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Remedial Investigation Report Operable Unit No. 4 (Sites 41 and 74)

Marine Corps Base Camp Lejeune, North Carolina

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LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of concern
AQUIRE	Aquatic Information Retrieval Database
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
AT	averaging time
ATV	all terrain vehicle
AWQC	Federal Ambient Water Quality Criteria
Baker	Baker Environmental, Inc.
BCF	bioconcentration factor
bgs	below ground surface
BI	biotoxic index
BOD	biological oxygen demand
BRA	baseline risk assessment
$CaCO_3$	calcium carbonate
CAMA	Coastal Area Management Act
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH	high plasticity clay
CL	low plasticity clay
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CN	chloroacetophene
COE	Corps of Engineers
COPC	contaminant of potential concern
COD	chemical oxygen demand
CRAVE	Carcinogen Risk Assessment Verification Endeavor
CRQL	Contract Required Quantitation Limit
CSA	Chemical Storage Area
CSF	Cancer Slope Factor
CSM	chemical surety material
DON	Department of the Navy
DQOs	data quality objectives
1,2-DCE	1,2-dichloroethene
DEM	Division of Environmental Management
DDE	dichlorodiphenyldichloroethylene
DDT	diphenyltrichloroethane
DS	downslope
ECD	electron capture detector
ED	exposure duration
EF	exposure frequency

Eh	oxidation reduction potential
EM	electromagnetic
EMD	Environmental Management Department
EPIC	Environmental Photographic Interpretation Center
ERA	ecological risk assessment
ER-L	Effects Range - Low
ER-M	Effects Range-Median
ESE	Environmental Science and Engineering, Inc.
ETC	electromagnetic terrain conductivity
FAWQC	Federal Ambient Water Quality Criteria
FDA	Former Disposal Area
FFA	Federal Facilities Agreement
FID	flame ionization detector
FPA	Former Pesticide Control Area
FSAP	Field Sampling and Analysis Plan
FWS	Fish and Wildlife Service
FWQSV	Freshwater Water Quality Screening Values
gpd/ft	gallons per day per foot
gpm	gallons per minute
GP	GP Environmental Services
GPR	ground penetrating radar
GW	groundwater well
H'	Diversity Index
HA	health advisory
HEAST	Health Effects Assessment Summary Tables
HHAG	Human Health Assessment Group
HHI	Hardin and Huber, Inc.
HHRA	Human Health Risk Assessment
HI	hazard index
Hoggard-Eure	Hoggard-Eure Associates
HCl	hydrochloric acid
HNO_3	nitric acid
HQ	hazard quotient
HQW	high quality water
HTH	high-test hypochlorite
i	hydraulic gradient
IAS	Initial Assessment Study
ICR	incremental cancer risk
ID	inside diameter
IDW	investigative derived wastes
IR	ingestion rate
IRA	interim remedial action
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program

K	hydraulic conductivity
K_d	soil sorption coefficient
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
LANTNAVFACENGCOM	Naval Facilities Engineering Command, Atlantic Division
LEL	lower explosive limit
LOAEL	lowest observed adverse effect level
MBI	Macroinvertebrate Biotic Index
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCL	maximum contaminant level
MEK	methylethyl ketone
MIBK	methyl isobutyl ketone
mg/kg	milligram per kilogram
mg/L	milligram per liter
MF	modifying factor
MH	plastic silt
MI	mobility index
ml	milliliter
ML	low plasticity silt
mL/g	milliliters per gram
mmhos/m	millimohos/meter
msl	mean sea level
MW	monitoring well
NACIP	Navy Assessment and Control of Installation Pollutants Program
NC DEHNR	North Carolina Department of Environment, Health and Natural Resources
NCMFC	North Carolina Marine Fisheries Commission
NCSPCS	North Carolina State Plane Coordinate System
NCWP	Near Coastal Waters Program
NCWQS	North Carolina Water Quality Standards
NCWRC	North Carolina Wildlife Resources Commission
N_e	effective porosity
NEESA	Naval Energy and Environmental Support Activity
NEP	National Estuary Program
NOAA	National Oceanic and Atmospheric Administration
NOAEL or NOEL	No observed adverse effect level
NPL	National Priorities List
NPS	National Park Service
NSW	nutrient sensitive waters
NWI	national wetlands inventory

OD	outside diameter
OS	on-site
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PA/SI	preliminary assessments/site investigations
PC	permeability constant
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PDA	Potential Disposal Area
PEF	particulate emissions factor
PHA	public health assessment
PID	photoionization detector
POL	petroleum, oil, lubricants
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QI	quotient index
RA	risk assessment
RBC	risk based concentrations
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI/FS	remedial investigation/feasibility study
ROD	record of decision
S, S	storativity, water solubility
SA	site assessment or surface area
SARA	Superfund Amendments and Reauthorization Act
Sj	Jaccard Coefficient
Ss	Sorenson Index
SB	soil boring
SCS	Soil Conservation Service
SD	sediment
SMCL	Secondary Drinking Water Regulations
SQC	sediment quality criteria
SOPs	standard operating procedures
SSV	sediment screening value
STP	sewage treatment plant
SVOCs	semivolatile organic compounds
SW	surface water
SWQSVs	surface water quality screening values
T	transmissivity
TAL	target analyte list
TBC	to be considered

TCE	trichloroethene
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TEF	toxicity equivalency factor
TEU	Technical Escort Unit
TICs	tentatively identified compounds
TOC	total organic carbon or top of casing
trans-1,2-DCE	trans-1,2-dichloroethene
TRC	Technical Review Committee
TRVs	terrestrial reference values
TSS	total suspended solids
TVS	total volatile solids
UCL	upper confidence limit
UF	uncertainty factor
μg/g	micrograms per gram
μg/L	micrograms per liter
USAEC	United States Army Environmental Center
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
USGS	United States Geological Survey
USMC	United States Marine Corps
UST	underground storage tank
VOCs	volatile organic compounds
VP	vapor pressure
V_x	average seepage velocity
WAR	Water and Air Research, Inc.
Weston	Weston Geophysical Corporation
WOE	weight of evidence
WQS	water quality standards
WQSV	water quality screening values
WS	Wilderness Society

EXECUTIVE SUMMARY

INTRODUCTION

Marine Corps Base (MCB), Camp Lejeune, North Carolina was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) that became effective 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 (DEHNR), and the United States Department of the Navy (DoN) then entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune. The primary purpose of the FFA was to ensure that environmental impacts associated with past and present activities at the Facility were thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives were developed and implemented as necessary to protect the public health and environment.

The Fiscal Year 1994 Site Management Plan for MCB Camp Lejeune, a primary document identified in the FFA, identifies 27 sites requiring Remedial Investigation/Feasibility Study (RI/FS) activities. This report documents the Remedial Investigation (RI) completed for two of these sites: Site 41 and Site 74. These two sites comprise Operable Unit (OU) No. 4 at MCB Camp Lejeune. Site 69, the Rifle Range Chemical Dump, was originally included in OU No. 4. However, this site has now been separated into its own operable unit, OU No. 14, to enable additional field investigation work to be performed prior to completion of the RI/FS.

The purpose of this remedial investigation is to characterize the nature and extent of contamination, and potential human health and environmental impacts for Operable Unit (OU) No. 4. This RI has been conducted in accordance with the requirements delineated in the National Contingency Plan (NCP) for remedial actions [40 Code of Federal Regulations (CFR) 300.430]. The USEPA's document <u>Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA</u> (USEPA, 1988a) has been used as guidance for preparing this document.

SITE DESCRIPTION AND HISTORY

MCB Camp Lejeune is located within the Coastal Plain Physiographic Province in Onslow County, North Carolina, approximately 45 miles south of New Bern and 47 miles north of Wilmington. The facility covers approximately 236 square miles. The military reservation is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The eastern border of MCB Camp Lejeune is the Atlantic shoreline. The western and northwestern boundaries are U.S. Route 17 and State Route 24, respectively. The City of Jacksonville, North Carolina, borders MCB Camp Lejeune to the north.

Operable Unit No. 4 consists of two sites which have a reported history of chemical warfare material (CWM) disposal. The CWM suspected at MCB Camp Lejeune are chemical agent identification sets (CAIS). [The following information about CAIS was obtained directly from documents published by the U.S. Army Chemical Material Destruction Agency (USACMDA).] There are various classifications associated with disposal of CWM. Based on a report published by USACMDA, the sites at MCB Camp Lejeune were classified as "Classification 3 - Suspected

Burial" (USACMDA, 1993). A classification 3 site is a site at which one or more of the following conditions apply:

- The normal duty activities performed on this site indicate a strong suspicion that buried CWM may still exist even though they are indicated in literature as destroyed. An example would be a burn pit where not all of the munitions may have been consumed even though the period literature indicated that they were.
- Chemical weapons were known to be disposed of on this site, but period literature indicates that the site was cleared. The period definition of cleared, and the technology for clearing such locations at that time, may lead to the conclusion that not everything was removed.
- The site is a known chemical range but the literature is unclear as to whether chemical agent was applied to the site by spraying (such that there would be no buried ordnance) or by range firing/bombing.

Based on information collected during the RI, which may not have been available at the time the USACMDA report was published, Site 41 may actually be classified as a Class 2 site (Likely Burial) and Site 74 may actually be classified as a Class 4 site (Possible Burial).

A Class 2 site is a site in which the following conditions apply:

- The burial of CWM has been reported. (Applies to Site 41)
- The firing of chemical weapons under range conditions (as opposed to static firing under test conditions) has been reported. (Does not apply to Site 41)
- The disposal of chemical weapons by dumping in shallow water has been reported. (Does not apply to Site 41)

A Class 4 site is a site in which the following conditions apply:

- Although no literature exists, which indicates burial was actually conducted, the activities and timeframe of the operations on the site indicate that burial of chemical weapons is a possibility. (Applies to Site 74)
- The normal duty activities performed on this site indicate some possibility that chemical weapons may have been buried as there exists no literature that documents their fate. (Applies to Site 74).
- There is enough literature to indicate that CAIS or chemical weapons were used extensively at the site in such a way that (although the literature does not indicate it) some chemical material may be present. (Does not apply to Site 74)

With respect to the criteria for a Class 2 site, a background report has indicated the burial of "gas" at Site 41 (Eakes, 1982). The report also indicated that agents may be at the site. Although no direct association of agent disposal has been identified for Site 74, background information referencing the disposal of wastes at Site 74 have indicated that "some drums may have been left over from a burial/disposal incident at the Rifle Range Chemical Dump (Site 69)." This reference indicates the possibility that CWM may also be present at Site 74.

CAIS were produced in large quantities (110,000 sets) and various configurations by the U.S. Army to train soldiers and sailors in the identification of actual chemical warfare agents and in the proper actions upon identification (U.S. Army, 1993). The sets contain vials (ampules) or bottles of agent. The agents used in these sets could contain blister agents [mustard (H) and lewisite (L)], nerve agents (GA, GB and VX), blood agents [hydrogen cyanide (AC) and cyanogen chloride (CK)], and choking agent [phosgene (CG)].

There are several different types of CAIS. One variety of CAIS was an instructional "sniff set" that contained agent impregnated charcoal. It was intended for use indoors to instruct military personnel in recognizing the odors of chemical agent. This type of set contained only small amounts of chemical agent. A second major variety of CAIS, designed for use outdoors, consisted of agent (pure or in solution) in sealed pyrex tubes. The gas tubes would be detonated, creating an agent cloud. Soldiers would then try to identify the agent based on its odor and other characteristics. These typically contained more agent then the instructional "sniff sets" and could produce a much greater hazard. A third major variety of CAIS were those containing bulk mustard. These CAIS were used in decontamination training by purposely contaminating the terrain or equipment with mustard, and then teaching the soldiers how to don the correct protective clothing and decontaminate the area or equipment. These CAIS contained relatively large quantities of pure mustard.

Unfortunately, the types of CAIS used at MCB Camp Lejeune is unknown. However, drums containing calcium hypochlorite, a decontaminant, have been identified at the base. Therefore, it is possible that the third variety of CAIS mentioned above (i.e., CAIS containing pure mustard) may have been used at MCB Camp Lejeune. Based on "best professional judgements" made by personnel at the U.S. Army Chemical Material Destruction Agency (USACMDA), CAIS at MCB Camp Lejeune most likely did not contain nerve agents.

In summary, there is a good likelihood that CWM are present at Sites 41 and 74. However, there is a lack of information to properly identify the amount, types, or disposal methods associated with CAIS disposal. With respect to disposal, it is not known whether the CWM was destroyed (via burning or detonation) prior to disposal. Existing information, however, does mention that drums were used during disposal.

Because both sites may contain CWM, they sites have been combined into OU No. 4. The following provides a description and history of the sites.

Site 41

Site 41, Camp Geiger Dump at the Former Trailer Park, is located east of Highway 17 within the Camp Geiger area of MCB Camp Lejeune. The site encompasses approximately 30 acres and is situated in a topographically high area. The central portion of the site is flat. Most of the site is heavily wooded and vegetated. Only one area of the site, which is essentially the middle area, is somewhat clear of trees. The northern boundary of the fill area is evidenced by an abrupt five to ten foot high change in elevation across the north central portion of the site. The "cleared" area described earlier is situated just south of this "highwall."

Several dirt roads bisect the site. Drainage is poor as evidenced by numerous ponding areas. Drainage from the site is received by Tank Creek to the south and an unnamed tributary to the north. The unnamed tributary flows in a southeast direction around the northeastern and eastern border of the site until it discharges into Southwest Creek. Tank Creek flows in a southeast direction and also discharges into Southwest Creek.

The surface of the site is littered with construction or demolition debris. This material consists mainly of sheet metal, steel I-beams, plastic wire, wood, and concrete. This same material was observed in the subsurface below uprooted trees (i.e., subsurface contents were observed below the root system of large uprooted trees). A few rusted empty drums were also noted throughout the site, including one drum which indicated "dry cleaning solvent." Two seeps were also noted. The seeps are located below the highwall described earlier and had an orange color appearance. A sheen was also noted on the seeps. The seeps flow northward and discharge into the unnamed tributary. Several circular depressions (approximately 5 to 7 foot radius and 2 to 3 feet in depth) were noted throughout the site area. Based on discussions with ordnance specialists from the U.S. Army Technical Escort Unit (TEU), these depressions may have been formed by exploding ordnance.

Site 41 is underlain by silty sand, with discontinuous layers of sand, clayey sand, sandy clay, silt, and clay to a depth between 11 and 29 feet bgs. No groundwater retarding layer was encountered beneath the site. The upper unit of the Castle Hayne was encountered beneath the silty sands. Shallow groundwater flow at the site is radial from the mound or fill area; however, the predominant flow direction is towards the southeast. Shallow groundwater discharges to the unnamed tributary to the north and east, and Tank Creek to the south. Groundwater flow within the Castle Hayne is linear and towards the southeast.

Site 41 was used as an open burn dump from 1946 to 1970. The dump received construction debris, POL wastes, mirex (a pesticide), solvents, batteries, and ordnance. In addition, CWM (most likely CAIS kits) was reportedly taken to the site for disposal.

Previous investigations under the IR Program involved the installation of five shallow monitoring wells around the perimeter of the site, and a limited number of surface water and sediment samples collected from Tank Creek and the unnamed tributary. Low levels of 1,2-DCE (1.1 μg/L), benzene (0.3 μg/L), and dichlorofluoromethane (8 μg/L) were detected in one monitoring well. This well (41GW2) is situated in the south central portion of what is believed to be fill material. Some of the surface water samples revealed low levels of the pesticides aldrin (maximum concentration of 0.015 μg/L) and BHC (maximum concentration of 0.047 μg/L). Sediment samples revealed low levels of chromium (maximum concentration of 5.09 mg/kg), lead (maximum concentration of 12.1 mg/kg), and 2,4,6-TNT (0.357 μg/kg).

