarbon (PAH) compounds, were most likely the result of former burning operations at Site 28. Concentrations of PAH compounds in soil samples were consistent with the site's historical use as a burn dump and indicative of waste or refuse incineration. SVOCs were identified in both surface and subsurface soil samples throughout the site. However, higher

concentrations of SVOCs were limited to the western portion of the study area. In addition, concentrations of SVOCs were typically higher in subsurface samples than in those obtained from the surface. In general, subsurface soil analytical results corresponded directly to the visual identification of fill and burn material recorded during the field investigation of the western portion of the study area.

Pesticides: Positive detections of pesticides were observed in both surface and subsurface soil samples throughout Site 28. The detected pesticide levels were generally low and most likely the result of routine pesticide application. A number of the pesticide detections were from subsurface samples (i.e., samples obtained from greater than one foot). Soil samples obtained from the western portion of the study area and at depths of greater than one foot below ground surface, had a majority of the higher pesticide concentrations. The western portion of the study area is composed of fill and burn material which may have also included residual concentrations of pesticides. The frequency and overall concentration of pesticides in soil, however, did not suggest past pesticide disposal activities.

Polychlorinated Biphenyls: Six positive detections of PCBs were observed in samples obtained from five separate soil borings, all located on the western portion of the site. Each of the six positive detections of a PCB were observed in conjunction with positive pesticide detections. At one time it was not uncommon to use oil, possibly containing PCBs, as a dust suppressor and to apply pesticides. The occurrence of both pesticides and PCBs within each of the six soil samples suggested that these organic compounds were introduced to the site concurrently. The observed levels of PCB contaminants from soil analyses at Site 28 were not characteristic of PCB disposal activities.

Metals: Several of the 93 soil samples submitted for analysis had metals concentrations greater than one order of magnitude above base-specific background levels. Metals 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. The metals copper, lead, manganese, and zinc were observed at maximum concentrations greater than two orders of magnitude above base-specific background levels in a limited number of soil samples from the western portion of the study area. Findings from the analytical program were consistent with visual observations of buried metallic objects and fill material recorded during the field investigation. Concentrations of metals in samples obtained from the western portion of the study area coincided directly with areas of fill and buried material. The buried metal, in the presence of naturally-occurring acidic soils, was most probably the source of metal contamination.

7.0 SUMMARY OF SITE RISKS

As part of the RI, a human health RA and an ecological RA were conducted to evaluate the actual and/or potential risks to human health and the environment resulting from the presence of COPCs at Site 28.

Human Health Risk Assessment

The human health RA investigated the potential for COPCs to affect human health and/or the environment, both now and in the future, assuming that no further remedial actions are implemented at the site. Hypothetical scenarios, in which hypothetical receptors were assumed to be exposed to the site COPCs, were used to evaluate the actual and potential risks that exist at the site.

For Site 28, military personnel, recreational receptors (both children and adults), and fishermen were assumed to be the receptors under the current scenario. Under the future scenario, future residents (both children and adults), future construction workers, and future fishermen were assumed to be the receptors. Table 1 identifies the exposure pathways by which each receptor was assumed to come in contact with the COPCs.

Numeric values that quantify the total risks associated with the site COPCs (both carcinogenic and noncarcinogenic risks) were generated. For carcinogenic risks, these values are known as incremental cancer risk (ICR) values. For noncarcinogenic risk, these values are known as hazard index (HI) values. ICR and HI values were generated for each potential receptor and its respective exposure pathways.

Tables 2, 3, and 4 present the ICR and HI values calculated for Site 28. More specifically, Table 2 presents the potential risks for the child receptor, Table 3 presents the potential risks for the adult receptor, and Table 4 presents the potential risks for the military personnel, fisherman, and construction worker receptors.

USEPA considers ICR values in the range of 1E-04 and 1E-06 to be generally acceptable and protective of human health and the environment. In other words, an ICR less than 1E-04 indicates that adverse carcinogenic health affects due to COPC exposure are unlikely. USEPA also considers HI values less than 1.0 to be generally acceptable and protective of human health and the environment. In other words, adverse noncarcinogenic health effects due to COPC exposure are unlikely. As shown on Tables 2, 3, and 4, the only unacceptable risks were noncarcinogenic risks associated with surface soil, subsurface soil, and groundwater, and carcinogenic risks associated with groundwater and sediment in the New River. These scenarios generated HI values greater than 1.0 and/or an ICR value greater than 1E-04.

Metals in groundwater, soil, and sediment drove the potential noncarcinogenic and carcinogenic risks at the site. The specific metals were manganese in soil and groundwater, and antimony in the sediment of the New River. Risks due to the sediment of the New River were not addressed in the FS because this river receives drainage from many other potentially contaminated sites at MCB, Camp Lejeune. Also, sediment remediation may create ecological problems.

Under the current scenario, the RA calculated a potential noncarcinogenic risk for the child receptor as a result of soil ingestion. The potential noncarcinogenic risk from surface soil exposure (1.3) is only slightly greater than the acceptable risk level of "1" for noncarcinogens. Although manganese contributed to this risk, the concentration of manganese used to determine potential risk did not exceed the risk-based concentration RBC that defines the acceptable limit of a contaminant in soil. Consequently, due to the conservative nature of the human health RA, this potential current risk may be an overestimate.

In terms of the future risk, there were potential noncarcinogenic risks for the child receptor from subsurface soil and groundwater exposure. For the adult receptor, the noncarcinogenic risk from groundwater ingestion and the total potential carcinogenic risk from groundwater exposure exceeded the acceptable risk level(s). Manganese in subsurface soil and groundwater contributed to these risks. The levels of both metals used to determine risk also exceeded federal standards and RBCs.

It is important to note that the future exposure scenario is 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 potential impacts associated with exposure to lead, use of the lead uptake/biokinetic (UBK) model indicates that exposure to surface soil, subsurface soil and groundwater at this site generates blood lead levels in children that are slightly greater than the acceptable level. However, it is important to note that the maximum levels of lead in the soils and groundwater were used to generate these modeled results. Consequently, the results from the lead UBK model were conservative and may be overestimates of the potential human health impact from exposure to lead in soil and groundwater.

Ecological Risk Assessment

The purpose of the ecological RA was to determine if COPCs were adversely impacting the ecological integrity of aquatic and terrestrial ecosystems 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. Overall, metals and pesticides appeared to be the most significant site related COPCs that had potential to affect the integrity of the aquatic receptors a Site 28. For the terrestrial receptors at Site 28, metals appeared to be the most significant site related COPC that 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 were determined to be low due to the low levels of most contaminants in its critical habitat. The following paragraphs describe the state of aquatic and terrestrial communities as determined in the ecological RA.

Aquatic Ecosystem: 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 1.0 slightly at a single station. Aluminum exceeded 1.0 in Orde Pond. However, the exceedence was only slightly above 1.0.

In the sediments, 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 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. However, these exceedences represent a moderate potential for risk to aquatic receptors. The levels detected in the sediments may be a result of routine application in the general vicinity of Site 28, especially near the sewage treatment plant and recreational area.

The results of the analysis of benthic macroinvertebrates and fish populations indicate 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 relative to this parameter. 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.

Terrestrial Ecosystem: 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 metals (cadmium, chromium, copper, manganese, nickel, and zinc), these contaminants at Site 28 were determined to have the potential to 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 appeared to be an ecological risk to terrestrial vertebrate receptors. This risk was expected to be significant if greater exposure to these contaminants resulted.

8.0 DESCRIPTION OF ALTERNATIVES

During the FS, remedial action alternatives (RAAs) were developed to address COPCs in the groundwater and surface soil at Site 28.

The following two groundwater RAAs were developed:

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

Active remediation alternatives were not developed for groundwater due to the nature of the COPCs, manganese and lead. Manganese naturally occurs at high levels and lead was only detected in the unfiltered samples, not the filtered samples. As a result, an active remediation alternative would not be appropriate.