Site 74

Site 74, Mess Hall Grease Pit Disposal Area, is located approximately one-half mile east of Holcomb Boulevard in the northeast section of MCB Camp Lejeune. Site 74 consists of two areas of concern (AOC) in a remote area of MCB Camp Lejeune: the former grease pit disposal area; and a former pest control area. Both areas of concern are heavily wooded, overgrown with vegetation, and flat. The former disposal area is approximately 5 acres in size and the former pest control area is less than one acre in size based on historical photographs. West of the pest control AOC is an area that may also have been used for disposal, based on mounded materials noted in historical photographs. This area encompasses approximately 4 acres Presently, this area is flat, wooded, and there are no signs of the soil mounds which were present in historical photographs. Henderson Pond, which is the only surface water body associated with the site, is situated south of the former pest control area. The grease pit area and pest control area are separated by a dirt road and are situated approximately one-quarter mile apart. There are no structures in the area that are associated with the operation of the Facility with the exception of an operational supply well (HP-654). Based on previous sampling results, this supply well is not contaminated. Military training exercises are conducted in the area. Currently, there are no restrictions to prevent access to the site.

Site 74 is underlain by sand and silty sand. No groundwater retarding layer was encountered beneath the site; however, the subsurface investigations were primarily limited to a depth of approximately 20 to 25 feet below ground surface. Based on other nearby environmental investigations (e.g., Site 82 located approximately one and one-half mile south of Site 74), no retarding layer was encountered until a depth of approximately 220 to 230 feet bgs. In addition, the Castle Hayne Aquifer was identified at a depth of approximately 90 to 100 feet, based on encountering a shell and limestone unit. The deep subsurface geologic conditions at Site 74 are believed to be similar to that described above for Site 82.

The site was used as a disposal area from the early 1950s until 1960. Grease was reportedly disposed of in pits. It was reported that a volatile substance (possibly fuel) was sometimes used to ignite the grease. Drums containing PCBs and "pesticide soaked bags" were also reportedly disposed in trenches. One internal memorandum reports that drums which were supposed to be taken to Site 69 for disposal were disposed at Site 74 instead. Since the report was rather vague to the contents of these drums, the site is being handled as a site where CWM may be present in buried drums since it has been well documented that CWM have been taken and disposed at Site 69.

There are no known disposal activities associated with the former pest control shop. Contamination at this area is likely due to routine pesticide storage and handling activities.

Historical photographs of the former grease pit disposal area depict extensive trenching activities, which corresponds to the history of this site. Currently, there are no apparent signs of disposal with the exception of one area within the grease pit disposal area where a small depression in the ground surface was observed. At the bottom of the depression was a drum fragment. It is possible that the depression occurred as a result of subsidence due to buried materials. The former pest control area is believed to have been used for the storage and handling of pesticides for pest control. Historical photographs depict a building which probably served the purpose of housing pesticides. This building, including the foundation, is not discernable.

Previous investigations conducted under the IR Program were conducted at the former grease pit disposal area and pest control area; however, these investigations involved only two soil samples from the pest control area and the installation of three monitoring wells at the former grease pit disposal area. Low levels of pesticides were detected at concentrations which would be considered "typical of" pesticide concentrations throughout MCB Camp Lejeune (maximum concentration was "typical of" pesticide concentrations throughout MCB Camp Lejeune (maximum concentration was 260 µg/kg for DDT). Low levels of the pesticides DDD and DDT were detected in one monitoring well.

REMEDIAL INVESTIGATIONS

The RI field investigations were initiated in January 1994 and completed in March 1994. In August 1994, selected monitoring wells at both sites were sampled using a low-flow purging technique for purposes of obtaining representative groundwater samples for subsequent total (unfiltered) and dissolved (filtered) metals analysis. In addition, a second round of surface water and sediment samples was collected at Site 41 to better characterize potential ecological impacts. A summary of the RI field program is provided below for each site.

Site 41

The RI at Site 41 involved a preliminary geophysical survey to characterize the site with respect to buried material. Determining the potential areas of buried drums was important from the standpoint that this RI would not deliberately encounter buried drums since these drums could potentially contain CWM such as mustard gas, based on background information. Following this survey, the boundary of the former fill area was estimated. The estimated boundary correlated with historical photographs, which showed activities at this site. The area of buried material delineated via the geophysical investigation "fits" within the area of concern identified in the aerial photographs.

Twenty-four test borings were augered in areas suspected of waste disposal. All test boring locations were screened in the field via geophysical methods in order to avoid encountering buried drums. In addition, the samples were screened by the U.S. Army TEU for chemical surety agents. Surface and subsurface soil samples were collected and analyzed for full TCL organic, compounds TAL inorganic analytes, chemical surety degradation compounds, and ordnance constituents. In addition to this investigation, shallow test borings were hand augered downslope of the former dump in order to evaluate off-site migration of contamination from surface runoff. Shallow test borings were also hand augered on site near surficial disposal areas. These areas included areas where surficial debris or anomalies were noted during a site reconnaissance (i.e., construction debris, drum fragments, etc.).

The groundwater investigation involved the installation of shallow (13 to 21 feet bgs) and upper Castle Hayne (37 to 50 feet bgs) monitoring wells throughout the site area, and in assumed downgradient and upgradient locations. Two rounds of groundwater samples were collected (approximately two months apart) and analyzed for full TCL organics and TAL inorganics. As previously noted, selected monitoring wells (wells 41-GW02, 41-GW07, and 41-GW10) were sampled in August 1994 using a low-flow purging technique for purposes of obtaining representative groundwater samples for subsequent total (unfiltered) and dissolved (filtered) metals analysis.

Two rounds of surface water and sediment samples were collected from the unnamed tributary, Tank Creek, and from two seeps which were noted during the site reconnaissance. During the first sampling round in February 1994, all surface water and sediment samples were analyzed for full TCL organics and TAL inorganics. A second round of surface water and sediment samples was collected at Site 41 in August 1994 to better characterize potential ecological impacts. The surface water samples were analyzed for both total (unfiltered) and dissolved (filtered) metals, pesticides, and PCBs.

Site 74

The RI at Site 74 focused on characterizing the nature and extent of soil and groundwater contamination at the former grease pit disposal area and pest control area. Soil sampling grids were established throughout the former grease pit disposal area, the pest control area, and the potential disposal area due west of the pest control area. Surface and subsurface soil samples were collected from each test boring and analyzed for full TCL organics and TAL inorganics. All samples were screened in the field for chemical surety agents by the U.S. Army TEU. The test borings were augered until groundwater was encountered (between 4 and 19 feet bgs). Two or three soil samples were collected from each boring. Test borings were also augered for purposes of constructing shallow monitoring wells. A total of six monitoring wells were installed between the three suspected disposal areas. One round of groundwater samples was collected and analyzed for full TCL organics and TAL inorganics. A second round of samples was collected in August 1994 from two monitoring wells using a different sampling technique (i.e., low-flow) in order to better assess total metals concentrations in the groundwater.

Three surface water and sediment samples were collected from Henderson Pond and analyzed for full TCL organics and TAL inorganics.

NATURE AND EXTENT OF CONTAMINATION

A brief summary of the nature and extent of contamination is provided in the following subsections for Sites 41 and 74. This summary focuses on the primary problems at each site and is not intended to address in detail all media or results. Detailed findings and evaluation of data are presented in Section 4.0 of this Report.

Site 41

Soil

Soil contamination was dominated by polycyclic aromatic hydrocarbons (PAHs) and low levels of pesticides, PCBs, and volatiles. The majority of the PAH contamination was detected in onsite surface soil where contaminant levels exceeded one part per million (i.e., greater than 1,000 μg/kg) in a few samples. PAH contamination in the surface soil is primarily located in the central and eastern portions of the former dump area. PAH contamination was also evident in subsurface soil, but at lower levels. The concentrations of PAHs in subsurface soils were detected in the hundred parts per billion range. Although PAHs are present in onsite surface and subsurface soil, groundwater was not contaminated with PAHs. In addition, off-site migration of PAHs was limited. None of the downslope soil samples exhibited PAHs. The source of the PAHs in soil is believed to be due to historical open burning operations.

Pesticides were detected in most of the surface soil samples collected from the former dump area, including downslope surface soil samples. Pesticides were also detected in subsurface soil samples, but primarily limited to the dump area (only one downslope subsurface soil sample exhibited pesticides). The pesticide levels detected in soil are similar to pesticide levels detected at other areas within MCB Camp Lejeune.

Volatile organics including benzene (maximum concentration of 1.0 μg/kg), chlorobenzene (100 μg/kg), ethylbenzene (58 μg/kg), and TCE (1.0 μg/kg) were detected in subsurface soil, but not at elevated concentrations. Chlorobenzene was detected more frequently than the other VOCs. Toluene (maximum concentration of 4 μg/kg) was the only VOC detected in surface soil. The VOCs in soil are likely a result of localized spills.

Surface soil contamination also consisted of low levels of Aroclor 1242 (82.9 μg/kg) and Aroclor 1260 (58.2 μg/kg) at two locations within the former dump. PCB constituents were also detected in subsurface samples collected from the same sampling location which exhibited surficial contamination. Aroclor 1254 was detected in soil boring SB19 at 36.7 μg/kg, and Aroclor 1260 was detected in soil boring SB23 at 34.6 μg/kg. Two other nearby sampling locations (Soil borings SB16 and GW11) also exhibited low levels of Aroclor 1260 (317 μg/kg) and Aroclor 1254 (214 μg/kg), respectively. These four borings are located in the central portion of the dump area. No PCBs were detected in groundwater indicating that vertical migration to the water table has not occurred.

The concentrations of a number of inorganic constituents exceeded twice the average background concentration for the base. An ongoing soil background database is being developed for MCB Camp Lejeune to support RI/FS efforts. At present, the database is limited to 17 surface and 6 subsurface soil samples collected as part of remedial investigations conducted to date at MCB Camp Lejeune. The average base-specific inorganic background soil concentrations were estimated using analytical data from the current database. Comparing the results for surface and subsurface soils, there appears to be little correlation between elevated metals concentrations in the surface and subsurface soils. For surface soils, chromium, iron, and vanadium were the predominant metals that exceeded background levels. In contrast, zinc, barium, manganese, arsenic, and lead were the major subsurface metals that exceeded twice the background levels. Although there were many background exceedances associated with the metals results, the data do not suggest a gross metals contamination problem at the site. The majority of elevated metals concentrations exceeded the twice background levels by less than an order of magnitude. In addition, the calculated background concentrations may increase as the database is expanded.

<u>Groundwater</u>

VOC contamination in shallow groundwater was detected in shallow wells 41GW09, 41GW10, and 41GW11. The VOCs included chloroform (1.36 to 3.17 μg/L in wells 41GW9 and 41GW10), benzene (2.67 μg/L in well 41GW11), chlorobenzene (1.49 μg/L in well 41GW11), and total xylenes (1.03 μg/L in well 41GW11). Well 41GW11 is located at the center of the former disposal area in the fill material. Naphthalene, a semivolatile organic, was detected in this well at a concentration of 3 μg/L. Low levels of 1,2-DCE (1.22 μg/L) and 1,1,1-trichloroethane (19 μg/L) were detected in deep well 41GW11DW. Chloroform (1.02 μg/L) and dibromochloromethane (1.27 μg/L) were detected in deep well 41GW12DW.

Metals detected during the first two sampling rounds were widely distributed in shallow groundwater. Elevated levels of total (unfiltered) metals during these sampling rounds included: lead (maximum concentration of 9,340 μg/L in well 41GW11), chromium (maximum concentration of 176 μg/L in well 41GW10), manganese (maximum concentration of 2,110 μg/L in well 41GW11), and iron (maximum concentration of 155,000 μg/L in well 41GW11). Well GW11, which is located in the center of the dump, exhibited the highest levels of total metals. Nine out of 18 groundwater samples exceeded the NCWQS for chromium, and 10 of 18 samples exceeded the NCWQS for lead. Iron concentrations exceeded the NCWQS in all samples, and manganese levels exceeded the NCWQS value in 14 samples.

In August 1994, shallow monitoring wells 41GW02, 41GW07, 41GW10, and 41GW11, which contained the highest combined concentrations of chromium and lead, were resampled using a low-flow purging technique. The low-flow purging technique was designed to collect a groundwater sample that is more representative of actual conditions compared to samples collected in previous rounds using much higher pumping rates (causing more suspended solids in the sample). The low-flow sampling results showed much lower total metals concentrations than those detected in the previous sampling rounds. For example, the lead concentration in well 41GW11 decreased from 12,600 μg/L in the April 1994 sample to 26.3 μg/L in the low-flow sample. Furthermore, chromium concentrations in all four wells sampled using the low-flow method decreased from levels exceeding 100 μg/L to non-detected values. Based on these results, the elevated concentrations of total metals detected in the first two sampling rounds appear to be largely the result of turbidity in the sample resulting from sampling procedures rather than from actual leaching of contamination from soils to groundwater. With the exception of iron and manganese, lead was the only inorganic constituent that exceeded its NCWQS and MCL value during the low-flow sampling round. Although lead was detected at 26.3 μg/L in the unfiltered sample from well 41GW11, it was not detected in the filtered sample. This result suggests that lead, in its dissolved form, may not be migrating through soil and groundwater, and that the elevated concentration detected in the unfiltered sample could still be the result of elevated turbidity in the sample. This conclusion is also supported by the fact that a source of lead contamination was not identified in the subsurface soils, and that lead typically exhibits a very low mobility in the environment due to its high adsorptive affinity for soils.

During the low-flow sampling round, iron concentrations exceeded the NCWQS in all four wells, and manganese exceeded the NCWQS in three of the wells. Elevated iron and manganese concentrations in excess of their NCWQS values have been detected throughout the base in both the shallow and Castle Hayne aquifers. Therefore, the iron and manganese concentrations detected in the shallow groundwater at Site 41 may be largely due to high background levels rather than associated with a site-related metals source.

The pesticides alpha-BHC, beta-BHC, and DDD were detected at trace levels in shallow wells 41GW02, 41GW09, and 41GW11. Their presence could be due to suspended fines in the sample, or vertical migration via leaching.

Deep groundwater (i.e., the Castle Hayne Aquifer) exhibited mainly total iron and manganese levels above NCWQSs. Similarly to the shallow groundwater, these metals are believed to be elevated naturally, and not due to site activities. The results of a Wellhead Monitoring Study performed in 1992 on 75 water supply wells indicated a base-wide average iron concentration of 1,400 μg/L, with concentrations ranging from 310 μg/L to 9,800 μg/L (Greenhorne & O'Mara, 1992). The average manganese concentration detected was approximately 78 μg/L, with concentrations ranging from 50 μg/L to 120 μg/L. Lead was detected in the unfiltered samples collected from three of the deep wells during Round 2, and cadmium appeared in two of the wells. All detections of these constituents exceeded their respective NCWQS and MCL standards. These inorganics were not detected in any of the deep wells during Round 1 nor were they detected in the filtered samples from both rounds. In addition, the lead and cadmium concentrations detected in Round 2 do not correlate with the southeast direction of groundwater flow in the Caste Hayne Aquifer. Lead and cadmium were detected in two upgradient wells (41GW6DW and 41GW9DW) but were not found in wells 41GW4DW and 41GW12DW, which can be considered downgradient of the site. Thus, it appears that the elevated lead and cadmium concentrations detected in the unfiltered sample are not site-related and could be the result of elevated turbidity in the sample.

Surface Water/Sediments

As previously mentioned, two seeps are present on site, which discharge into the unnamed tributary of Tank Creek. The seeps apparently are the result of groundwater discharging from the former dump area. One seep is located in the eastern portion of the site and flows into the unnamed tributary. The second seep is located in the north central portion of the site and also flows to the unnamed tributary.

Surface water samples collected from the seeps primarily contained elevated levels of iron (maximum concentration of 14,100 µg/L) and manganese (maximum concentration of 209 µg/L). The evaluation of surface water data shows that concentrations of lead, iron, and manganese within the seeps are higher than concentrations in the unnamed tributary, particularly for the eastern seep. A comparison of the average upstream lead concentration to the average downstream level indicates that the seeps may have a slight impact on unnamed tributary.

A comparison of total (unfiltered samples) and dissolved (filtered samples) metals within the northern and eastern seeps, and in the unnamed tributary was performed. Total iron values detected in unfiltered samples were an order-of-magnitude higher than iron levels found in filtered samples, suggesting that part of the total iron values may be attributable to turbidity in the surface water. Lead was detected in most unfiltered surface water samples from the seeps and downstream in the unnamed tributary, but was not detected in the filtered samples. These data suggest that the lead may be associated with suspended or colloidal matter in the water rather than dissolved species. Metals present as suspended or colloidal solids are generally not considered to be bioavailable to aquatic organisms.

Pesticides in surface water were detected at only one sampling location in the unnamed tributary during Round 1. Lindane and DDT were detected at 0.020 µg/L and 0.030 µg/L, respectively, at location 41-UN-SW02. During Round 2, heptachlor was the only pesticide detected. It was detected at 0.055 µg/L at sampling location 41-UN-SW20. Since there appears to be no site-related pattern associated with these pesticide detections, the source of the pesticides is most likely a result of past pest control activities.

Sediment sampling results show that pesticides were detected in the unnamed tributary, Tank Creek, and seep sediments. Pesticide levels above the NOAA sediment screening criteria (ER-L and ER-L) were detected in upstream as well as downstream locations, suggesting the source of the pesticides is due to historical pest control activities.

Iron and manganese concentrations in the seep sediments, particularly in the eastern seep, are generally an order of magnitude or more higher than in the unnamed tributary. Thus, it appears that significant portions of these inorganics are precipitating out of the surface water and accumulating in the seep sediments before reaching the unnamed tributary. The oxidation and precipitation of iron is evident from the brownish-orange color observed in the water and sediment in the eastern seep. The lead concentration exceeded the NOAA sediment screening criterion (ER-L) in 2 out of 28 samples.

A few sediment samples from Tank Creek and the unnamed tributary exhibited PAHs. The PAHs in sediment were present in one location, which is adjacent to U.S. Highway 17. Runoff from the highway may be the source of the PAHs at this location.

PCBs, consisting of Aroclor 1248 and 1254, were detected at low levels in a sediment sample collected from the eastern seep. Concentrations of Aroclor 1242 exceeded the NOAA sediment screening criterion (ER-L) in 3 out of 28 samples. PCBs were not encountered in the northern seep.

The ordnance constituent 1,3,5-trinitrobenzene (1,390 µg/kg) and TCE (2 µg/kg) were detected in sample location 41-UN-SD14.

Site 74

<u>Soil</u>

Soil was the medium most impacted by former disposal operations at Site 74.

Pesticides were detected throughout the site area, but were most elevated in the former pest control area. In the former pest control area, DDE (maximum concentration of 3,700 µg/kg), DDT (maximum concentration of 3,840 µg/kg), DDE (maximum concentration of 1,730 µg/kg), alpha-chlordane (1,160 µg/kg), and gamma-chlordane (maximum concentration of 1,680 µg/kg) were detected well above background levels. The extent of this contamination is primarily limited to the surface soil. Although pesticides were also detected in subsurface soil, the concentration levels were not significantly elevated relative to the surface soil.

Soil contamination within the former grease pit disposal area included TCE (maximum concentration of 8 µg/kg), total xylenes (maximum concentration of 6 µg/kg), and toluene (maximum concentration of 3 µg/kg). Although some low levels of VOCs were detected in surface soils, groundwater has not been impacted with volatiles. PAHs were also detected at low levels in a limited number of samples. The PAHs could potentially be present due to the burning operations, which reportedly was conducted to destroy the grease. The extent of both PAH and VOC contamination is limited. Pesticides were also detected in this area, but at levels equivalent to pesticide levels typically observed throughout MCB Camp Lejeune.

<u>Groundwater</u>

Groundwater sampling results for Site 74 show that metals are the primary contaminants of concern. On-site shallow groundwater exhibited total manganese, lead, and chromium above Federal MCLs and NCWQSs in only a limited number of wells, whereas iron exceeded the its NCWQS and MCL in every well. The distribution of these contaminants does not suggest a source area. The contaminant levels and distribution are very similar to other sites investigated at MCB Camp Lejeune, indicating that the shallow geologic conditions and sampling methods may have elevated the concentration of total metals rather than a specific disposal event. Upgradient well 74GW03A also exhibited these metals, including lead, at higher concentrations than wells located closer to the site.

In August 1994, shallow monitoring wells 74GW03A and 74GW07 were resampled using the low-flow purging technique. The low-flow sampling results showed much lower total metals concentrations than those detected in the previous sampling round. Only iron, which is elevated throughout the base, exceeded its NCWQS and MCL (secondary) during this round. This comparison supports the conclusion that the elevated total metals detected in some of the shallow groundwater samples are a result of turbity in the well rather than of past disposal activities. Dissolved (filtered samples) metals in shallow groundwater were not elevated.

Shallow groundwater under the former pest control area exhibited low levels of alpha-chlordane, gamma-chlordane, lindane (gamma-BHC), and endosulfan. The detected concentrations were below Federal MCLs and/or NCWQS. Monitoring well 74GW2, located east of the grease pit and northwest of the former pest control area, exhibited heptachlor at 0.01J µg/L (the NCWQS for heptachlor is 0.008 µg/L).

Surface Water/Sediment

Surface water samples collected from Henderson Pond exhibited metals. Lead was the only constituent which exceeded the Federal AWQC (chronic). Low levels of pesticides (DDE, DDT, endosulfan II, methoxychlor, and endrin aldehyde) were detected in all three sediment sampling locations, but at levels below the EPA Region IV sediment screening values. The source of the pesticides could be due to historical pest control applications since the pesticide levels are similar to levels detected in sediments throughout the base. TCE was detected in two sediment samples; one collected from the northern portion of the pond and the other collected from the southern portion of the pond. The source of the TCE is unknown. TCE was not detected in surface water or groundwater at the site.

HUMAN HEALTH RISK ASSESSMENT

The baseline human health risk assessment was based on possible exposure pathways under current and future potential exposure scenarios. Under current conditions, the exposed population considered base personnel who may be exposed to site contaminants during military training operations (both sites are in remote areas of the base where military training occurs). The exposure medium is primarily associated with surface soil. Groundwater was not considered as an exposure medium under current conditions since the base is serviced by a public (base) water supply system. In addition, there are no supply wells which have been impacted by either site. Future potential exposure scenarios involved construction activities and residential use. For the residential scenario, groundwater and surface soil were identified as exposure media. It should be noted that the future residential exposure pathway to soil or groundwater is extremely unlikely given that both sites are suspected of containing buried CWM. For the future construction pathway, subsurface soil was identified as the exposure medium.

Site 41

The total site ICR estimated for current military personnel (6E-07) was less than the USEPA's target risk range (1E-04 to 1E-06). Additionally, the total HI value estimated for this receptor was less than unity. The total site ICR estimated for future residential children (6E-04) and adults (1E-03) exceeded the USEPA's upper bound risk range (1E-04). The total site ICR estimated for future construction workers (9E-08) was less than the USEPA's target risk range of 1E-04 to 1E-06. Additionally, the total site HI for future residential children (16) and adults (8) exceed unity. The total site HI estimated for the future construction worker (0.2) did not exceed unity. However, buried CWM, if present, would still pose a risk to a construction worker at the site. The total site risk was driven by future potential exposure to shallow groundwater, based on total metals analysis.

Site 74

The total site ICR estimated for current military personnel (8E-08) was less than the lower bound USEPA's target risk range (1E-06). Additionally, the total HI value estimated for this receptor was less than unity. Under the future potential risk exposure scenario, the total site ICR estimated for children (2E-04) and adults (3E-04) exceeded the USEPA's upper bound risk range (1E-04). The total site ICR estimated for construction workers (2E-08) was less than the USEPA's target risk range of 1E-04 to 1E-06. Additionally, the total site HI for children (8) and adults (3) exceed unity. The total site HI estimated for the construction worker (<0.01) did not exceed unity. However, buried CWM, if present, would still pose a risk to a construction worker at the site. The total site risk under the future potential exposure scenarios was driven by exposure to shallow groundwater, based on total metals analysis.

ECOLOGICAL RISK ASSESSMENT

Overall, metals and pesticides appear to be the most significant site related COPCs that have the potential to affect the integrity of the aquatic ecosystems at OU No. 4. For the terrestrial ecosystems, metals appear to be the most significant site related COPCs that have the potential to affect terrestrial receptors at OU No. 4.

Potential adverse impacts to threatened or endangered species are low due to the absence of critical habitats or noted observations at the three sites. Biohabitats maps did not indicate a significant impact to ecological resources on or near the three sites.

Site 41

Aluminum, copper, iron, lead, mercury, and zinc exceeded surface water ARVs and lead, silver, zinc, 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, dieldrin, alpha-chlordane, and gamma-chlordane exceeded the sediment ARVs. The surface water and sediments with the greatest potential impact to aquatic receptors are associated with the two seeps and their drainage channels to the unnamed tributary to Tank Creek. The surface waters of the unnamed tributary and Tank Creek do not show significant potential for impact to aquatic receptors from COPC concentrations except for aluminum and iron. However, these COPCs lacked an upstream to downstream concentration gradient in the tributary and the creek. The sediments of the unnamed tributary and Tank Creek do not show a significant potential for impact to aquatic receptors from COPC concentrations due to the lack of upstream to downstream concentration gradients that would indicate a source area for COPCs on site.

The seeps and drainage channels to the unnamed tributary do not represent a significant habitat for aquatic receptors. Although the seeps were flowing during various site visits, extended drought conditions could result in more ephermal conditions. While it is recognized that these systems will support some tolerant species, the natural conditions that exist in both the seeps and the drainage channel are not conducive to attainment of a diverse and stable aquatic community. The populations that would occur in both the seeps and the drainage channel at the site would exhibit high temporal and spatial variability in both diversity and densities due to the natural conditions that exist. This type of natural variability has been recognized as one of the most significant components of the uncertainty associated with ecological risk assessments. Because there is no point of departure (e.g., 1×10^{-6} for human health carcinogenic risk) for determining when a ecosystem has been impacted by site conditions verses when a ecosystem is exhibiting natural temporal and spatial fluctuations, the high natural variability of ecosystems that exist in drainage channels and seeps makes it difficult to quantify site impacts to the ecological integrity of these systems.

However, the potential for impacts to the integrity of aquatic receptors in the seeps and drainage channels warranted additional investigation of these ecosystems. Subsequently, additional surface water and sediment analysis for metals in the seeps was initiated and were reported and discussed in this version of the report. In addition to total metal analyses, dissolved metal analyses were conducted on surface water samples. It has been established that the dissolved fraction of the sample represents the most bioavailable form of the metal and is a more accurate indication of potential risks. Mercury and aluminum were not detected in the dissolved analysis, and dissolved lead was detected only once at a concentration below the surface water ARV. Based on the additional investigations, these results support the conclusion that the seeps are not adversely impacting the aquatic ecosystems of the unnamed tributary and Tank Creek and potential impacts from sediments are limited to the seeps and drainage channels to the unnamed tributary to Tank Creek.

Comparison of surface soils and soil toxicity studies indicate that beryllium, chromium, copper, iron, lead, manganese, and zinc were detected in concentrations that potentially may decrease the integrity of terrestrial invertebrates and floral species at Site 41. However, based on the comparison of chronic daily intakes and terrestrial reference values, there does not appear to be an impact to terrestrial organisms including rabbits, deer, quail, fox, and raccoon from the site. This analysis included exposure to surface waters of the seeps, unnamed tributary, and Tank Creek, which supports the conclusion that any potential impacts from the seeps are limited to only aquatic receptors in the seeps itself.

Site 74

Aluminum and lead exceeded the ARVs in surface water. There were no COPCs detected that exceeded any sediment ARVs. Aluminum was detected at concentrations below both the median and average base-wide concentrations, while lead was detected at concentrations above both the base-wide average and median concentrations, but the quotient ratio was not indicative of a significant potential for impact to surface water aquatic receptors. For surface soils, chromium at the site exceeded soil toxicity reference levels. Based on the comparison of chronic daily intakes and terrestrial reference values, there appears to be a small potential for adverse affect to terrestrial organisms due to manganese for the quail and rabbit. There does not appear to be an impact to terrestrial organisms based on the comparison of chronic daily intakes and terrestrial reference values for the fox and deer receptors.

CONCLUSIONS

Site 41

1. Polycyclic aromatic hydrocarbons (PAHs) detected in soil may be the result of reported burning operations during disposal activities. The extent of this contamination is within the central portion of the former disposal area. PAHs were not detected in groundwater.

2. Pesticides were detected in most soil samples; however, the pesticide levels are within base-wide concentrations which are indicative of historical pest control spraying. Low levels of pesticides were detected at isolated areas within the shallow aquifer and the upper portion of the Castle Hayne aquifer, indicating that pesticides have migrated to a limited extent from the soil matrix to shallow groundwater.

3. Although there were many background exceedances associated with the metals results, the data do not suggest a gross metals contamination problem in either the surface or subsurface soils at the site. The majority of elevated metals concentrations exceeded the twice background levels by less than an order of magnitude.

4. Total lead, iron, and manganese were detected above State and Federal groundwater standards in most of the wells during the RI field investigation. Monitoring well 41GW11, which is located in the central portion of the former disposal area, exhibited the highest levels of lead, iron, and manganese. However, the elevated concentrations of total metals may be due to turbidity in the well or sampling techniques rather than from leaching of these metals from soil to groundwater. Resampling of selected shallow monitoring wells using the low-flow sampling technique resulted in significantly lower metal concentrations. Lead, iron and manganese concentrations in well 41GW11 only exceeded drinking water standards during this round.

5. Shallow groundwater is apparently discharging from the landfill via two seeps. Surface water samples collected from the seeps have exhibited elevated levels of iron, lead, and manganese. However, the unnamed tributary and Tank Creek do not appear to be significantly impacted by the site or seep discharges. Downstream surface water samples exhibited slightly higher iron and lead levels than upstream samples. Sediment samples along the seep pathway primarily exhibited pesticides above EPA Region IV screening values. High iron concentrations were detected in the seep sediments, suggesting that much of the iron in the seep surface water is being deposited in the sediments through oxidation and precipitation.

6. Under current exposure pathways, there are no adverse human health risks mainly because the site is in a remote area, and there is no exposure pathway associated with the groundwater (i.e., no water supply wells are currently located near the site).

7. Under future potential exposure pathways involving residential use, adverse human health risks would result primarily due to metal concentrations in groundwater. However, future residential use of the area is unlikely since the site is suspected of containing buried CWM. In addition, there are no plans to use this area for residential housing.

8. No adverse human health risks were calculated for the future construction worker. However, buried CWM, if present, would still pose a risk to a construction worker at the site.

9. The risk analysis for environmental media concentrations and terrestrial intake models did not indicate that there are significant ecological risks associated with Site 41 to terrestrial receptors and aquatic receptors in the unnamed tributary and Tank Creek.

10. Based on the results of the human health and ecological risk assessments, there are no areas of concern associated with soils or sediment that require remediation. However, institutional controls are considered in the FS to restrict site access and land use because of the unacceptable risk calculated for the residential use scenario as well as the suspected buried CWM.