In addition to these groundwater RAAs, the following five surface soil RAAs were developed:

- Surface Soil RAA 1 - No Action
- Surface Soil RAA 2 - Institutional Controls
- Surface Soil RAA 3 - Capping
- Surface Soil RAA 4 - Excavation and On-Site Treatment
- Surface Soil RAA 5 - Excavation and Off-Site Disposal

A brief description of each groundwater and surface soil RAA is presented below.

- **Groundwater RAA 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 contaminants identified in the groundwater. 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.

- **Groundwater RAA 2 - Institutional Controls**

Capital Cost: $0
Annual O&M Costs: $30,000
NPW: $430,000
Years to Implement: 30

Under RAA 2, no additional remedial actions will be performed to reduce the toxicity, mobility, or volume of metals in the groundwater. Instead, the following institutional controls will be implemented: a continued groundwater monitoring plan, ordinances (or directives) preventing the operation of nearby supply wells, and deed restrictions prohibiting the future construction of potable water supply wells. Under the groundwater monitoring plan, samples will be 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.

- **Surface Soil RAA 1 - No Action**

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

Under Surface Soil RAA 1, no remedial actions will be performed to reduce the toxicity, mobility, or volume of surface soil contaminants. The no action RAA 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.

- **Surface Soil RAA 2 - Institutional Controls**

Capital Cost: $0
Annual O&M Costs: $0
NPW: $0
Years to Implement: Less than one

Under Surface Soil RAA 2, no remedial actions will be performed to reduce the toxicity, mobility, or volume of surface soil contaminants. However, deed restrictions prohibiting the future placement of wells at Site 28 will be implemented.

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.

- **Surface Soil RAA 3 - Capping**

Capital Cost: $100,000
Annual O&M Costs: $8,000
NPW: $220,000
Years to Implement: Less than one

Under Surface Soil RAA 3, three soil/clay caps will be installed over the AOCs identified on Figure 4. The purpose of the caps will be to reduce the mobility of the contaminants in the soil. (The caps, however, will not reduce the toxicity or the volume of the contaminants in the soil.) Also, the caps will provide a barrier between receptors and the contaminated soil. The thickness of each cap will be approximately two feet.

Installation of the caps will require a minimal amount of surface grading, but surface soils will not be removed from the areas to be capped. Once the caps are in place, they will be revegetated to blend in with the surrounding environment and periodically maintained to ensure their integrity.

In addition to capping, RAA 3 incorporates deed restrictions to limit the future use of land at Site 28, and long-term groundwater monitoring around and downgradient of the caps.

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.

- **Surface Soil RAA 4 - Excavation and On-Site Treatment**

Capital Cost: $380,000
Annual O&M Costs: $0
NPW: $380,000
Years to Implement: Less than one

Surface Soil RAA 4 will involve the excavation and on-site treatment of contaminated surface soil. Once the soil is treated, it will be returned to the excavated areas on the site. The areas to be excavated are the AOCs identified on Figure 4. Although surface soil samples extended from 0 to 6 inches bgs, soils will be excavated to a 1 foot depth to ensure collection of the contaminants. Thus, approximately 90 cubic yards of soil will be excavated.

After the contaminated soil is excavated, it will be transported to an on-site treatment facility where it will undergo metals removal via soil washing. Soil washing is an ex situ process which incorporates size classification and vigorous scrubbing of soil particles with water to remove metals or organic contaminants. In some cases, wash-enhancing agents, such as water soluble surfactants, chelating agents, acids, or bases, may be used to facilitate contaminant removal. A treatability study is extremely important in designing the optimum soil washing system.

The soil is first screened to remove oversize material which is typically uncontaminated. The screened soil is then further screened via size and gravity separation to produce a coarse and fine fraction. The coarse material is "washed" to remove contaminants (sometimes wash-enhancing agents are added) and any fine particles adhering to the coarse particles. Attrition scrubbing removes adherent contaminant films from coarser particles. The cleaned coarse material is dewatered and can be returned to the site as backfill. The fines are dewatered and sent to off-site disposal or treatment.

The advantage of soil washing is the large volume reduction. Often only 10 to 30 percent of the original soil volume requires disposal. In addition, process water is recycled. Therefore, water treatment is minimal.

After the soil is treated, the excavated areas left at the site will be graded and revegetated to conform to the surrounding terrain.

- **Surface Soil RAA 5 - Excavation and Off-Site Disposal**

Capital Cost: $200,000
Annual O&M Costs: $0
NPW: $200,000
Years to Implement: Less than one

Surface Soil RAA 5 will involve excavation and off-site disposal of contaminated surface soil. Thus, this RAA provides permanent removal of the contaminants from the site. The areas to be excavated are the AOCs identified on Figure 4. Although surface soil samples extended from 0 to 6 inches below ground surface, soils will be excavated to a 1 foot depth to ensure collection of the contaminants. Thus, approximately 90 cubic yards of soil will be excavated.

Before contaminated soils are excavated, composite samples will be collected and analyzed to determine if the soil is hazardous or non-hazardous. If the soil is hazardous, it will be transported for disposal at a RCRA facility. If the soil is non-hazardous, it will be transported for disposal at a nearby landfill.

Finally, the excavated areas left at the site will be graded and revegetated to conform to the surrounding terrain.

9.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

During the FS, the groundwater and surface soil RAAs were comparatively analyzed to identify their relative advantages and disadvantages with respect to seven evaluation criteria. These criteria are: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements (ARARs); long-term effectiveness/performance; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. (Two other criteria, USEPA/State acceptance and community acceptance, will be evaluated later in the ROD document.) The following paragraphs summarize the comparative analysis of groundwater and surface soil RAAs. In addition, Table 5 summarizes the Groundwater RAA evaluation and Table 6 summarizes the Surface Soil RAA evaluation. Table 7 provides definitions of the evaluation criteria.

Comparative Analysis of Groundwater RAAs

Overall Protection of Human Health and the Environment: Groundwater RAA 1, the no action alternative, does not reduce potential risks to human health and the environment. On the other hand, Groundwater RAA 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 COPCs, lead and manganese, do not pose substantial risks to human health or the environment for the following reasons:

- Manganese concentrations (in both unfiltered and filtered samples) in groundwater at MCB, Camp Lejeune often exceed the state and federal standard of 50 µg/L. Elevated manganese levels, at concentrations above the standard, were reported in samples collected from a number of base potable water supply wells. Manganese concentrations at several Site 28 wells exceeded the standards, and all but one sample fell within the range of concentrations for samples collected elsewhere at MCB, Camp Lejeune.

- Lead was detected above its RL 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 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 at 28-GW08 was 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.

- The depth to the water table (approximately 10 feet) makes it unlikely that any ecological receptors will come in contact with the groundwater.

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

Compliance with ARARs: Under RAAs 1 and 2, lead and manganese levels are expected to exceed their chemical-specific ARARs. However, this is not a great concern because manganese at the base naturally occurs at high levels, and the lead sample at well 28-GW08 contained high suspended solids.

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

Long-Term Effectiveness and Permanence: RAA 1 allows the most residual risk, and RAA 2 allows less residual risk. Regardless, the magnitude of any residual risk will be minimal.

RAA 2 involves monitoring, aquifer-use restrictions, and deed restrictions, which are all adequate and reliable controls; RAA 1 involves no controls. As a result, RAA 2 can mitigate the potential for groundwater exposure, but RAA 1 cannot. Also, the effectiveness of RAA 2 can be determined more often than the effectiveness of RAA 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: RAAs 1 and 2 do not involve active treatment processes so these alternatives will not reduce toxicity, mobility, or volume of the groundwater COPCs (except by natural attenuation processes). Thus, neither RAA satisfies the statutory preference for treatment.

Short-Term Effectiveness: Implementation of RAAs 1 and 2 will not increase risks to the community. RAA 1 will not increase risks to workers, but RAA 2 will. RAA 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 RAAs 1 and 2. The current environmental impacts associated with the groundwater COPCs are expected to continue, and these impacts are minimal.

Implementability: RAA 1 is the most implementable, if not the most effective, alternative. RAA 2 is not as implementable as RAA 1, but it is still easily implementable. RAA 2 involves conventional, well-demonstrated, and commercially available technologies, and it has been easily implemented in the past.