11. Remediation of the groundwater and seep discharges is considered in the FS because there were some exceedances of State and Federal ARARs. In addition, the seep discharge may pose a future potential threat to the environment and habitat along the unnamed tributary.

Site 74

1. Soil at the former pest control area exhibited pesticides above base background levels, indicating that former pest control activities have resulted in soil contamination. The extent of soil contamination at the former pest control area is limited.

2. Low levels of pesticides were detected in shallow groundwater at the pest control area; however, the levels are below State and Federal drinking water standards.

3. Soil and groundwater at the former grease pit disposal area have not been significantly impacted by former disposal activities. Although organic and inorganic contaminants were detected in soil, the low concentrations and infrequent distribution of the contaminants do not suggest that there is a source area associated with former disposal areas.

4. The subsurface conditions at the former grease pit disposal area are unknown since no intrusive investigations (e.g., trenching) could be conducted due to suspected buried CWM. Therefore, the background information, which indicated that PCBs and other wastes were disposed at the site, cannot be verified.

5. No chemical agents were detected during borehole monitoring by the U.S. Army TEU. In addition, no chemical surety degradation compounds were detected in soil samples.

6. Elevated total metals in groundwater are not believed to be indicative of former disposal activities. Dissolved metal concentrations were below State and Federal drinking water standards.

7. Under current exposure pathways, there are no adverse human health risks associated with the site (i.e., the shallow groundwater is not currently being used for any purpose).

8. Under future potential exposure pathways involving residential use, adverse human health risks would result due to groundwater usage. However, future residential use of the area is unlikely since the site is suspected of containing buried CWM.

9. No adverse human health risks were calculated for the future construction worker. However, buried CWM, if present, would still pose a risk to a construction worker at the site.

10. The risk analysis for environmental media concentrations and terrestrial intake models indicated that there are no significant ecological risks associated with Site 74 to aquatic and terrestrial receptors.

11. Based on the results of the human health and ecological risk assessments, there are no areas of concern associated with the soils that require remediation. However, institutional controls are considered in the FS to restrict site access and land use because of the unacceptable risk calculated for the residential use scenario as well as the suspected buried CWM.

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). Subsequent to this listing, 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) entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune. The primary purpose of the FFA was to ensure that environmental impacts associated with past and present activities at MCB, Camp Lejeune are thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives are developed and implemented as necessary to protect the public health, welfare and the environment (FFA, 1989).

The FFA identifies 27 sites requiring Remedial Investigation/Feasibility Study (RI/FS) activities. These 27 sites have been divided into 14 operable units to simplify proceeding with RI/FS activities. This report describes the RI conducted at Operable Unit (OU) No. 4, which is comprised of Sites 41 and 74.

The purpose of this RI is to evaluate the nature and extent of the threat to public health and the environment caused by the release or threatened release of hazardous substances, pollutants, or contaminants. This was accomplished by sampling several media (soil, groundwater, surface water, and sediment) at OU No. 4, evaluating the analytical data, and performing a human health Risk Assessment (RA) and ecological RA. This RI report contains the results of all field investigations, the human health RA, and the ecological RA. Furthermore, the RI provides information to support the FS and Record of Decision (ROD) for a final remedial action.

Site 41 is known as the "Camp Geiger Dump" and Site 74 is referred to as the "Mess Hall Grease Pit Disposal Area". These sites are spread out across the entire MCB Camp Lejeune. Site 41 is located in the northwestern section of MCB, Camp Lejeune, with Highway 17 bordering the site to the west. Site 74 is located in the northeast section of MCB, Camp Lejeune with Holcomb Boulevard bordering the site to the west and Piney Green Road bordering the site to the east. These sites are identified on Figure 1-1. [Note that all figures and tables are presented at the end of the text section.]

This RI has been submitted to the Naval Facilities Engineering Command, Atlantic Division (LANTDIV) MCB, Camp Lejeune Environmental Management Department (EMD), USEPA Region IV, North Carolina Department of Health and Natural Resources (NC DEHNR), and members of the Technical Review Committee (TRC).

1.1 Report Organization

The following sections are presented in this RI report.

Section 1.0	Introduction
Section 2.0	Study Area Investigation
Section 3.0	Physical Characteristics of the Study Area
Section 4.0	Nature and Extent of Contamination
Section 5.0	Contaminant Fate and Transport

Section 6.0 Baseline Human Health Risk Assessment (BRA)
Section 7.0 Ecological Risk Assessment (ERA)
Section 8.0 Summary and Conclusions
Section 9.0 References

Section 1.0 focuses on the purpose of the RI, and a description of the location, setting, and history of Sites 41 and 74.

Section 2.0 describes the field sampling activities conducted during the RI at OU No. 4. This section describes the purpose of the sampling procedures, sampling grids, and sampling locations for all media. Figures are included to show sampling locations. Drilling logs and well installation logs are also provided to show site geologic conditions. This section also discusses quality control conducted during the sampling events.

Section 3.0 addresses the physical features of OU No. 4. This section discusses the surface features, meteorology, surface water hydrology, geology, soils, hydrogeology, demography, land use, the ecology in and around OU No. 4, and water supply wells identified within the vicinity of OU No. 4.

Section 4.0 presents the nature and extent of the contamination found at OU No. 4. This section presents the results of the field sampling activities conducted as part of this RI. The results of the sampling activities are presented in the first part of this section. Also included in this section is a discussion of the extent of contamination, a summary of the contaminants detected, and a discussion of the potential sources.

Section 5.0 characterizes the fate and transport contaminants found at OU No. 4. This characterization includes: potential routes of contaminant migration, contaminant persistence, and contaminant migration.

Section 6.0 contains the BRA conducted for OU No. 4. The BRA contains a human health evaluation and an environmental evaluation.

Section 7.0 contains the ERA conducted for OU No. 4. The ERA contains an ecological evaluation based on possible impacts related to each site.

Section 8.0 includes the Summary and Conclusions. This section summarizes the nature and extent of contamination, contaminant fate and transport and the human health and ecological RA. In addition, the conclusions address any data limitations and recommended remedial action objectives.

Section 9.0 includes references cited in this report.

1.2 Operable Unit Description

Operable units are formed as an incremental step towards addressing individual site problems. There are currently 27 Installation Restoration Program (IRP) sites on MCB Camp Lejeune which have been grouped into 14 operable units to simplify the specific problems associated with a site or a group of sites. Figure 1-2 shows the breakdown of the operable units within MCB Camp Lejeune. OU No. 4 includes Sites 41 and 74 which were grouped because the sites had historic documentation of disposal of Chemical Weapons Material (CWM) and industrial wastes.

Each site included under OU No. 4 is one half hour in driving distance away from the other. Site 41 is located in the northeast section of the base and is in the southern portion of the Camp Geiger area. The site is situated east of U.S. Highway 17, south of Douglass Road, west of an unnamed tributary, and north of Tank Creek. Site 41 is estimated to be approximately 30 acres in size. Site 74 is located in the northeastern section of the base. Site 74 has two areas of concern (AOC) associated with it, the first AOC is the Mess Hall Grease Pit Disposal Area, and the second AOC is the Former Pest Control Area. Both AOCs are located one half mile to the east of Holcomb Boulevard and are north of Wallace Creek and Henderson Pond. The Mess Hall Grease Pit Disposal Area is estimated to be approximately 3 acres in size, and the Former Pest Control Area is estimated to be only 1,000 square feet. Site descriptions and histories of each site included under OU No. 4 are presented in section 1.3.

1.3 Site Descriptions and Histories

This section provides a description of the physical setting of the sites included under OU No. 4. A detailed history of the sites is presented in each subsequent section.

1.3.1 Site 41 Description

Site 41, Camp Geiger Dump Near Former Trailer Park, is located in the Camp Geiger area of MCB Camp Lejeune. Figure 1-3 presents a site map of Site 41. Site 41 is heavily wooded and vegetated. The former disposal areas physical boundary are barely discernible. Dirt roads are present along the boundary and through the center of the site. Some portions of these roads are overgrown and impassible due to ponding.

The areas along the eastern and southern boundaries are classified as wooded (Palustrine) wetlands (United State Fish and Wildlife Service, National Wetland Inventory, 1986). These areas are downslope of the former disposal area.

Throughout the former disposal area are piles of construction debris, mainly metal and concrete. Drums of various sizes (i.e., 5 gallons up to 55 gallons) are also present throughout the disposal area at random locations.

The former dump is situated at a local topographic high area with an elevation of approximately 20 feet msl (see Figure 1-3). This portion of the study area is relatively flat, the area surrounding the former dump is comprised of moderate to steep hillsides which slope toward the unnamed tributary to the north and east, and to Tank Creek to the south and southwest.

Soils identified by the Soil Conservation Service survey (USDA, 1984) at Site 41 were excavated soils. The occurrence of excavated soils at Site 41 would tend to confirm past disposal activities.

1.3.2 Site 41 History

Site 41 was used as an open burn dump from 1946 to 1970. The dump received construction debris and several types of wastes including petroleum, oil, and lubricants (POL), solvents, batteries, mirex in bags, thousands of mortar shells, one case of grenades, and one 105 mm Howitzer shell. In addition, it is reported that in the mid-1960s, at least two waste disposal incidents occurred involving the disposal of drummed wastes from trucks. At such times, a fire truck was present. These wastes were described as being similar to the types of wastes disposed of at Site 69 (Rifle Range Chemical

Dump). More definitive information is not available to properly identify these wastes. However, it is documented that drums of chemical training agents, which may contain small quantities of blister agents, were disposed of at Site 69. In addition, an incident occurred at Site 69 involving the explosion of containers containing HTH.

1.3.3 Site 74 Description

Site 74 is located in a stand of woods approximately one-half mile east of Holcomb Boulevard in the northeast portion of MCB Camp Lejeune. Figure 1-4 presents a site map of Site 74. There are two AOCs at Site 74: the Mess Hall Grease Pit Disposal Area and the Former Pest Control Area. The Mess Hall Grease Pit Disposal Area is reportedly located just north of the gravel road, and west of the dirt road (i.e., northwest of the intersection of the two roads as shown on Figure 1-4). This grease pit reportedly measures 135 feet long by 30 feet wide by 12 feet deep (Environmental Science and Engineering (ESE), 1991). However, this pit was not observed during a June 1992 site reconnaissance, and during the field investigation of this site, nor was it detected by geophysical techniques. Review of historical aerial photographs indicated that the disposal area is approximately five acres in size.

The second AOC, the Former Pest Control Area, is reportedly located about 150 feet east of potable water supply well No. HP-654 (ESE, 1991). This area reportedly measures an area of 100 feet by 100 feet; however, the area was not recognizable during a site reconnaissance in June 1992, and during the field investigation from January to March 1994. The general area is heavily overgrown with vegetation. Surrounding the former pest control area is a large tract of land that may also be associated with disposal based on review of historical aerial photographs. This area encompasses approximately four acres as shown on Figure 1-4.

Both AOCs are relatively flat. There are no significant surface water drainage features (i.e., ditches, streams, etc.) on site. Henderson Pond, which is used for recreational fishing, is located about one-half mile southeast from the site. Surface water runoff is expected to be toward the southeast. However, the area is heavily overgrown with vegetation, which could reduce surface runoff.

1.3.4 Site 74 History

There are presently no disposal activities on site. The site was used as a disposal area from the early 1950s until 1960. Mess Hall grease was disposed of in the pit until 1954, when Hurricane Hazel reportedly washed the grease out of the pit. Use of the pit was discontinued at this time. It was reported that on at least one occasion, a volatile substance was used unsuccessfully to burn the grease. Drums containing either pesticides or transformer oil containing PCBs, and pesticide soaked bags were also reportedly disposed of near the grease pit. Drums containing chemical surety materials may also be present since it was reported that drums that were supposed to be disposed at Site 69 were taken to Site 74. No information about the activities at the Former Pest Control Area is available.

1.4 Previous Investigations

In response to the passage of the CERCLA, the DoN initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program to identify, investigate, and clean up past hazardous waste disposal sites at Navy installations. The NACIP investigations conducted by the DoN consisted of Initial Assessment Studies (IAS), similar to the EPA's Preliminary Assessments/Site Investigations

(PA/SI) and Confirmation Studies, similar to the EPA's RI/FS. When the Superfund Amendment and Reauthorization Act (SARA) was passed in 1986, the DoN aborted the NACIP program in favor of the Installation Restoration Program (IRP), which adopted the EPA Superfund procedures.

1.4.1 Initial Assessment Study

An IAS was conducted by Water and Air Research (WAR) in 1983. The IAS identified a number of sites at MCB Camp Lejeune as potential sources of contamination, including the sites discussed in this RI. The IAS reviewed historical records and aerial photographs, as well as performing field inspections and personnel interviews to evaluate potential hazards at various sites on MCB Camp Lejeune. The IAS recommended performing confirmation studies at Sites 41 and 74 to evaluate the necessity of conducting mitigating actions or clean-up operations.

1.4.2 Confirmation Study

A confirmation study was conducted by ESE from 1984 through 1987. The purpose of this investigation was to investigate the potential source areas identified in the IAS. Sites 41 and 74 were identified in the IAS. The Confirmation Study was divided into two separate reports: a Verification Step done in 1984 and a Confirmation Step done in 1986 through 1987. Results from the Confirmation Study for Sites 41 and 74 are presented in Sections 1.4.2.1 and 1.4.2.2, respectively.

1.4.2.1 <u>Site 41</u>

Previous investigations at Site 41 focused on groundwater, surface water, and sediment. A soil investigation was not conducted under any step of the Confirmation Study.

Groundwater Investigation

In July 1984, as part of the Verification Step, ESE installed four shallow groundwater monitoring wells (41GW1, 41GW2, 41GW3, 41GW4). Shallow groundwater monitoring wells ranged in depth from 24 to 26 feet bgs. In 1986 a fifth shallow well (41GW5) was installed in a upgradient direction. Figure 1-5 presents the shallow monitoring well locations.

Groundwater samples were collected from wells 41GW1, 41GW2, 41GW3, and 41GW4 in July 1984, additional groundwater samples were also collected in January 1987 from the four wells and 41GW5. Well 41GW5 was sampled again in March 1987. The groundwater samples collected from these wells were analyzed for the following (ESE, 1991):

- Cadmium
- Chromium
- Hexavalent Chromium (1987 only)
- Lead
- VOCs
- Total Phenols
- Organochloride Pesticides
- Oil and Grease
- Mirex
- Ordnance Compounds
- Tetrachlorodioxin (1987 only)

- Xylenes (1987 only)
- MEK (1987 only)
- MIK (1987 only)

Analytical findings for both phases of the groundwater investigation are provided on Table 1-1.

Volatile organics benzene (0.3 μg/L), dichlorodifluoromethane (8.0 μg/L), trans-1,2-DCE (1.1 μg/L), and vinyl chloride (1.0 μg/L) were detected in groundwater collected from monitoring well 41GW2. The concentration of dichlorofluoromethane and vinyl chloride exceeded the NCWQS established for these compounds.

Groundwater results from the second round of sampling indicated that concentrations of methylene chloride in groundwater collected from monitoring well 41GW2 (8 μg/L) exceeded the NCWQS (0.19 μg/L).

Pesticide contaminants aldrin (0.017 μg/L) and heptachlor (0.007 μg/L) were detected in groundwater collected from monitoring well 41GW5. Neither of these concentrations exceeded any state or federal criteria.

First round inorganic groundwater data indicates that groundwater collected from well 41GW3 had levels of cadmium (7.1 μg/L) which exceeded the MCL and the NCWQS. Chromium was detected in groundwater collected during both rounds from monitoring wells 41GW1, 41GW2, 41GW3, and 41GW5. Chromium was detected from the initial groundwater samples collected from 41GW4. Lead was detected in wells 41GW1 (74.6 μg/L), 41GW2 (196.3 μg/L), and 41GW3 (119.4 μg/L) during the first round. These concentrations exceed the Federal Action Level of 15.0 μg/L and the NCWQS Action Level of 50 μg/L for lead. Lead was not detected in second round groundwater samples collected from monitoring wells 41GW1 and 41GW3. Lead concentrations for well 41GW2 indicated a decrease in concentration.

Oil and grease was detected in all groundwater samples collected during the first and second rounds. Concentrations ranged from 900 μg/L (41GW3) to 48,000 μg/L (41GW4).

Phenols were detected in all five monitoring wells. The highest concentration of phenol was detected in well 41GW5 (18 μg/L).

Analytical findings from the second round of groundwater sampling indicated that a nitroaromatic compound (RDX) was detected in well 41GW3. This positive detection indicates that groundwater may have been impacted by ordnance disposal at Site 41 (ESE, 1991).

Surface Water Investigation

Four surface water and sediment samples were collected and analyzed in January 1987. Surface water and sediment samples were collected from two locations in Tank Creek and from two locations in the unnamed tributary to Southwest Creek. Surface water and sediment sampling locations are provided on Figure 1-5. The surface water samples were analyzed for the following (ESE, 1991):

- Cadmium
- Chromium

- Hexavalent Chromium
- Lead
- VOCs
- Total Phenols
- Organochloride Pesticides
- Oil and Grease
- Mirex
- Ordnance Compounds
- Tetrachlorodioxin
- Xylenes
- MEK
- MIK

Results from the surface water samples are provided on Table 1-2.

Methylene chloride was detected in all four surface water samples. Concentrations ranged from 5.5 μg/L (41SW2) to 9.7 μg/L (41SW3).

Analytical results for the surface water samples indicated that oil and grease was present in all samples. Concentrations ranged from 200 μg/L (41SW3) to 1,000 μg/L (41SW1).

Phenols were detected above North Carolina Surface Water Standards (NCSWS) for fresh water, in all four surface water samples, but below the Federal Ambient Water Quality Criteria (AWQC) standards. The highest detection of phenol at a concentration of 10 μg/L was found in surface water sample 41SW4.

The pesticide aldrin was detected in samples 41SW2 (0.013 μg/L), 41SW3 (0.015 μg/L), and 41SW4 (0.014 μg/L). All three concentrations exceed the NCSWS for aldrin. Surface water 41SW2 also had a positive detection for delta benzene hexachloride (D-BHC) at a concentration of 0.047 μg/L.

Inorganic contaminants were not detected in the surface water samples.

Sediment Investigation

The sediment samples collected for this Confirmation Study were analyzed for the following:

- Cadmium
- Chromium
- Hexavalent Chromium
- Lead
- Oil and Grease
- Total Phenols
- Mirex
- Organochloride Pesticides
- Tetrachlorodioxin
- Ordnance

Results from the sediment samples are provided on Table 1-3.

Oil and grease was detected in all sediment samples . Concentrations ranged from 40 μg/g (41SE3) to 208 μg/g (41SE1).

Phenols and 2,4,6-TNT were detected in samples 41SE3 and 41SE4. Both of these sediment samples were collected from Tank Creek. The highest concentrations detected for phenol and 2,4,6-TNT were 0.118 μg/g and 0.357 μg/g, respectively.

Chromium was detected in all four sediment samples at concentrations ranging from 1.77 μg/g (41SE2) to 5.09 μg/g (41SE4). Hexavalent chromium was detected in sediment samples 41SE2, 41SE3, and 41SE4. Concentrations for hexavalent chromium ranged from 1.36 μg/g (41SE2) to 3.74 μg/g (41SE4). Lead was detected in sediment samples 41SE1 (12.1 μg/g) and 41SE2 (4.89 μg/g).

1.4.2.2 Site 74

Previous investigations at Site 74 focused on soil and groundwater. Surface water and sediments were not included as part of this Confirmation Study. Henderson Pond, the nearest surface water body, is located approximately 0.4 miles southeast of the site.

Soil Investigation

Two soil borings were hand augered in the Pest Control Area with three samples taken from each boring during August 1984. The samples were analyzed for organochlorine pesticides. Currently, there is no documentation that shows the locations of these soil borings.

Analytical findings indicate that 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were present in the soil. 4,4'-DDD was reported in five of the six soil samples with a maximum concentration of 0.0084 μg/g. 4,4'-DDE was reported in all six samples. Concentrations for 4,4'-DDE ranged from 0.0004 to 0.044 μg/g. 4,4'-DDT was reported in all three soil samples collected from soil boring 74S1. The concentration of 4,4'-DDT ranged from 0.011 μg/g to 0.260 μg/g. The maximum concentration of each contaminant was reported in the sample collected closest to the surface. Analytical findings are presented in Table 1-4.

Groundwater Investigation

Three shallow monitoring wells (ranging in depths from 24 to 26 feet bgs) were installed during the site investigation conducted at this site. Two of the wells (74GW1 and 74GW2) were installed in 1984. The third well (74GW3) was installed in 1986. Well 74GW1 is located east of the Grease Pit Disposal Area. Well 74GW2 is located southeast of the disposal area between the disposal area and Supply Well HP-654. Well 74GW3 is located northwest and upgradient of the disposal area; this well was installed as part of the second round of sampling conducted in 1986/1987. Well locations are provided on Figure 1-6.

The three monitoring wells were sampled during two previous sampling efforts. The first sampling effort was conducted in July 1984, with wells 74GW1 and 74GW2 being sampled. The second combined effort was conducted in December 1986 and March 1987. Wells 74GW1, 74GW2, and 74GW3 were sampled in 1986 and well 74GW3 was sampled again in 1987.

The groundwater samples collected during the 1984 investigation were analyzed for the following target compounds:

- Organochlorine Pesticides
- Chlorinated Herbicides
- PCBs

From this round of sampling only two contaminants, 4,4'-DDE and 4,4'-DDT, were detected in monitoring well 74GW2 at concentrations of 0.001 μg/L for 4,4'-DDE, and 0.007 μg/L for 4,4'-DDT.

The groundwater samples collected during the 1986/1987 investigation were analyzed for the following compounds:

- Organochlorine Pesticides
- Chlorinated Herbicides
- PCBs
- Tetrachlorodioxin
- VOCs

From the second round of sampling, 4,4'-DDD was reported at a concentration of 0.029 μg/L from the groundwater sample collected from 74GW2. One positive detection for methylene chloride (3.8 μg/L) was reported in monitoring well 74GW3. It is possible that this was due to laboratory contamination and is not a true indication of the contamination at this site; however, no information is available to assess the analytical methods employed or the Quality Assurance/Quality Control (QA/QC) protocols used in the laboratory and therefore, this value is reported.

Table 1-5 presents only the analytical findings for those contaminants that were reported above the detection limit in at least one analytical sample for the years 1984 through 1987.

In July of 1992, included as part of a pre-investigation sampling effort, groundwater samples were collected from monitoring wells 74GW1 and 74GW2. These samples were collected to aid in characterizing current site conditions and scope data needs for the RI. The third well, 74GW3, could not be located and may have been destroyed. Repeated attempts have been made to locate this well.

Groundwater samples collected from these wells were analyzed for full TCL organics and for total and dissolved TAL inorganics by Contract Laboratory Program (CLP) protocols and Level IV Data Quality.

Organic contaminants were not detected in the groundwater samples collected at this site. Total metals detected at this site included aluminum, barium, iron, magnesium, potassium, and sodium. With the exception of iron (301 μg/L), detected in groundwater collected from monitoring well 74GW1, exceeding the NCWQS, no other inorganic exceeded applicable state or federal criteria.

Table 1-6 presents the analytical findings for the pre-investigation groundwater sampling.

SECTION 1.0 TABLES

TABLE 1-1

CONFIRMATION STUDY
DETECTED TARGET CONTAMINANTS IN GROUNDWATER SAMPLES, SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Federal MCLs[1]	North Carolina WQS[2]	Sample ID/Date Sampled									
			41GW1 7/16/84	41GW1 1/8/87	41GW2 7/16/84	41GW2 1/8/87	41GW3 7/16/84	41GW3 1/13/87	41GW4 7/16/84	41GW4 1/13/87	41GW5 1/13/87	41GW5 3/5/87
Benzene	5	1	<0.3	<1	0.3	<1	<0.3	<1	<0.3	<1	<1	<1
Dichlorodifluoromethane	NS	0.19	<1	<10	8	<10	<1	<10	<1	<10	<10	<10
trans-1,2-Dichloroethene	100	70	<1	<1.6	1.1	<1.6	<1.1	<1.6	<1.1	<1.6	<1.6	<1.6
Vinyl chloride	2	0.015	<0.7	<1	1	<1	<0.9	<1	<0.9	<1	<1	<1
Aldrin	NS	NS	<0.0008	<0.013	<0.0008	0.017	<0.0008	<0.013	<0.0008	<0.013	<0.013	<0.006
Heptachlor	0.40	0.076	<0.0007	<0.013	<0.0007	<0.013	<0.0007	<0.013	<0.0007	<0.013	<0.013	0.007
Cadmium	NS	5	<6	<2.9	<6	<2.9	7.1	<2.9	<6	<2.9	4	<3.5
Chromium	100	50	76	10	530	43	230	28	32	<9.4	117	17
Lead	15*	50	74.6	<27	196.3	52	119.4	<27	<40	<27	<27	<27
Oil and Grease	NS	NS	2,000	1,000	2,000	1,000	2,000	900	48,000	2,000	1,000	3,000
Phenols	NS	NS	<1	11	4	11	1	<2	2	6	18	<2
RDX	NS	NS	<3.42	<0.745	<3.23	<7.45	<3.3	1.28	<3.3	<0.745	<0.745	<0.745

(1) Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act of 1986.
(2) NCWQS - North Carolina Administrative Code, Title 15, N.C. DEHNR, Subchapter 2L, Section .0202 - Water Quality Standards for Groundwater, August 4, 1989. Glass GA standards.

NS = No standard established
*Standard is an action level
Values reported are concentrations in micrograms per liter (μg/L); this approximates parts per billion (ppb).
Source: ESE, 1990.

TABLE 1-2

CONFIRMATION STUDY
DETECTED CONTAMINANTS IN SURFACE WATER SAMPLES, SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Federal Ambient Water Quality Criteria		North Carolina Surface Water Standards	Sample ID/Date Sampled			
	Organisms[(1)]	Health[(2)]		41SW1 1/8/87	41SW2 1/8/87	41SW3 1/8/87	41SW4 1/8/87
Oil and Grease	NS	NS	NS	1,000	500	200	300
Phenols	2,560[(3)]	3,500	1	4	7	6	10
Aldrin	NS	0.000074	0.002	<0.013	0.013	0.015	0.014
delta-BHC	NS	NS	NS	<0.026	0.047	<0.026	<0.026
Methylene chloride	NS	NS	NS	8.7	5.5	9.7	6.8

(1) Freshwater Chronic Criteria
(2) Protection of Human Health - Water and Organisms.
(3) Insufficient data to develop criteria value presented in the LOEL.
NS = No standard established

Values reported are concentrations in micrograms per liter (μg/L); this approximates parts per billion (ppb).

Source: ESE, 1990.

TABLE 1-3

CONFIRMATION STUDY
DETECTED CONTAMINANTS IN SEDIMENT SAMPLES, SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample ID/Date Sampled			
	41SE1 1/8/87	41SE2 1/8/87	41SE3 1/8/87	41SE4 1/8/87
Chromium	2.66	1.77	1.86	5.09
Chromium (+6)	<1.31	1.36	1.57	3.74
Lead	12.1	4.89	<3.49	<4.63
Oil and Grease	208	111	40	159
Phenols	<0.066	<0.066	0.081	0.118
2,4,6-TNT	<0.00341	<0.00345	0.00459	0.357

Values reported are concentrations in micrograms per gram (μg/g); this approximates parts per million (ppm).

Source: ESE, 1990.

TABLE 1-4

CONFIRMATION STUDY
DETECTED CONTAMINANTS IN THE SOIL, SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sample ID/Date Sampled					
	74S1A 08/03/84	74S1B 08/03/84	74S1C 08/03/84	74S2A 08/03/84	74S2B 08/03/84	74S2C 08/03/84
DDD, 4,4	0.0084	<0.0006	0.0006	0.0029	0.0006	0.0006
DDE, 4,4	0.044	0.006	0.0072	0.0051	0.001	0.0004
DDT, 4,4	0.260	0.0086	0.011	<0.0012	<0.0012	<0.0013

Values reported are concentrations in micrograms per gram (μg/g); this approximates to parts per million (ppm).

Note: There are no North Carolina pesticide soil standards.

Source: ESE, 1990.

TABLE 1-5

CONFIRMATION STUDY
DETECTED TARGET CONTAMINANTS IN GROUNDWATER (1984-1987), SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Federal MCLs[1]	North Carolina WQS[2]	Sample ID/Date Sampled						
			74GW1 07/04/84	74GW1 12/04/86	74GW2 07/04/84	74GW2 12/04/86	74GW3 12/04/86	74GW3 03/04/87	Supply Well (654) 07/04/84
DDD, 4,4	NS	NS	<0.0008	<0.006	<0.0008	0.029	<0.006	<0.006	<0
DDE, 4,4	NS	NS	<0.0008	<0.006	0.001	<0.006	<0.006	<0.006	<0.006
DDT, 4,4	NS	NS	<0.005	<0.006	0.007	<0.006	<0.006	<0.006	<0.005
Methylene Chloride	NS	5	NA	<2.8	NA	<2.8	3.8	<2.8	NA

(1) Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act of 1986.
(2) NCWQS - North Carolina Administrative Code, Title 15, N.C. DEHNR, Subchapter 2L, Section .0202 - Water Quality Standards for Groundwater, August 4, 1989. Class GA Standards.
NS = No standard established.
NA = Not analyzed.

Values reported are concentrations in micrograms per liter (µg/L).

Source: ESE, 1990.