Despite its implementability, RAA 1 does not have adequate monitoring to determine its effectiveness. As a result, failure to detect increases in COPC levels could result in potential ingestion of groundwater. RAA 2 involves a monitoring plan so there will be notice of contaminant increases before significant groundwater exposure can occur.

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

Cost: In terms of NPW, the no action alternative (RAA 1) would be the least expensive RAA to implement, followed by RAA 2. The estimated NPW values are $0 (RAA 1) and $430,000 (RAA 2).

Comparative Analysis of Surface Soil RAAs

Overall Protection of Human Health and the Environment: All of the Surface Soil RAAs, with the exception of the no action alternative (RAA 1), provide protection to human health and the environment. The RAAs differ by the method in which they provide this protection. RAA 2 (institutional controls) provides protection by limiting future land use at the site. RAA 3 (capping) provides protection by reducing the potential for direct contact with contaminated surface soil and mitigating contaminant mobility. RAA 4 (excavation and on-site treatment) provides protection by removing contaminated soil, treating the COPCs, then returning the treated soil to the areas that it came from. RAA 5 (excavation and off-site treatment) provides protection by permanently removing the soil from the site. RAAs 4 and 5, however, provide more protection than RAAs 2 and 3. This is because unlike RAAs 2 and 3, RAAs 4 and 5 do not allow contaminated soil to remain on site.

Compliance with ARARs: RAAs 4 and 5 are the only alternatives that will cause copper and manganese in the surface soil to meet their chemical-specific ARARs. Under RAA 4, the ARARs will be achieved by treating the contaminated soil. Under RAA 5, the ARARs will be achieved by replacing the contaminated soil with clean backfill. Both of these methods for achieving ARARs are equally effective. Under RAAs 1, 2, and 3, however, copper and manganese will not meet their chemical-specific ARARs because the COPCs will remain untreated on site.

RAAs 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 RAAs 1 and 2.

Long-Term Effectiveness and Permanence: RAA 1 is not an effective alternative because it provides no protection against the contaminated soil. RAA 2 provides the next lowest level of protection against the contaminated soil. RAA 3 will provide long-term effectiveness as long as the cap is maintained. However, the cap may not be a permanent containment option because over time, it could be damaged or removed. Thus, RAA No. 3 may not be a permanent alternative.

Comparing RAAs 4 and 5, RAA 4 allows the most residual risk because it requires stockpiling the contaminated soil on site and it creates soil washing residuals that require further treatment. RAA 5, on the other hand, eliminates residual risk because it is a source removal alternative. Thus, although both RAAs 4 and 5 are permanent alternatives, RAA 5 provides more long-term effectiveness.

RAAs 1, 2, and 3 will require a 5-year review. Until remediation levels are met, RAA 4 will require a 5-year review. Under RAA 5, a 5-year review is not required.

Reduction of Toxicity, Mobility, or Volume: No form of treatment is included under RAAs 1, 2, and 3. Under RAAs 1 and 2, there will be no reduction in toxicity, mobility, or volume of COPCs. Under RAA 3, there will be no reduction in toxicity or volume, but there may be some reduction in the mobility of the COPCs. Under RAA 4, treatment is included. Therefore, RAA 4 will reduce the toxicity, mobility, and/or volume of the COPCs. Under RAA 5, there is no on-site treatment of the COPCs, but their toxicity, mobility, and volume at the site will be eliminated because they will be removed.

RAA 4 is the only alternative in which residuals will remain after treatment. These residuals will include: (1) clean soil (sand and gravel particles) that will become backfill for the excavated areas,

(2) contaminated sludge and fines which will require proper disposal, and (3) used washing fluids which will require treatment and subsequently, may be recycled through the system.

In addition, RAAs 1, 2, and 3 do not satisfy the statutory preference for treatment, whereas RAAs 4 and 5 do satisfy the preference.

Short-Term Effectiveness: Risks to community and workers are not increased with the implementation of RAAs 1 and 2. Under RAAs 3, 4, and 5, risks to the community and workers will be temporarily increased during capping, excavation, off-site transport, and on-site treatment operations. For all five RAAs, implementation is not expected to impact the environment.

Implementability: With respect to implementability, RAA 1 would be the easiest alternative to implement, if not the most effective alternative, since there are no activities associated with it. RAA 2 should be the next easiest to implement since deed restrictions have been easily procured in the past, followed by RAA 3 in which the primary construction activities only require common earth construction equipment.

RAAs 4 and 5 share a common implementation obstacle: buried debris, such as wire and partially burned waste, within the soil that may inhibit excavation. Pre-excavation test pitting will help to alleviate this problem but the potential for difficulties may still exist. RAA 4, however, may be considered less implementable than RAA 5 because soil washing is an emerging technology in the United States. Also, soil washing creates residual waste that requires further treatment. Unlike RAA 5, RAA 4 also involves the construction of an on-site treatment plant and the need to operate and maintain a treatment system. RAA 5 is implementable because it involves a conventional, well-demonstrated approach for source removal and it has been easily implemented in the past.

The effectiveness of RAA 3 can be monitored through periodic cap maintenance. The effectiveness of RAA 4 is monitored through periodic system O&M checks. RAAs 1, 2, and 5 provide no means for monitoring their effectiveness. Under RAAs 1 and 2, this lack of monitoring contributes to the potential for human health and ecological risks. Under RAA 5, the lack of monitoring is appropriate because there will be no contaminants remaining on site to monitor.

In terms of administrative feasibility, RAA 5 requires the most coordination with federal and state agencies. In addition, RAA 5 is the only alternative in which capacity concerns at off-site facilities come into play. RAA 4 requires less coordination with agencies than RAA 5, and RAA 3 requires less coordination than RAA 4. RAA 1, however, requires no coordination with agencies.

Cost: No costs are associated with RAAs 1 and 2. The estimated NPW of the other Soil RAAs, in increasing order, are: $200,000 (RAA 5 - excavation and off-site disposal); $220,000 (RAA 3 - capping); and $380,000 (RAA 4 - excavation and on-site treatment).

10.0 SELECTED REMEDY

This section of the ROD focuses on the remedy that was selected for Site 28. A description of the selected remedy will be presented along with the estimated costs to implement the remedy. In addition, the remediation levels to be attained at the conclusion of the remedy will be discussed.

Remedy Description

The selected remedy for Site 28 combines Groundwater RAA 2 - Institutional Controls and Surface Soil RAA 5 - Excavation and Off-Site Disposal. The major components of this remedy are:

- A long-term groundwater monitoring plan that is depicted in Figure 5. As shown, certain wells will be sampled semiannually and the samples will be selectively analyzed for the groundwater COPCs.
- Aquifer use restrictions that will prohibit the future use of the aquifer as a potable water source.
- Deed restrictions that will limit the future use of land at the site, including placement of wells.
- Excavation of the surface soil AOCs to a depth of 1 foot.
- Disposal of the contaminated soil at an off-site facility.

Each component of this selected remedy will mitigate the principal threats at Site 28: the potential for ingestion of contaminated groundwater and surface soil.

Estimated Costs

The estimated costs for the selected remedy are:

Capital Cost: $200,000
Annual O&M Cost: $0
Net Present Worth: $200,000

It is important to note that this cost estimate was calculated for the FS evaluation and may not be as accurate as a construction cost estimate. An FS cost estimate should have an accuracy of +50 to -30 percent.

Remediation Levels

The RLs for the groundwater COPCs are: 15 µg/l for lead, and 50 µg/l for manganese. These RLs are based on North Carolina state water quality standards. The RLs for the surface soil COPCs are: 2900 µg/kg for copper, and 390 µg/kg for manganese. These RLs are based on site-specific risk-based calculations (RBCs).

The selected remedy should cause all of the COPCs, except manganese in the groundwater, to reach their Rls. In the case of manganese in the groundwater, however, the RL will probably never be achieved because this metal naturally occurs at high levels at MCB, Camp Lejeune.