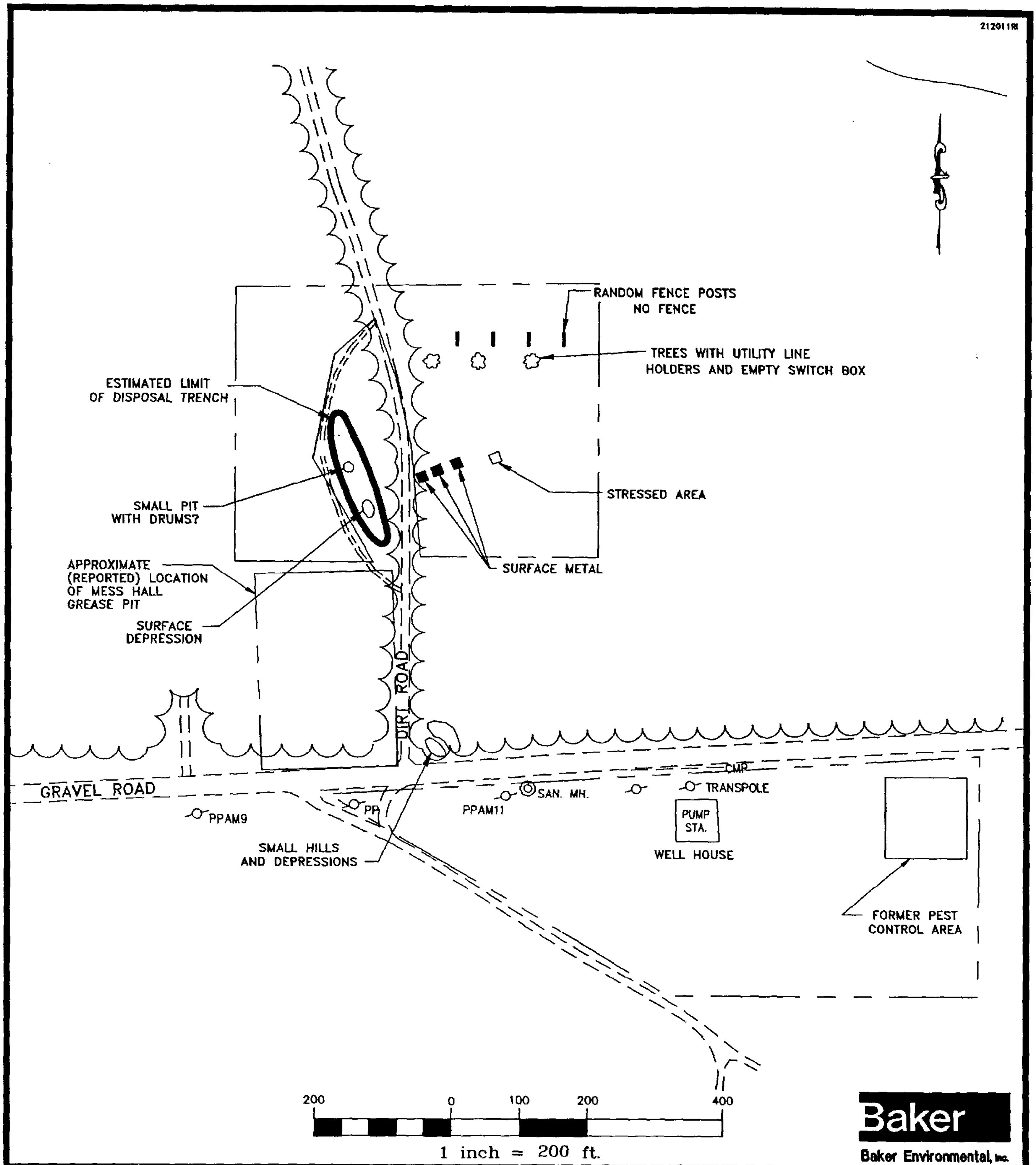
TABLE 1-6

PRE-INVESTIGATION
DETECTED CONTAMINANTS IN THE GROUNDWATER (1992), SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Federal MCLs[1]	North Carolina WQS[2]	Sample ID/Date Sampled			
			74GW1 07/07/92		74GW2 07/07/92	
			Total	Dissolved	Total	Dissolved
Aluminum	NS	NS	1,980	ND	ND	ND
Barium	2,000 (P)	1,000	28	27	32	32
Iron	NS	300	301	ND	41	ND
Magnesium	NS	NS	1,030	916	957	936
Potassium	NS	NS	923	913	605	703
Sodium	NS	NS	3,860	3,850	2,900	2,970

(1) Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act of 1986.
(2) NCWQS - North Carolina Administrative Code, Title 15, N.C. DEHNR, Subchapter 2L, Section .0202 -Water Quality Standards for Groundwater, August 4, 1989. Class GA Standards.
(P) = Proposed
ND = Not Detected at Method Detection Limit
NS = No standard established
Total/Dissolved metal concentrations
Concentrations reported in microgram per liter (µg/L).
Source: Baker Environmental, July 1992.

SECTION 1.0 FIGURES



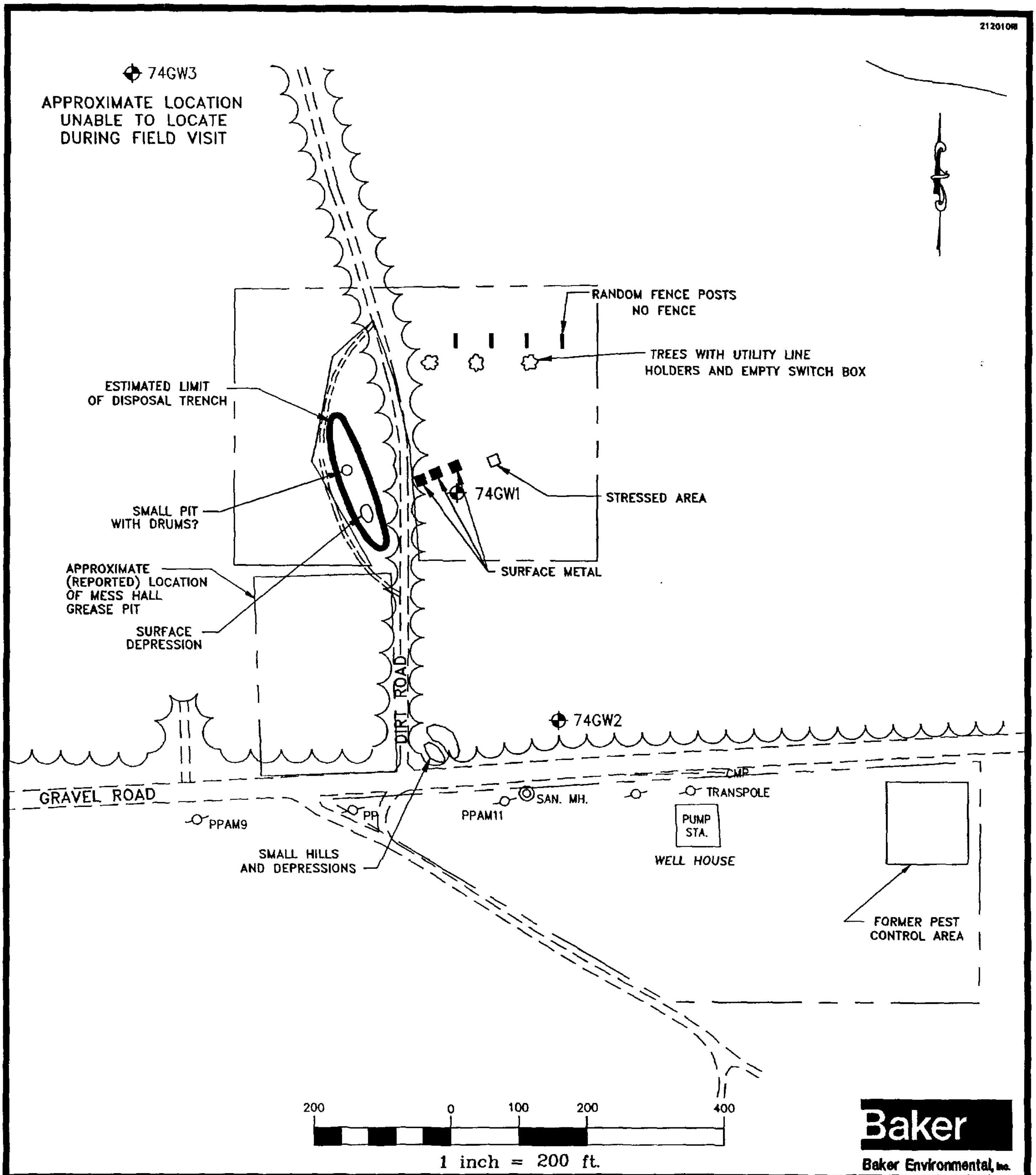
LEGEND

- VEGETATION

- ROAD (UNIMPROVED)

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-4
SITE MAP
SITE 74 - MESS HALL
GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74GW1 - EXISTING SHALLOW WELL

- VEGETATION

- ROAD (UNIMPROVED)

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-6
CONFIRMATION STUDY
SHALLOW MONITORING WELL
LOCATIONS - SITE 74
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

2.0 STUDY AREA INVESTIGATION

The field programs at OU No. 4 (Sites 41 and 74) were initiated to characterize potential disposal related impacts and threats to human health and the environment resulting from previous operations, and disposal activities. This section discusses the site-specific RI objectives for each site (Section 2.1) along with the preliminary RI field activities and the RI field activities conducted to fulfill those objectives for each site.

2.1 Remedial Investigation Objectives

The purpose of this section is to define the site-specific RI objectives aimed at characterizing the problems at each site, assessing potential impacts to the public health and environment, and providing feasible alternatives for consideration in the preparation of the ROD. The site-specific remedial objectives presented in this section have been identified based on review and evaluation of existing background information, assessment of potential risks to the public health and environment, and the consideration of potential feasible technologies/alternatives.

For each site-specific objective identified, the criteria necessary to meet that objective is identified, along with a general description of the study or investigation efforts required to obtain information. This information is presented in tabular form; Site 41, the Camp Geiger Dump Near the Former Trailer Park, is addressed on Table 2-1; and Site 74, the Mess Hall Grease Pit Disposal Area and Former Pest Control Area, is addressed on Table 2-2.

The RI field investigation performed at Site 41 commenced on January 3 and continued through March 4, 1994. The field program implemented during the investigation consisted of a geophysical investigation, soil investigation including drilling and sampling a groundwater investigation including monitoring well installation (shallow and deep wells) and sampling, surface water and sediment investigations, and an aquatic and ecological survey.

2.2 Site 41 - Camp Geiger Dump Near Former Trailer Park

The RI field investigation performed at Site 41 commenced on January 3 and continued through March 4, 1994. The field program implemented during the investigation consisted of a geophysical investigation, soil investigation including drilling and sampling, a groundwater investigation including monitoring well installation (shallow and deep wells) and sampling, surface water and sediment investigations, and an aquatic and ecological survey.

2.2.1 Geophysical Investigation

A geophysical survey was conducted at Site 41 from January 14 to 18, 1994. The survey objectives were to characterize subsurface conditions present at the site by delineating areas of suspected disposal and by identifying locations of buried metal. Weston was retained to perform the Site 41 survey.

Prior to the survey, a grid was established on Site 41 by Hoggard/Eure Associates. A baseline was established along an old access road which bisects the site in a northwest to southeast orientation. Geophysical traverses were established perpendicular to the baseline at one hundred foot intervals. The geophysical grid for Site 41 is provided on Figure 2-1.

Two geophysical techniques were employed during the survey including EM, and magnetometry. EM profiling was performed to measure lateral variations in subsurface conductivity, which can be indicative of previous disposal and backfilling, and to identify buried metallic objects and debris. Magnetic profiling was performed to complement the EM interpretation of subsurface objects and debris.

Results from the EM and magnetometry survey provided on Figure 2-1, indicated a broad area of anomalously high conductivity and magnetic intensity prominent in the east-central portion of the site (Lines F to M). The geophysical data indicated widespread burial of ferrous and non-ferrous metallic objects, which could include construction debris, steel reinforced concrete, drums, fencing, or general scrap metal.

On the west side of the site, survey results indicated only scattered locations of buried metallic debris. Disposal may consist mostly of construction type materials, which were observed on the ground surface in this area.

Elevated levels of conductivity were encountered in the southern portion of the site (along Lines I to L between stations 12 to 14). The lateral change in subsurface conductivity may be indicative of isolated fill type materials or due to a localized change in clay/moisture content.

Appendix A contains the report prepared by Weston for the geophysical survey at Site 41.

2.2.2 Soil Investigation

The soil investigation performed at Site 41 was intended to assess the nature and extent of contamination which may have resulted from previous disposal practices or site activities. Additionally, the investigation was performed to assess human health, ecological, and environmental risks associated with exposure to surface and subsurface soils. The following describes the sample collection procedures, sample locations, and analytical program.

The soil investigation conducted at Site 41 focused on three main areas of concern; the background and surface soil quality downslope of the former disposal area, the on-site surface and subsurface soil quality at the suspected former disposal area, and the subsurface soil quality from monitoring well boreholes for correlation to groundwater analyses. The drilling procedures, soil sample locations, sampling procedures, and the analytical program for this soil investigation are summarized below.

2.2.2.1 Drilling Procedures

Drilling activities at Site 41 commenced on February 1, 1994 and continued through February 16, 1994. Hardin and Huber, Inc. (HHI) was retained to perform the drilling services. The majority of surface soil samples were collected by a hand auger. The boreholes for well installations were advanced by a All Terrain Vehicle (ATV) mounted drill rig using 3-1/4-inch inside diameter (ID) hollow stem augers. Split-spoon samples were collected from inside the augers according to ASTM Method D 1586-84 (ASTM, 1984). Additionally, when samples could not be collected with the drill rig due to access or site conditions (i.e., swamp or low areas), samples were obtained by a hand auger. The ID of the hand auger is 3.5 inches, and had a sample depth of 6 inches. For soil borings requiring sample depths of greater than 6 inches, extension poles were affixed to the hand auger to obtain samples form varying depths. Soil cuttings obtained during the drilling program were contained and handled according to the procedures outlined in Section 2.5.

Two types of borings were drilled during the investigation: exploratory borings (i.e., borings installed for sample collection only) and borings advanced for monitoring well installation. The sampling intervals for each type of boring were slightly different because of the analytical requirements for each type. [Note that only selected samples (see Soil Sampling Procedures discussion below) were submitted to the laboratory for analysis.] Soils obtained from exploratory borings were collected from the surface (ground surface to 1 foot bgs) and then at continuous two-foot intervals (starting at one foot) until the borings were terminated at the approximate depth of the water table (varied from 3 to 11 feet bgs). In some cases where potential wetting fronts were suspected (i.e., perched water table), an additional split-spoon was driven below the water table to confirm groundwater depth. Soils obtained from borings advanced for monitoring well installation were obtained at continuous two-foot intervals (from the ground surface) to 10 feet below the encountered water table for shallow monitoring wells, then at approximate five-foot intervals thereafter for the deep monitoring wells, until the borings were terminated. This sampling scheme was employed because surface soils were not subject to analytical testing from monitoring well borings. A summary of the sample/boring; numbers, depths, and intervals for Site 41 is provided in Table 2-3.

Hand auger cuttings and split-spoon soil samples were classified in the field by a geologist. Soils were classified using the USCS by the visual-manual methods described in ASTM D-2488. Lithologic descriptions were recorded in a field logbook and later transposed onto boring log records. Soil classification included characterization of soil type, grain size, color, moisture content, relative density (from "blow counts"), plasticity, and other pertinent information such as indications of contamination. Lithologic descriptions of site soils are provided on the Test Boring Records in Appendix B and Well Construction Records in Appendix C.

2.2.2.2 Soil Sampling

Soil samples were collected throughout Site 41 as depicted on Figure 2-2. The sampling distribution was intended to evaluate the vertical and horizontal extent of contamination at the three areas of concern. Selection of sample locations was based on review of historical aerial photographs, geophysical survey results, Camp Lejeune historical records, and previous investigation data. Review of these documents indicated several areas that have been used for disposal. A total of 16 borings were advanced to assess the background and surface soil downslope of the former disposal area at Site 41. Additionally, 34 borings were advanced to assess on-site surface and subsurface soils within the former disposal area. Moreover, 13 borings were advanced for monitoring well installation to assess subsurface soil quality for correlation to groundwater analysis (note three of the monitoring wells were placed in background locations, away from the former disposal area).

2.2.2.3 Soil Sampling Procedures

Surface (ground surface to 1 foot bgs) and subsurface (deeper than 1 foot bgs) soil samples were retained for laboratory analysis. Both surface and subsurface samples were collected to evaluate the nature and extent (both horizontal and vertical) of potentially impacted soils. Only the surface soils, however, were collected for human health and ecological risk assessment evaluation. A summary of the sample/boring; numbers, depths, intervals, and parameters analyzed for Site 41 is provided in Table 2-3.

Soil samples were obtained via a drill rig (i.e., split-spoon samples) or a hand auger as described in the section on drilling procedures. Surface samples were collected by driving a split spoon sampler or advancing a hand auger to approximately 1 foot bgs so that the soil cuttings could be retained for the grab sample. Deeper subsurface samples were collected with a split-spoon sampler in accordance with ASTM Method D 1586-84. The augers, split-spoons samplers, and hand auger buckets were decontaminated prior to sample collection according to the procedures outlined in Section 2.4.