11.0 STATUTORY DETERMINATIONS

A selected remedy should satisfy the statutory requirements of CERCLA Section 121 which include: (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-

effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment that reduces toxicity, mobility, or volume as principal element, or provide and explanation as to why this preference is not satisfied. The evaluation of how the remedy for Site 28 satisfies these requirements is presented below.

Protection of Human Health and the Environment

The remedy provides protection to human health and the environment by mitigating the potential risks associated with ingestion of contaminated groundwater and surface soil.

Compliance with Applicable or Relevant and Appropriate Requirements

The remedy will comply with ARARs identified in the FS.

Cost-Effectiveness

The selected remedy, has been evaluated to be the most cost-effective alternative considered for Site 28 (excluding the no action and limited action alternatives).

Utilization of Permanent Solutions and Alternative Treatment Technologies

The remedy does not utilize permanent solutions or alternative treatment technologies. However, it is still capable of providing adequate protection to human health and the environment.

Preference for Treatment as a Principal Element

The remedy does not satisfy the preference for treatment. However, the remedy still provides adequate protection from contaminated groundwater and surface soil.

12.0 RESPONSIVENESS SUMMARY

Overview

To be completed after the public meeting.

Background on Community Involvement

A record review of the MCB, Camp Lejeune files indicates that the community involvement centers mainly on a social nature, including the community outreach programs and base/community clubs. The file search did not locate written Installation Restoration Program concerns of the community. A review of historic newspaper articles indicated that the community is interested in the local drinking and groundwater quality, as well as that of the New River, but that there are no expressed interests or concerns specific to the environmental sites (including Site 28). Two local environmental groups, the Stump Sound Environmental Advocates and the Southeastern Watermen's Association, have posed questions to the base and local officials in the past regarding other environmental issues. These groups were sought as interview participants prior to the development of the Camp Lejeune, IRP, Community Relations Plan. Neither group was available for the interviews.

Community relations activities to date are summarized below:

- Conducted additional community relations interviews, February through March 1990. A total of 41 interviews were conducted with a wide range of persons including base personnel, residents, local officials, and off-base residents.

- Prepared a Community Relations Plan, September 1990.

- Conducted additional community relations interviews, August 1993. Nineteen persons were interviewed, representing local business, civic groups, on- and off-base residents, military and civilian interests.

- Prepared a revised Final Draft Community Relations Plan, February 1994.

- Established two information repositories.

- Established the Administrative Record for all of the sites at the base.

- Released PRAP for public review in repositories,_____.

- Released public notice announcing public comment and document availability of the PRAP, _____.

- Held Restoration Advisory Board meeting, _____, to review PRAP and solicit comments.

- Held public meeting on _____, to solicit comments and provide information. Approximately ____ people attended. The public meeting transcript is available in the repositories.

Summary of Comments Received During the Public Comment Period and Agency Responses

To be completed after the public meeting.

TABLES

TABLE 1

SUMMARY OF EXPOSURE PATHWAYS
SITE 28, HADNOT POINT BURN DUMP AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Receptor	Exposure Pathway
Current Military Personnel	Surface soil ingestion, dermal contact and inhalation Surface water ingestion and dermal contact (Orde Pond) Sediment ingestion and dermal contact (Orde Pond)
Current Residential Adult and Child	Surface soil ingestion, dermal contact and inhalation Surface water ingestion and dermal contact (New River and Cogdels Creek) Sediment ingestion and dermal contact (New River and Cogdels Creek)
Fisherman	Surface water ingestion and dermal contact (New River and Orde Pond) Sediment ingestion and dermal contact (New River and Orde Pond) Fish ingestion (New River and Orde Pond)
Future Construction Worker	Subsurface soil ingestion and dermal contact
Future Residential Adult and Child	Subsurface soil ingestion, dermal contact and inhalation Groundwater ingestion, dermal contact and inhalation Surface water ingestion and dermal contact (New River and Cogdels Creek) Sediment ingestion and dermal contact (New River and Cogdels Creek)

TABLE 2

SUMMARY OF POTENTIAL RISKS FOR THE CHILD RECEPTOR
SITE 28, HADNOT POINT BURN DUMP AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	NC Risk (HI)	Carc Risk (ICR)
Surface Soil Ingestion	1.3	5.8E-06
Surface Soil Dermal Contact	8.5E-02	7.6E-07
Surface Soil Inhalation	3.2E-03	4.5E-10
total	1.4	6.6E-06
Subsurface Soil Ingestion	4.4	2.1E-05
Subsurface Soil Dermal Contact	2.6E-01	2.1E-06
Subsurface Soil Inhalation	1.2E-02	1.7E-09
total	4.7	2.3E-05
Groundwater Ingestion	20	4.1E-05
Groundwater Dermal Contact	0.3	2.1E-05
total	20.3	6.2E-05
NEW RIVER		
Surface Water Ingestion	3.8E-03	6.9E-08
Surface Water Dermal Contact	8.7E-03	2.1E-07
total	1.3E-02	2.8E-07
Sediment Ingestion	1.2	3.1E-06
Sediment Dermal Contact	6.9E-02	3.3E-07
total	1.2	3.4E-06
COGDELS CREEK		
Surface Water Ingestion	1.0E-03	NA
Surface Water Dermal Contact	2.4E-03	NA
total	3.4E-03	NA
Sediment Ingestion	1.3E-01	3.0E-06
Sediment Dermal Contact	7.5E-03	3.7E-07
total	1.4E-01	3.4E-06
Current Risk (New River)	1.6	1.0E-05
Current Risk (Cogdels Creek)	1.5	1.0E-05
Future Risk (New River)	25.2	8.8E-05
Future Risk (Cogdels Creek)	25.1	8.8E-05

NC = Noncarcinogenic Risk (Shaded Areas indicate HI >1.0)
Carc = Carcinogenic Risk (Shaded Areas indicate ICR >1.0E-04)
NA = Not Applicable

TABLE 3

SUMMARY OF POTENTIAL RISKS FOR THE
ADULT RECEPTOR
SITE 28, HADNOT POINT BURN DUMP
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	NC Risk (HI)	Carc Risk (ICR)
Surface Soil Ingestion	1.4E-01	3.1E-06
Surface Soil Dermal Contact	4.6E-02	2.1E-06
Surface Soil Inhalation	1.4E-03	9.6E-10
total	1.9E-01	5.2E-06
Subsurface Soil Ingestion	4.7E-01	1.1E-05
Subsurface Soil Dermal Contact	1.4E-01	5.7E-06
Subsurface Soil Inhalation	4.9E-03	3.6E-09
total	6.2E-01	1.7E-05
Groundwater Ingestion	8.6	8.8E-05
Groundwater Dermal Contact	1.5E-01	5.2E-05
total	8.8	1.4E-04
NEW RIVER		
Surface Water Ingestion	8.1E-04	7.4E-08
Surface Water Dermal Contact	4.7E-03	5.8E-07
total	5.5E-03	6.5E-07
Sediment Ingestion	1.3E-01	1.7E-06
Sediment Dermal Contact	3.7E-02	8.8E-07
total	1.7E-01	2.6E-06
COGDELS CREEK		
Surface Water Ingestion	2.2E-04	NA
Surface Water Dermal Contact	1.3E-03	NA
total	1.5E-03	NA
Sediment Ingestion	1.4E-02	1.6E-06
Sediment Dermal Contact	4.1E-03	9.9E-07
total	1.8E-02	2.6E-06
Current Risk (New River)	0.4	8.4E-06
Current Risk (Cogdels Creek)	0.2	7.8E-06
Future Risk (New River)	9.5	1.6E-04
Future Risk (Cogdels Creek)	9.4	1.6E-04

NC = Noncarcinogenic Risk (Shaded Areas indicate HI > 1.0)
Carc = Carcinogenic Risk (Shaded Areas indicate ICR > 1.0E-04)
NA = Not Applicable