Typically, two samples per borehole were submitted for analysis. In some cases, a third sample from a borehole was also submitted for analysis if indications of contamination (i.e., elevated PID readings or visual contamination) were noted or if the encountered groundwater table was deeper than 6 feet. In general, samples retained for laboratory analysis were collected from the surface and just above the water table. A sample was also submitted from just below the water table at borings advanced for monitoring well installation so that groundwater results could be correlated with soil conditions. Note that surface soil samples were not submitted from monitoring well borings.

Soil samples retained for analysis were prepared and handled according to USEPA Region IV SOPs. Samples collected for volatile organic analysis were extracted with a stainless-steel spoon from different sections of the split-spoon or auger bucket which represented the entire sampling interval. Precautions were taken not to aerate the sample to minimize volatilization. Samples retained for other analytical parameters (e.g., semivolatiles, pesticides/PCBs, and metals) were first thoroughly homogenized and then placed in the appropriate laboratory containers.

Following sample collection, each sample retained for laboratory analysis was stored on ice in a cooler. Samples remained within the cooler until written documentation from the United States Army TEU was provided that showed that the samples were screened for possible CWMs. Upon Baker receiving written documentation that the samples were clear of any CWMs, the samples were then processed and packaged for shipment to the laboratory. Note, all soil samples from Site 41 were tested for CWMs, by the TEU, and all results showed non-detect concentrations. Sample preparation also included documentation of sample number, depth, location, date, time, and analytical parameters in a field logbook. Chain-of-Custody documentation, (provided in Appendix D) which includes information such as sample number, date, time of sampling, and sampling personnel, accompanied the samples to the laboratory. Samples were shipped overnight via Federal Express to GP in Gaithersburg, Maryland for analysis.

2.2.2.4 Field Screening and Air Monitoring

Several air monitoring and field screening procedures were implemented during the drilling and sampling activities for health and safety and initial contaminant monitoring. Air monitoring and field screening procedures implemented at Site 41 were: screening of the surface water, and screening of the sediment with a PID to measure for volatile organic vapor. Moreover, samples (i.e., split-spoon samples) were screened with a PID to measure for volatile organic vapor. Measurements obtained in the field were recorded in a field logbook and later transposed onto the Test Boring Records and Well Construction Records which are provided in Appendices B and C respectively. Field instruments were calibrated and documented on calibration forms prior to the start of field work each day.

2.2.2.5 Quality Assurance and Quality Control

Field Quality Assurance/Quality Control (QA/QC) samples were collected during the soil investigation. These samples were obtained to: (1) ensure that decontamination procedures were properly implemented (e.g., equipment rinsate samples); (2) evaluate field methodologies (e.g., duplicate samples); (3) establish field background conditions (e.g., field blanks [accomplished at Site 69]); and (4) evaluate whether cross-contamination occurred during sampling and/or shipping (e.g., trip blanks). Data Quality Objectives (DQOs) for the QA/QC samples were implemented in Quality Assurance Manual, USEPA Region IV (USEPA, 1991). This DQO Level is equivalent to Naval Energy and Environmental Support Agency (NEESA) DQO Level D, as specified in the "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Programs" document (1988).

Four types of field QA/QC samples were collected and analyzed including: duplicate samples; equipment rinsates samples; field blanks; and trip blanks. These sampling definitions are listed below (USEPA, 1991):

- Duplicate Sample: Two or more samples collected simultaneously into separate containers from the same source under identical conditions.

- Equipment Blanks: Equipment field blanks are defined as samples which are obtained by running organic free water over/through sample collection equipment after it has been cleaned. These samples are used to determine if cleaning procedures were adequate. (The equipment could have been cleaned in the field or prior to the field operation.) Equipment blanks were collected daily but only samples collected on every other day were analyzed.

- Field Blanks: Organic-free water is taken to the field in sealed containers and poured into the appropriate sample containers at designated locations. This is done to determine if contaminants present in the area may have an affect on the sample integrity. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.

- Trip Blanks: Trip blanks are prepared prior to the sampling event in the actual sample container and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with the other samples and sent for analysis. At no time after their preparation are the sample containers to be opened before they return to the laboratory. Field sampling teams utilize volatile organic trip blanks to determine if samples were contaminated during storage and transportation back to the laboratory. If samples are to be shipped, trip blanks are to be provided for each shipment but not necessarily for each cooler (i.e., coolers with samples for volatile analysis only).

Field QA/QC samples were also collected during the soil investigation at Site 41 (including duplicate samples; equipment rinsate samples; and trip blanks). Table 2-3 summarizes field QA/QC sample types, sample frequencies, the number of QA/QC samples, and parameters analyzed. Field QA/QC samples were collected according to the procedures outlined in the USEPA Region IV SOPs (note that equipment rinsate samples were collected daily, but were analyzed every other day in accordance with USEPA Region IV SOPs).

2.2.2.6 Analytical Program

The analytical program initiated for the soil investigation at Site 41 focused on the suspected contaminants of concern which were based on previous disposal practices. In general, soils collected from the background and downslope locations were analyzed for the following; full TCL organics and TAL inorganics, CWM, thiodyglycol, mirex, ordnance, and cyanide. On-site soils were analyzed for full TCL organics and TAL inorganics, CSM (degradation products), thiodyglycol, mirex, ordnance, and cyanide; however, 10 of the 34 on-site samples were analyzed for only full TCL organics and TAL inorganics only. Soil samples obtained from monitoring well installations were analyzed for full TCL organics and TAL inorganics. A summary of the sample/boring; numbers, depths, intervals, and parameters analyzed for Site 41 is provided in Table 2-4.

In addition to analyzing for the contaminants of concern, two borings/well installations were advanced for the collection of soils for analysis of engineering parameters (i.e., particle size, and Atterberg limits). Engineering parameter samples consisted of composites of individual grab samples collected from the ground surface to the water table. Note that the samples were prepared and handled as described in the previous paragraph (i.e., samples were thoroughly homogenized prior to filling the sample jars).

2.2.3 Groundwater Investigation

The groundwater investigation performed at Site 41 was intended to assess the nature and extent of contamination which may have resulted from previous disposal practices or site activities. Additionally, the investigation was performed to assess human health, ecological, and environmental risks associated with exposure to surface and subsurface soils. The following describes the sample collection procedures, sample locations, and analytical program.

Seven shallow Type II (i.e., wells installed without casing to seal off a confining layer) monitoring wells (41GW07, 41GW08, 41GW09, 41GW10, 41GW11, 41GW12, and 41GW13) were installed at Site 41 between February 3, 1994, and February 16, 1994 at the locations shown on Figure 2-3. In addition to the shallow wells, 6 deep Type II wells (41GW04DW, 41GW06DW, 41GW07DW, 41GW09DW, 41GW11DW, and 41GW12DW) were also installed during this period and are shown on Figure 2-3. The shallow monitoring wells were installed to collect groundwater from the surficial aquifer for characterizing the nature and horizontal extent of potentially impacted groundwater, and to evaluate shallow groundwater flow patterns at the site. The deep monitoring wells were installed to characterize the deeper portion of the Castle Hayne aquifer. Selection for the placement of the wells was based on review of historical aerial photographs, geophysical investigation results and analytical data from previous investigations.

2.2.3.1 Monitoring Well Drilling and Construction

Shallow monitoring wells were installed upon completion of advancing boreholes. Each borehole was overdrilled with 8-1/4-inch ID hollow stem augers prior to well installation. Well depths ranged from 14 to 21 feet bgs. In general, the wells were installed approximately 10 feet below where the water table was encountered during the initial drilling. The wells were installed at depths and with screen interception intervals sufficient to compensate for seasonal variations in the water table (known to fluctuate from 2 to 4 feet). Well construction details for the wells are summarized on Table 2-5, and well construction diagrams are shown on the Well Construction Records provided in Appendix C.

Deep monitoring wells were installed upon completion of advancing the boreholes. Each borehole used the drilling method of mud rotary to complete the borehole to the desired depth. Each borehole was drilled with a 8-3/4-inch OD roller bit prior to well installation. Well depths ranged from 42 to 52 feet bgs. All deep well screen intervals were set in similar geologic material, which best represented the upper portion of the Castle Hayne aquifer. Well construction details are summarized on Table 2-5, and well construction diagrams are shown on the (TR2) Well Construction Records provided in Appendix C.

The wells (both shallow and deep), for Site 41 were constructed of 2-inch nominal diameter Schedule 40, flush-joint and threaded polyvinyl chloride (PVC) casing with a 10-foot long No. 10 (.01 inch) slotted screen section. A fine-grained sand pack (No. 1 silica sand), extending approximately 2 feet above the top of the screen, was placed in the annulus between the screen and the borehole wall from inside the augers on the shallow wells (note, since augers were not utilized in deep well installation, the sand pack was poured down the borehole manually). A 1 to 2 foot sodium bentonite pellet seal was then placed (by dropping the pellets down the borehole) above the sand pack and hydrated with potable water. The seal was installed to prevent cement or surface run-off from intruding into the sand pack. The remaining annular space was backfilled with a mixture of Portland cement and 5 percent bentonite to ground surface, and then a 6 inch protective casing with cover was placed over the well and into the cement. A protective locking cap was also installed to the top of the PVC well pipe. A 5 foot by 5 foot by 5 inch pad was placed around the protective well casing. Then four protective bollard posts were installed around the corners of the concrete pad. Well tags were installed at the top of each well which contained well construction information. Typical Type II well construction details are shown on Figure 2-4.

2.2.3.2 Well Development

Following well construction and curing of the bentonite seal, each newly-installed well was developed to remove fine-grained sediment from the screen and to establish interconnection between the well and the formation. The shallow wells were developed by a combination of surging and pumping (centrifugal pump). The deep wells were development by using a large compressor (with a filter) and "air lifting" the water out of the well. Typically, 50 gallons (approximately 3 to 5 borehole volumes) of water was evacuated from the shallow wells, followed by 10 minutes of surging, then continued pumping. Anywhere from 50 to 150 gallons of water (approximately 3 to 5 borehole volumes) was evacuated from the deep wells. Groundwater recovered during well development was temporarily stored in drums, then transferred into an on-site tanker (refer to Section 2.5 for IDW handling). Pumping hoses (constructed of flexible PVC) were dedicated for each well to minimize the potential for cross contamination.

Three to five borehole volumes were removed from each well (where conditions permitted) until the groundwater was essentially sediment-free. Measurements of pH, specific conductance, and temperature were recorded at each borehole volume to assist in determining well stabilization. Periodic flow and volume measurements were also recorded during development to evaluate flow rates of the shallow water-bearing zone. Well Development Forms summarizing this information are provided in Appendix E.

2.2.3.3 Water Level Measurements

Upon completion of well development activities static water level measurements were collected from TOC reference points (marked on the PVC casing) at each existing and newly-installed well (refer to Section 3 of this RI Report for water level results). Complete rounds of the measurements were collected on February 22, March 1, and April 26 through 28, 1994. Groundwater measurements were recorded using an electric measuring tape. Measurements were recorded to the nearest 0.01 foot from TOC. Water level data were collected within a three hour period.

2.2.3.4 Groundwater Sampling

Groundwater samples were collected from the five existing shallow wells, the seven newly-installed shallow wells, and the 6 newly installed deep wells at Site 41 during the period of February 14 through February 20, 1994. A second round of groundwater samples were collected during the period April 26 through April 28, 1994. Results of the second round of groundwater samples is presented in Section 4.1.3.1 of this RI Report. The locations of these wells are shown on Figure 2-3.

Groundwater samples were collected to confirm the presence and/or absence of contamination in the shallow and deep aquifers, which may have resulted from previous site disposal practices. At Site 41, the contaminants of concern were: volatiles, pesticides (Mirex), metals, CWMs, ordnance, and thiodyglycol based on previous investigative results and historical records. Accordingly, the sampling program initiated at Site 41 focused on these contaminants.

Prior to groundwater purging, water levels from each well were measured according to procedures outlined in previous paragraphs. The total well depth was also recorded from each well to the nearest 0.1 foot using a decontaminated steel tape. Water level and well depth measurements were used to calculate the volume of water in each well and minimum volume of water necessary to purge the well.

Water was purged from each well using a decontaminated teflon bailer. Measurements of pH, specific conductance, and temperature were made prior to purging and after each well volume was removed to ensure that the groundwater was stabilized before sampling. These measurements were recorded in a field logbook (refer to Section 4 of this RI Report for results). Purge water was contained and handled as described in Section 2.5.

Groundwater samples were collected using decontaminated teflon bailers (i.e., bottom loading bailer). The samples were introduced directly from the bailer into laboratory-prepared, preserved sample containers (where appropriate) and stored on ice. Sample bottles for volatile analysis were filled first, followed by Semivolatiles, pesticides/PCBs, thiodyglycol, mirex, ordnance, TAL metals (total and dissolved), and cyanide. Volatile samples were collected by slowly pouring water from the bailer into 40 ml vials to minimize volatilization. Samples analyzed for dissolved metals were first collected in laboratory-prepared bottles and filtered in the field prior to placement in bottles [preserved with nitric acid (HNO_3)]. The samples were filtered through a disposable 0.45 micron membrane which was attached to teflon tubing. A peristaltic pump was used for the filtering procedures.

To further investigate the effects of particulates in groundwater samples on total metal concentrations, four shallow monitoring wells from Site 41 were selected for sampling. These wells were purged prior to sampling using a low flow submersible pump. The pump was set approximately 2-3 feet below the top of the groundwater surface. The flow rate was adjusted to approximately 0.25 gallons per minute (gpm). Water quality measurements for pH, specific conductance, temperature, turbidity, and dissolved oxygen were taken to determine when the groundwater had reached a state of equilibrium. Samples were collected from the pump discharge immediately following purging at four of the eight wells. One well (41-GW11) exhibited a decrease in groundwater flow during purging, and was allowed to recharge prior to sampling with the pump. One well was purged and allowed to set overnight prior to sampling with a teflon bailer. Groundwater samples were analyzed for pesticides/PCBs, and total and dissolved metals. Pesticide/PCBs results were inconclusive for the low flow purging technique. Few pesticides were detected, and those detected were at fairly low concentrations.

Preparation of groundwater samples incorporated similar procedures as to those described for soil samples. Sample collection information including well number, sample identification, time and date of sample collection, samplers, analytical parameters, and required laboratory turnaround time were recorded in a field logbook and on the sample labels. Chain-of-custody documentation (provided in Appendix D) accompanied the samples to GP.

Several air monitoring and field screening procedures were implemented during the groundwater sampling activities for health and safety and initial contaminant monitoring. Air monitoring and field screening procedures implemented at Site 41 were: screening of the well head, and screening of the actual purged groundwater with a PID to measure for volatile organic vapor. Measurements obtained in the field were recorded in a field logbook. Field instruments were calibrated and documented on calibration forms prior to the start of field work each day.

2.2.3.5 Quality Assurance and Quality Control Samples

Field QA/QC samples were also submitted during the groundwater investigation. These samples included trip blanks, equipment rinsates, and duplicates. Equipment rinsates were collected from the sampling bailers prior to usage. Table 2-6 summarizes the QA/QC sampling program employed for the first round of groundwater sampling conducted at Site 41.

2.2.3.6 Analytical Program

One round of groundwater samples were analyzed from the five existing and seven newly-installed shallow wells, and the 6 newly installed deep wells. During sampling (conducted from February 18 through 20, 1994) the groundwater samples were collected for volatiles, semivolatiles, pesticides/PCBs, CWMs, thiodyglycol, mirex, ordnance, TAL metals (total and dissolved), and cyanide.