TABLE 4

SUMMARY OF POTENTIAL RISKS FOR THE MILITARY, FISHERMAN, AND CONSTRUCTION WORKER RECEPTORS SITE 28, HADNOT POINT BURN DUMP MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Military		Fisherman		Construction Worker	
	Nc Risk	CARC Risk	NC Risk	Carc Risk	NC Risk	Carc Risk
Surface Soil Ingestion	4.7E-01	1.5E-06	NA	NA	NA	NA
Surface Soil Dermal Contact	4.2E-02	2.8E-07	NA	NA	NA	NA
Surface Soil Inhalation	1.4E-03	1.3E-10	NA	NA	NA	NA
total	5.2E-01	1.8E-06	NA	NA	NA	NA
Subsurface Soil Ingestion	NA	NA	NA	NA	5.8E-01	4.5E-07
Subsurface Soil Dermal Contact	NA	NA	NA	NA	2.6E-02	3.6E-08
Subsurface Soil Inhalation	NA	NA	NA	NA	NA	NA
total	NA	NA	NA	NA	6.1E-01	4.9E-07
Groundwater Ingestion	NA	NA	NA	NA	NA	NA
Groundwater Dermal Contact	NA	NA	NA	NA	NA	NA
total	NA	NA	NA	NA	NA	NA
Orde Pond						
Surface Water Ingestion	1.5E-05	NA	1.6E-05	NA	NA	NA
Surface Water Dermal Contact	8.5E-05	NA	9.1E-05	NA	NA	NA
total	1.0E-04	NA	1.1E-04	NA	NA	NA
Sediment Ingestion	3.5E-02	9.8E-07	4.7E-03	1.0E-06	NA	NA
Sediment Dermal Contact	1.0E-02	2.9E-07	1.4E-03	2.9E-07	NA	NA
total	4.5E-02	1.3E-06	6.1E-03	1.3E-06	NA	NA
Fish Ingestion	NA	NA	3.1E-01	NA	NA	NA
New River						
Surface Water Ingestion	NA	NA	8.6E-04	7.9E-08	NA	NA
Surface Water Dermal Contact	NA	NA	5.0E-03	6.2E-07	NA	NA
total	NA	NA	5.9E-03	7.0E-07	NA	NA
Sediment Ingestion	NA	NA	1.4E-01	1.8E-06	NA	NA
Sediment Dermal Contact	NA	NA	4.0E-02	9.4E-07	NA	NA
total	NA	NA	1.8E-01	2.7E-06	NA	NA
Fish Ingestion	NA	NA	3.8E-01	4.5E-06	NA	NA
Current Risk (Orde Pond)	0.6	3.0E-06	0.3	1.3E-06	NA	NA
Current Risk (New River)	0.5	1.8E-06	0.6	7.9E-06	NA	NA
Future Risk (Orde Pond)	4.5E-02	1.3E-06	0.3	1.3E-06	0.6	4.9E-07
Future Risk (New River)	NA	NA	0.6	7.9E-06	0.6	4.9E-07

NC = Noncarcinogenic Risk (Shaded Areas indicateHI >1.0)
Carc = Carcinogenic Risk (Shaded Areas indicate ICR > 1.0E-04)
NA = Not Applicable

TABLE 5

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

Evaluation Criteria	RAA 1 No Action	RAA 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	The COCs are expected to exceed their chemical-specific ARARs. However, manganese exceeds federal and/or state ARARs in groundwater throughout MCB, Camp Lejeune.	The COCs are exptected to exceed their chemical-specific ARARs. However, manganese exceeds federal and/or state ARARs in groundwater throughout MCB, Camp Lejeune.
• 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.
• Time Until Action is Complete	Not applicable.	Estimated 30 years.

TABLE 5 (Continued)

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

Evaluation Criteria	RAA 1 No Action	RAA 2 Institutional Controls
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	$0	$430,000

TABLE 6

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

Evaluation Criteria	RAA 1 No Action	RAA 2 Institutional Controls	RAA3 Capping	RAA 4 Excavation and On-Site Treatment	RAA 5 Excavation and Off-Site Disposal
OVERALL PROTECTIVENESS • Human Health	No reduction in potential human health risks.	Reduces potential human health risks.	Reduces potential human health risks.	Eliminates potential human health risks.	Eliminates potential human health risks.
• Environmental Protection	No reduction in potential risks to ecological receptors. Also, no reduction in potential for contaminant migration.	No reduction in potential risks to ecological receptors. No reduction in potential for contaminant migration.	Reduces potential risks to ecological receptors. Also, reduces potential for contaminant migration.	Eliminates potential risks to ecological receptors. Also, eliminates potential for contaminant migration.	Eliminates potential risks to ecological receptors. Also, eliminates potential for contaminant migration.
COMPLIANCE WITH ARARS • Chemical-Specific ARARs	The COCs, copper and manganese, will exceed chemical-specific ARARs.	The COCs, copper and manganese, will exceed chemical-specific ARARs.	The COCs, copper and manganese, will exceed chemical-specific ARARs.	The COCs, copper and manganese, are expected to meet chemical-specific ARARs.	The COCs, copper and manganese, are expected to meet chemical-specific ARARs because contaminated soil will be replaced with clean backfill.
• Location-Specific ARARs	Not applicable.	Not applicable.	Not applicable.	Can be designed to meet location-specific ARARs.	Can be designed to meet location-specific ARARs.
• Action-Specific ARARs	Not applicable.	Not applicable.	Not applicable.	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	Since contaminated soil will remain on site, residual risks will also remain. (For example, humans will continue to be exposed to the COCs.)	Since contaminated soil will remain on site, residual risks will also remain, but they will be slightly reduced by the deed restrictions.	Since contaminated soil will remain on site, residual risks will also remain, but they will be significantly reduced by the caps. (For example, human exposure to the COCs would be unlikely when the caps are in place.)	Contaminated soil will be treated, so there will be no residual risks.	No contaminated soil will remain on site, so there will be no residual risks.

TABLE 6 (Continued)

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

Evaluation Criteria	RAA 1 No Action	RAA 2 Institutional Controls	RAA3 Capping	RAA 4 Excavation and On-Site Treatment	RAA 5 Excavation and Off-Site Disposal
• Adequacy and Reliability of Controls	Not applicable-no controls.	Deed restrictions will be adequate controls for preventing exposure to the contaminants.	The caps will be an adequate and reliable controls if they are maintained properly. Deed restrictions may not be an adequate control for ensuring that the caps remain in place over time.	Source removal and on-site treatment will be adequate and reliable controls for preventing exposure to the contaminants.	Source removal will be an adequate and reliable control because it is permanent and irreversible.
• 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.	Review will be required to ensure adequate protection of human health and the environment.	Until the surface soil contaminants meet remediation goals, review will be required to ensure adequate protection of human health and the environment.	Review will not be required because the contaminated soil will be removed from the site.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT • Treatment Process Used	No treatment process.	No treatment process.	No treatment process.	Treatment process includes a soil washing system.	Off-site treatment.
• Amount Destroyed or Treated	None.	None.	None.	All COCs will be treated.	All COCs will be removed from the site.
• Reduction of Toxicity, Mobility, or Volume	None.	None.	No reduction in toxicity or volume, but the cap may reduce mobility of COCs.	Reduction in toxicity, mobility, and volume of COCs.	Eliminates toxicity, mobility, and volume of COCs at the site.

TABLE 6 (Continued)

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

Evaluation Criteria	RAA 1 No Action	RAA 2 Institutional Controls	RAA3 Capping	RAA 4 Excavation and On-Site Treatment	RAA 5 Excavation and Off-Site Disposal
• Residuals Remaining After Treatment	Not applicable-no treatment.	Not applicable-no treatment.	Not applicable-no treatment.	Residuals will include clean soil (sand and gravel particles) which will be backfilled, some contaminated sludges and fines which will require proper disposal, and used washing agents which will require treatment but may be recycled through the system.	No residuals will remain on site after treatment.
• Statutory Preference for Treatment	Not satisfied.	Not satisfied.	Not satisfied.	Satisfied.	Satisfied.
SHORT-TERM EFFECTIVENESS • Community Protection	Potential risks to the community will not be increased. Risk of human exposure to surface soil remains.	Potential risks to the community will be slightly reduced by deed restrictions.	Potential risks to the community will be temporarily increased during soil grading and cap installation. Once the caps are in place, potential risks will be reduced.	Potential risks to the community will be temporarily increased during soil excavation, treatment plant operation, and backfilling activities. Once the soil is treated and backfilled, potential risks will be eliminated.	Potential risks to the community will be temporarily increased during soil excavation and transport. Once the excavation is complete, potential risks will be eliminated.
• Worker Protection	No risks to workers.	No risks to workers.	Potential risks to workers will be temporarily increased during soil grading and cap installation.	Potential risks to workers will be increased during excavation and treatment plant operation.	Potential risks to workers will be temporarily increased during soil excavation and transport.
• Environmental Impact	No additional environmental impacts; current impacts will continue.	No additional environmental impacts; current impacts will continue.	No additional environmental impacts; current impacts will continue.	No additional environmental impacts; current impacts will continue.	No additional environmental impacts; current impacts will be eliminated.
• Time Until Action is Complete	Not applicable.	Not applicable.	Less than one year; monitoring for 30 years.	Less than one year.	Less than one year.

TABLE 6 (Continued)

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

Evaluation Criteria	RAA 1 No Action	RAA 2 Institutional Controls	RAA3 Capping	RAA 4 Excavation and On-Site Treatment	RAA 5 Excavation and Off-Site Disposal
IMPLEMENTABILITY • Ability to Construct and Operate	No construction or operation activities.	No construction or operation activities.	Easy to construct and maintain; requires materials handling procedures.	Although soil washing is an emerging technology, it should be easy to execute and operate; requires a treatability test; soil sludges/fines and used washing agents will require further treatment; buried debris may make excavation difficult.	Excavation is the only on-site operation involved; buried debris may make excavation difficult.
• Ability to Monitor Effectiveness	No monitoring plan for measuring effectiveness.	No monitoring plan for measuring effectiveness.	Cap maintenance and groundwater monitoring will adequately measure effectiveness.	Periodic O&M system checks will measure effectiveness.	No means for measuring effectiveness.
• Availability of Services and Capacities; Equipment	No services or equipment required.	No services or equipment required.	No special services or equipment required; cap materials should be readily available.	Services and equipment should be readily available.	Off-site treatment and/or disposal facilities should have adequate capacity.
• Requirements for Agency Coordination	None required.	None required.	Must submit semiannual reports to document sampling.	Air and water discharge permits may be required.	Coordination with Department of Transportation for off-site transport of soils; federal and state acceptance of off-site facility is required.
COST	$0	$0	$220,000	$380,000	$200,000

TABLE 7
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.
- **USEPA/State Acceptance** - indicates whether, based on review of the RI and FS reports and the PRAP the USEPA and state concur with, oppose, or have no comments on the preferred alternative.
- **Community Acceptance** - will be assessed in the Record of Decision (ROD) following a review of the public comments received on the RI and FS reports on the PRAP.

FIGURES

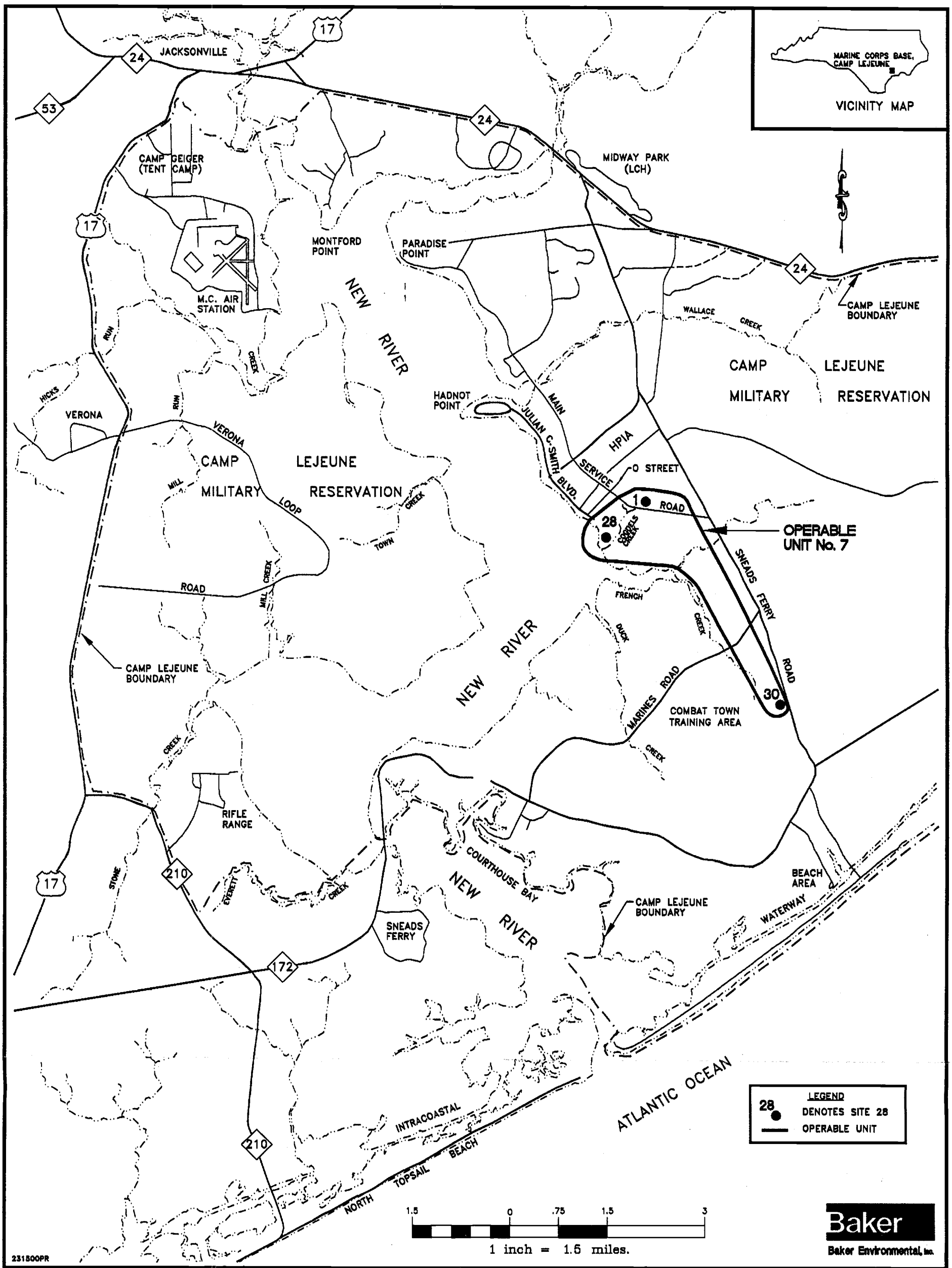
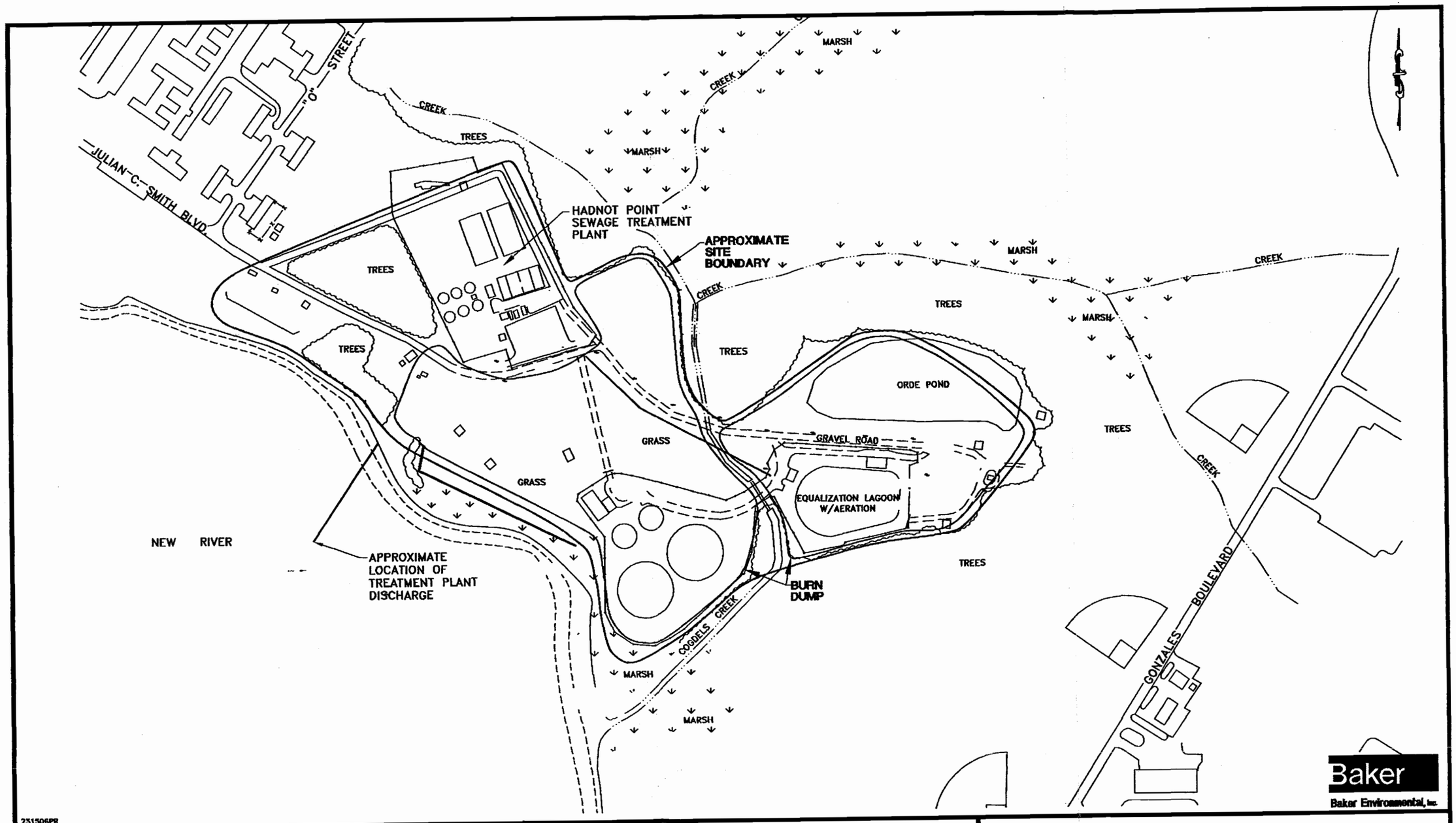