2.2.4 Surface Water and Sediment Investigation

This section discusses the surface water and sediment investigations conducted for Site 41. Included in this section are the sampling methodologies, procedures, locations, analytical requirements, and QA/QC sample types of the surface water and sediment investigations. Surface water and sediment samples were collected from Site 41 during other site related operations (i.e., surface waters and sediments were collected from Site 41 while drilling operations were ongoing).

The following subsections describe the surface water and sediment sampling locations, sampling procedures, analytical program, and QA/QC for Site 41.

2.2.4.1 Surface Water and Sediment Sampling Locations

Fourteen surface water and sediment samples were collected at Site 41 during the first sampling event. Four of the samples were obtained from a unnamed tributary, which borders the site to the north and runs west to east. Another four samples were obtained from Tank Creek, which borders the site to the south and runs west to east. One of the samples was obtained from a unnamed tributary, which borders the site to the east and runs north to south. Four samples were collected from two different drainage areas. The one drainage area was located in the central-western area of Site 41 and flowed to the northeast eventually flowing into the unnamed tributary which ran west to east. The second drainage area was located in the central-eastern area of Site 41 and flowed to the north eventually flowing into the unnamed tributary which ran west to east. All of the above mentioned surface water and sediment locations are provided on Figure 2-6. Surface water samples are designated with an SW (i.e., 41-UN-SW01 represents Site 41, unnamed tributary, surface water station 01). Sediment samples are designated with an SD. Sediment locations, depth of sample, sampling interval, and analytical parameters for Site 41 are provided on Table 2-7.

A second surface water and sediment sampling event was conducted in August 1994 at fourteen locations (refer to Figure 2-6A). The areas sampled were the two seeps located in the northern and eastern areas of Site 41, and the unnamed tributary, upstream and downstream from the confluence of the seeps with the unnamed tributary. Sediment locations, depth of sample, sampling interval, and analytical parameters for Site 41 are provided on Table 2-7.

2.2.4.2 Surface Water and Sediment Sampling Procedures

At all sampling stations, surface water samples were collected by dipping the sample container directly into the water surface. Most samples were collected at the approximate vertical mid-point by dipping the sample bottles directly into the water. Samples analyzed for volatiles were obtained prior to any other sample collection. Care was taken to avoid excessive agitation that could result in loss of VOCs. At all surface water locations, water quality readings were taken (i.e., pH, specific conductance, and temperature). In general, samples were collected at surface water features that were either on-site or adjacent to Site 41 to accurately assess any impacts resulting from former disposal operations.

Sediment samples at Site 41 were collected at two intervals: the first interval was from 0 to 0.5 feet bgs, and the second interval was from 0.5 to 1.0-foot bgs. All sediment samples were collected below an aqueous layer using either a stainless steel spoon or hand auger. The sediment was then placed into the appropriate sample containers, volatiles being collected prior to the remaining analytical parameters.

All surface water samples were collected in clean containers provided by the laboratory. Bottles for surface water sample collection containing a preservative (i.e., nitric acid), a transfer bottle was utilized for sample collection.

The majority of the surface water samples were collected from areas where the water contained minimal flow. This was the case throughout many of the surface water features due to the small amount of precipitation incurred during the field investigation. Sediment samples were collected following collection of the surface water samples to minimize sediment resuspension that may have interfered with the water analysis.

following collection of the surface water samples to minimize sediment resuspension that may have interfered with the water analysis.

All sample locations were displayed by placing a pin flag at the nearest bank or shore. The sample number was marked on the pin flag with indelible ink.

2.2.4.3 Field Screening and Air Monitoring

Several air monitoring and field screening procedures were implemented for the surface water and sediment sampling activities for health and safety and initial contaminant monitoring. Air monitoring and field screening procedures implemented at Site 41 were: screening of the surface water, and screening of the sediment with a PID to measure for volatile organic vapor. Measurements obtained in the field were recorded in a field logbook. Note, prior to daily monitoring, the field instruments were calibrated and documentation was recorded in a field logbook and on calibration forms.

2.2.4.4 Quality Assurance and Quality Control Samples

Field QA/QC samples were also collected during the surface water and sediment investigations including duplicate samples, equipment rinsate samples, and trip blanks. The QA/QC sample collection frequencies are the same as those described in Section 2.2.2.5. Table 2-8 summarizes field QA/QC samples collected for the surface water and sediment program.

2.2.4.5 Surface Water and Sediment Analytical Program

The analytical program initiated for the surface water and sediment investigation at Site 41 focused on suspected contaminants of concern and the overall surface water/sediment quality. As mentioned previously, the contaminants of concern were identified from previous investigations. Both surface water and sediment samples for the first sampling event were analyzed for TCL organics, TAL inorganics, ordnance, and mirex. Samples collected for the second event were analyzed for pesticides/PCBs, and metals. Surface water samples were analyzed for both total and dissolved metals. These analyses were to better define contamination for the Feasibility Study.

2.3 Site 74 - Mess Hall Grease Pit Disposal Area

The RI field investigation performed at Site 74 commenced on January 3 and continued through March 4, 1994. The field program implemented during the investigation consisted of the following: geophysical survey, preliminary site survey, soil investigation including drilling and sampling, a groundwater investigation including monitoring well installation (shallow and deep wells) and sampling, surface water and sediment investigations, and an aquatic and ecological survey.

2.3.1 Geophysical Investigation

A geophysical survey was conducted at Site 74 from June 18 to 19, 1992. The survey objectives were to characterize subsurface conditions present at the site by delineating areas of suspected disposal and by identifying locations of buried metal. Weston was retained to perform the Site 74 survey.

Geophysical data obtained during this survey were referenced by taped distance measurements to monitoring wells, roads, fences, and other physical features on site. Geophysical survey lines are provided on Figure 2-7.

To accomplish this survey, the non-invasive geophysical investigation included EM and ground penetrating radar (GPR) techniques. EM profiling was performed to map the lateral extent of buried waste and to identify buried metal objects and other debris on site. GPR profiling was conducted over the area of the suspected disposal trench in an attempt to better define the limits of excavation and to characterize the buried waste materials.

EM measurements conducted along orthogonal traverses resulted in background conductivity values between 1 to 3 mmhos/m. The small fluctuation of lateral conductivity values observed across this area suggest little or no subsurface disturbance, indicating that the location of the trench may have been incorrectly reported. Figure 2-7 shows the approximate (reported) location of the Mess Hall Grease Pit. Shown on Figure 2-8 are the four east-west EM conductivity profile printouts, conducted on the southern portion of the site.

A visual inspection of the area north of the entrance to Site 74, noted a small pit containing deteriorated drums. An EM traverse was conducted across this area and a large change in conductivity was measured near the pit as shown on Figure 2-8, Line 4 + 60N. Reconnaissance EM measurements surrounding the area allowed for an approximate delineation of the feature, which is located between two roads, as shown on Figure 2-7. This area is a potential former trench which was likely used for the disposal of waste materials.

GPR was conducted across the suspected trench in an attempt to more accurately establish the limits of the trench and to further characterize any buried materials. GPR was not effective, however, in detecting the boundaries of the excavation nor any debris materials due to limited radar signal penetration.

Appendix A contains the report prepared by Weston for the geophysical survey at Site 74.

2.3.2 Preliminary Site Survey

The soil grids at Site 74 were established to encompass the areas in which possible disposal activities occurred. Three grid areas were set up for Site 74. The first grid established was the Former Disposal Area (FDA), which was placed in the general area of the Mess Hall Grease Pit Disposal Area. The second grid established was the Former Pesticide Control Area (FPA), which was placed in the general area of the former pesticide storage and mixing building. Lastly, the third grid established was the Potential Disposal Area (PDA), which was placed to the south and east of the FPA, where possible storing, mixing, and disposal of pesticides may have occurred.

All three soil grids at Site 74 were placed by scaling existing CADD drawings for distance, and then by taping these distances off from existing structures present at the site. The FDA grid was established on 100 foot by 100 foot spacings. The FPA grid was established on 50 foot by 50 foot spacings. Grid PDA was established on a 200 foot by 200 foot spacings. Pin flags were then placed at the measured locations with their respective sample identification numbers placed onto the pin flag. Provided in Figure 2-9 are the soil sampling grids for Site 74.

Proposed well locations were also established by utilizing existing CADD drawings for reference.

Access to some of the well locations at Site 74, being that the site is partially wooded, required a minor amount of clearing. Heavy equipment (i.e., CASE 38EE front end loader) was utilized to plow trials and make cuts into heavily vegetated areas. Chainsaws were also used to cut down larger trees preventing drill rig access. Proposed wells were then staked and given their corresponding identification number. Provided on Figure 2-10 are the well locations for Site 74.

2.3.3 Soil Investigation

The soil investigation performed at Site 74 was intended to assess the nature and extent of contamination which may have resulted from previous disposal practices or site activities. Additionally, the investigation was performed to assess human health, ecological, and environmental risks associated with exposure to surface and subsurface soils. The following describes the sample collection procedures, sample locations, and analytical program.

The soil investigation conducted at Site 74 focused on the surface and subsurface soil quality for the following areas of concern; the former disposal area (FDA), the former pest control area (FPA), and the potential disposal area (PDA) which surrounds the pest control area. In addition to the above mentioned AOC, the subsurface soil quality from monitoring well boreholes for correlation to groundwater analyses is also an area of concern. The drilling procedures, soil sample locations, sampling procedures, and the analytical program for this soil investigation are summarized below.

2.3.3.1 Drilling Procedures

Drilling activities at Site 74 commenced on January 10, 1994 and continued through February 21, 1994. Drilling procedures have already been identified under the Site 41 Soil Investigation. Section 2.2.2.1 provides procedures, and equipment which were utilized during the soil investigation.

Two types of borings were installed during the soil investigation: exploratory borings (i.e., borings installed for sample collection only) and borings advanced for monitoring well installation. The sampling intervals for each type of boring were different because of the analytical requirements for each type. [Note that only selected samples (see Soil Sampling Procedures discussion below) were submitted to the laboratory for analysis.] Soils obtained from exploratory borings were collected from the surface (ground surface to 1 foot bgs) and then at continuous two-foot intervals (starting at one foot) until the borings were terminated at the approximate depth of the water table (varied from 1 to 19 feet bgs). In some cases where potential wetting fronts were suspected (i.e., perched water table), an additional split-spoon was driven below the water table to confirm groundwater depth. Soils obtained from borings advanced for monitoring well installation were obtained at continuous two-foot intervals (from the ground surface) to 10 feet bgs the encountered water table for shallow monitoring wells, until the borings were terminated. This sampling scheme was employed because surface soils were not subject to analytical testing from monitoring well borings. A summary of the sample/boring; numbers, depths, and intervals for Site 74 is provided in Table 2-9.

Hand auger cuttings and split-spoon soil samples were classified in the field by a geologist. Soils were classified using the USCS by the visual-manual methods described in ASTM D-2488. Lithologic descriptions were recorded in a field logbook and later transposed onto boring log records. Soil classification included characterization of soil type, grain size, color, moisture content, relative density (from "blow counts"), plasticity, and other pertinent information such as indications of contamination. Lithologic descriptions of site soils are provided on the Test Boring Records in Appendix B and Well Construction Records in Appendix C.

2.3.3.2 Soil Sampling

The majority of soil samples were collected from the three grids (FDA, FPA, and PDA) established for Site 74, as depicted on Figure 2-11. The sampling distribution was intended to evaluate the vertical and horizontal extent of contamination at the areas of concern. Selection of sample locations was based on review of historical aerial photographs, geophysical survey results, Camp Lejeune historical records, and previous investigation data. Review of these documents indicated that the areas identified were either used for disposal at some time and had operations being conducted that could possibly result in contamination (i.e., pesticide mixing at the former pest control area). Listed below are the soil samples obtained from each area of concern.

Soil samples from grid FDA were collected for both surface and subsurface assessment. A total of 32 borings were advanced to assess the surface and subsurface soil quality. Five hand auger borings were advanced to assess surface soil quality, and two hand auger borings were advanced to assess background surface soil quality. In addition, four borings were advanced for monitoring well installation to assess subsurface soil quality for correlation to groundwater analysis.

Soil samples from grid FPA were collected for both surface and subsurface assessment. A total of 9 borings were advanced to assess surface and subsurface soil quality. One boring was advanced for monitoring well installation to assess subsurface soil quality for correlation to groundwater analysis.

Soil samples from grid PDA were collected for both surface and subsurface assessment. A total of 10 borings were advanced to assess surface and subsurface soil quality. Five borings were advance via a hand auger to assess surface soil quality and two borings were advanced to assess background surface soil quality. One boring was advanced for monitoring well installation to assess subsurface soil quality for correlation to groundwater analysis.

2.3.3.3 Soil Sampling Procedures

Surface (ground surface to 1 foot bgs) and subsurface (deeper than 1 foot bgs) soil samples were retained for laboratory analysis. Both surface and subsurface samples were collected to evaluate the nature and extent (both horizontal and vertical) of potentially impacted soils. Surface soils, however, were collected for human health and ecological risk assessment evaluation. A summary of the sample/boring; numbers, depths, intervals, and parameters analyzed for Site 74 is provided in Table 2-9.

Soil samples were obtained via a drill rig (i.e., split-spoon samples) or a hand auger as described in the section on drilling procedures. Surface samples were collected by slowly advancing the augers to approximately 1 foot bgs so that the soil cuttings could be retained for the grab sample. Deeper subsurface grab samples were collected with a split-spoon sampler in accordance with ASTM Method D 1586-84. The augers, split-spoons samplers, and hand auger buckets were decontaminated prior to sample collection according to the procedures outlined in Section 2.4.

Only one sample from each of the surface soil borehole locations was retained for laboratory analysis. Typically, two samples per monitoring well borehole were submitted for analysis. In some cases, a third sample from the borehole was also submitted for analysis if indications of contamination (i.e., elevated PID readings or visual contamination) were noted or if the encountered groundwater table was deeper than 6 feet. In general, samples retained for laboratory analysis were collected from the surface. Samples were also submitted from just above and below the water table at borings advanced for monitoring well installation so that groundwater results could be correlated with soil conditions. Note that surface soil samples were not submitted from monitoring well borings.

Soil samples retained for analysis were prepared and handled according to USEPA Region IV SOPs. Samples collected for volatile organic analysis were extracted with a stainless-steel spoon from different sections of the split-spoon or auger bucket which represented the entire sampling interval. Precautions were taken not to aerate the sample to minimize volatilization. Samples retained for other analytical parameters (e.g., semivolatiles, pesticides/PCBs, and metals) were first thoroughly homogenized and then placed in the appropriate laboratory containers.

Following sample collection, each sample retained for laboratory analysis was stored on ice in a cooler. Samples remained within the cooler until written documentation from the United States Army TEU was provided that showed that the samples were screened for possible CWMs. Upon Baker receiving written documentation that the samples were clear of any CWMs, the samples were then processed and packaged for shipment to the laboratory. Sample preparation also included documentation of sample number, depth, location, date, time, and analytical parameters in a field logbook. Chain-of-Custody documentation, (provided in Appendix D) which include information such as sample number, date, time of sampling, and sampling personnel, accompanied the samples to the laboratory. Samples were shipped overnight via Federal Express to GP in Gaithersburg, Maryland for analysis.

2.3.3.4 Field Screening and Air Monitoring

Several air monitoring and field screening procedures were implemented during the drilling and sampling activities for health and safety and initial contaminant monitoring. Air monitoring and field screening procedures implemented at Site 74 were the same as those described for Site 41. Moreover, samples (i.e., split-spoon samples) were screened with a PID to measure for volatile organic vapor. Measurements obtained in the field were recorded in a field logbook and later transposed onto the Test Boring Records and Well Construction Records which are provided in Appendices B and C. Note prior to daily monitoring, the field instruments were calibrated and documentation was recorded in a field logbook and on calibration forms.

2.3.3.5 Quality Assurance and Quality Control

Field QA/QC samples