FIGURE 1
OPERABLE UNIT No. 7 – SITES 1, 28, AND 30
MARINE CORPS BASE, CAMP LEJEUNE

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00241 II BIZ



251506PR

LEGEND

- VEGETATION
- FENCE
- CREEK/DRAINAGE
- MARSH

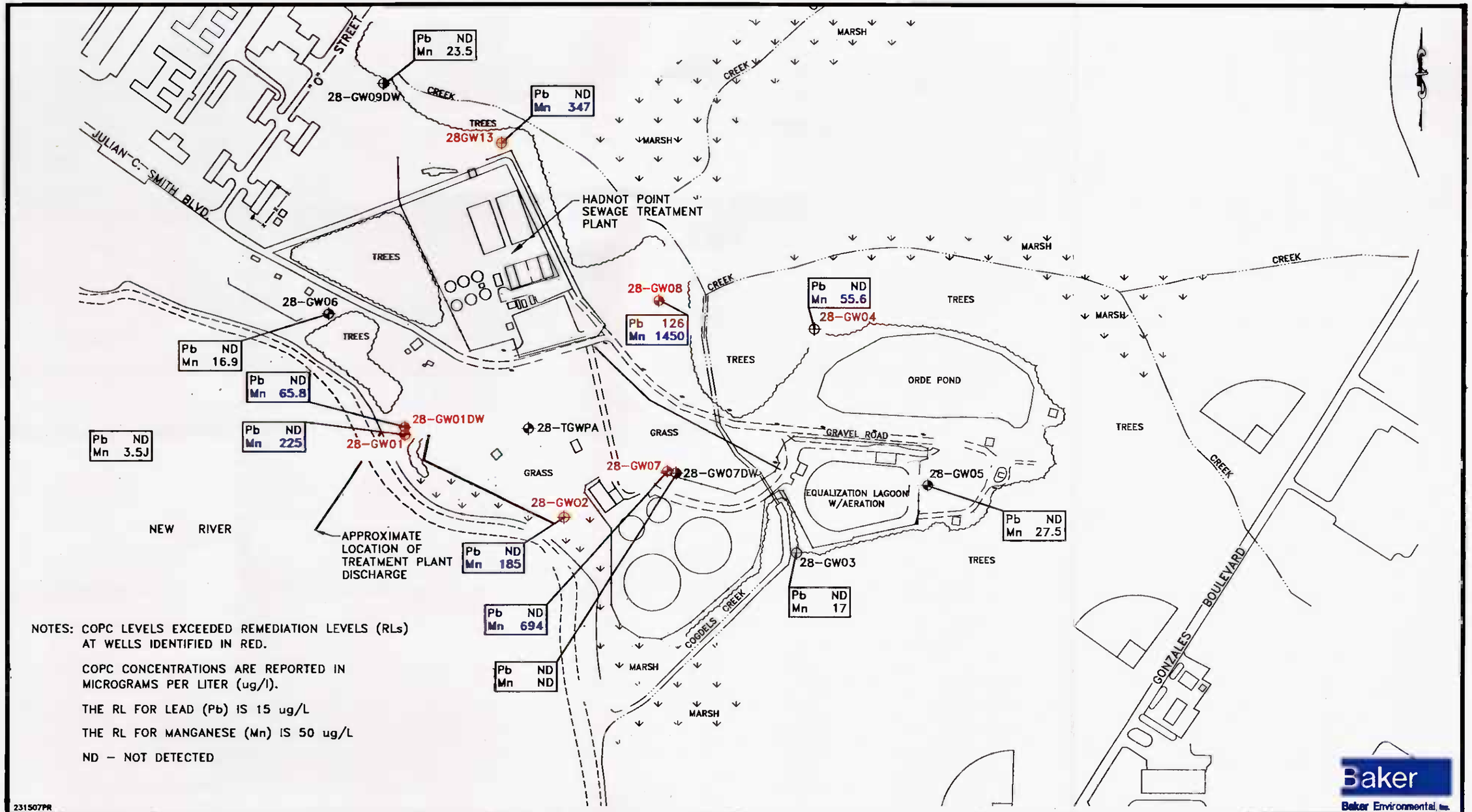
SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON, JUNE 1994

300 0 150 300 600

1 inch = 300 ft.

FIGURE 2
SITE MAP
SITE 28 – HADNOT POINT BURN DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



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

COPC 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

231507PR

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

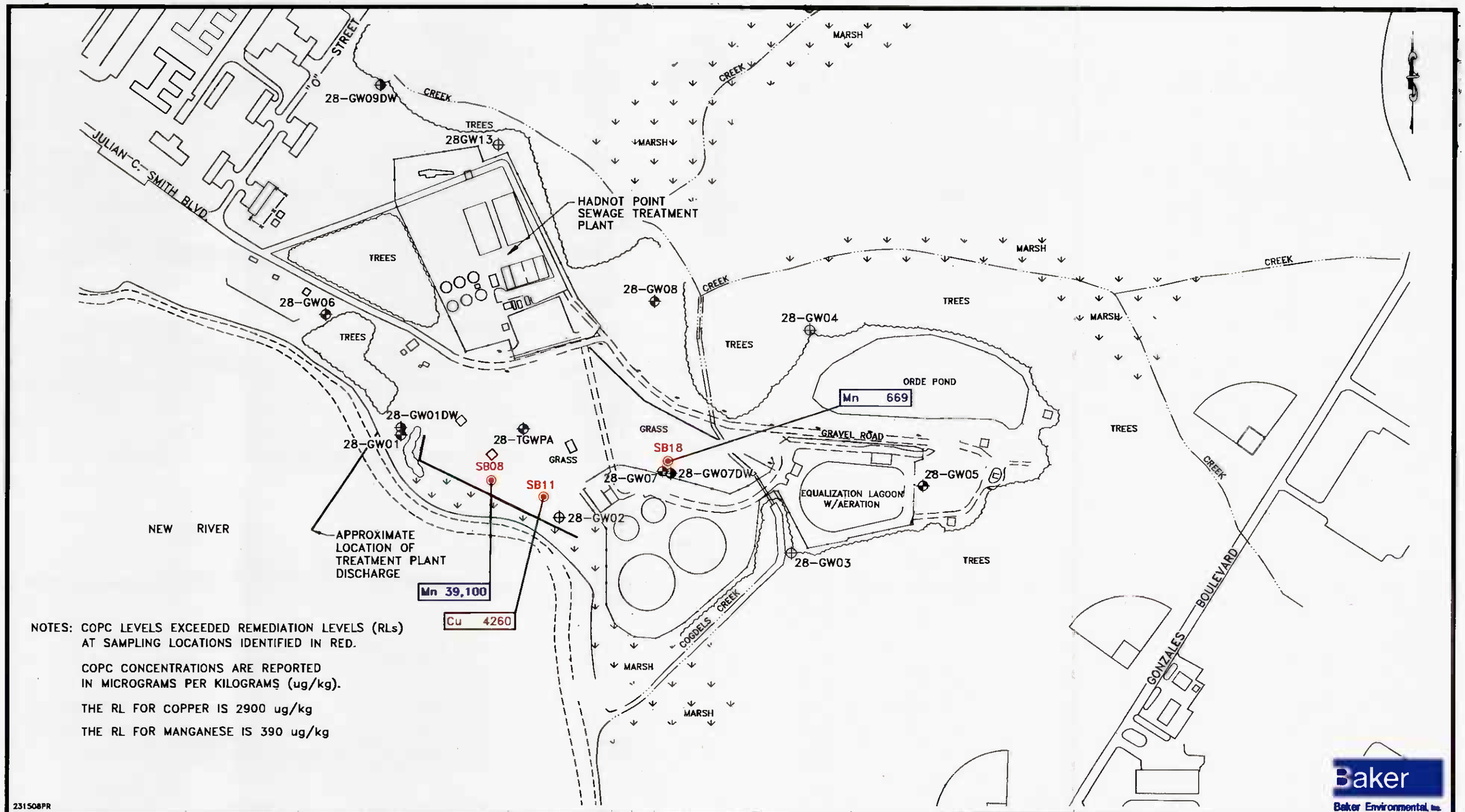
1 inch = 300 ft.

FIGURE 3
GROUNDWATER AREAS OF CONCERN
SITE 28 – HADNOT POINT BURN DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker
Baker Environmental, Inc.

AQUIFER



NOTES: COPC LEVELS EXCEEDED REMEDIATION LEVELS (RLs) AT SAMPLING LOCATIONS IDENTIFIED IN RED.

COPC CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER KILOGRAMS (ug/kg).

THE RL FOR COPPER IS 2900 ug/kg

THE RL FOR MANGANESE IS 390 ug/kg

231508PR

Baker
Baker Environmental, Inc.

LEGEND

- 28-GW01 — SHALLOW MONITORING WELL
- 28-GW01DW — DEEP MONITORING WELL
- SB08 — SURFACE SOIL SAMPLING LOCATION WHERE COPC EXCEEDED RLs
- Mn 39,100 — CONCENTRATION EXCEEDING THE MANGANESE RL
- Cu 4260 — CONCENTRATION EXCEEDING THE COPPER RL

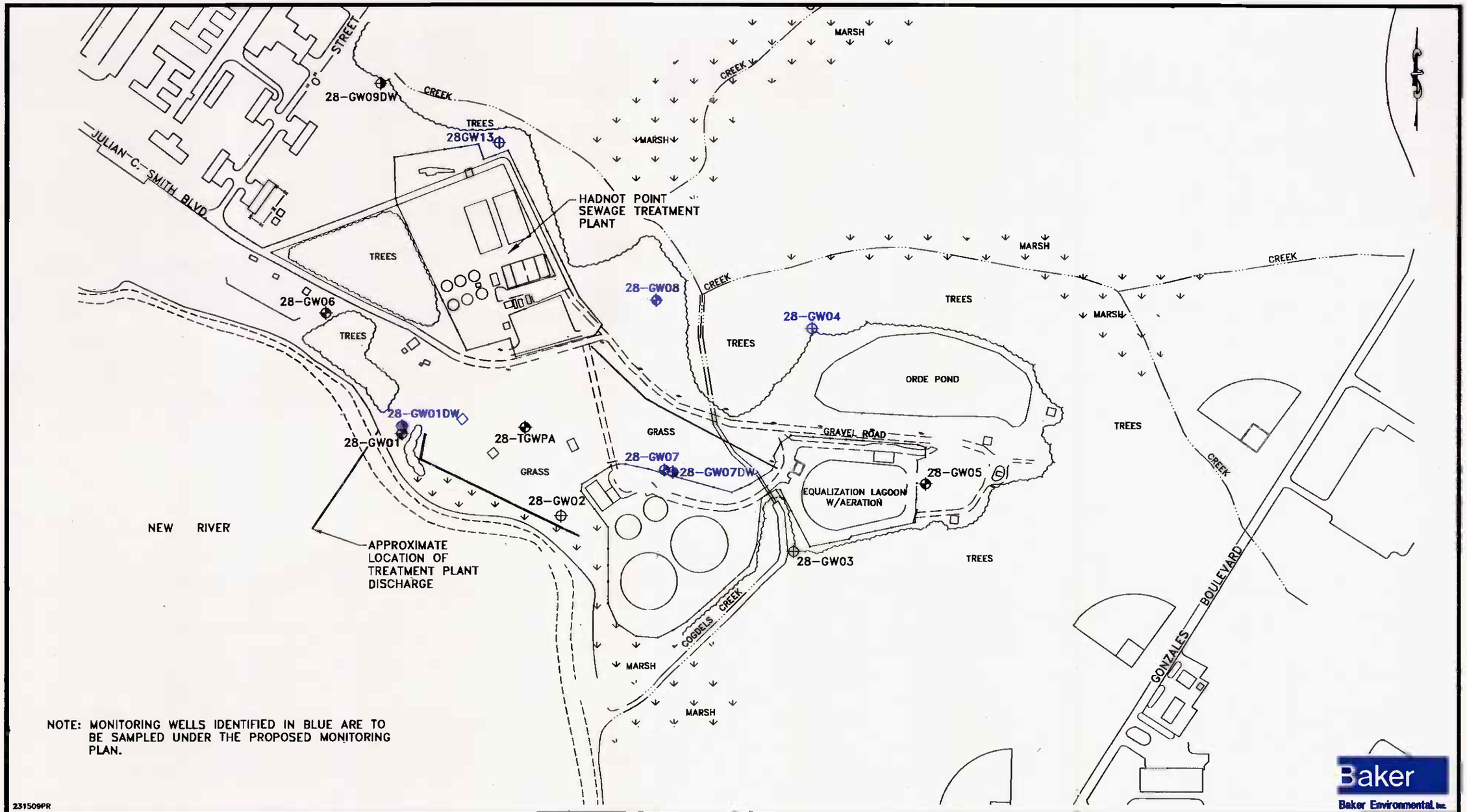
SOURCE: LANTDIV, FEBRUARY 1992 AND W.K. DICKSON, JUNE 1994

300 0 150 300 600

1 inch = 300 ft.

FIGURE 4
SURFACE SOIL AREAS OF CONCERN
SITE 28 – HADNOT POINT BURN DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



NOTE: MONITORING WELLS IDENTIFIED IN BLUE ARE TO BE SAMPLED UNDER THE PROPOSED MONITORING PLAN.

231509PR

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 5
PREFERRED GROUNDWATER ALTERNATIVE – GROUNDWATER RAA 2:
INSTITUTIONAL CONTROLS
SITE 28 – HADNOT POINT BURN DUMP
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA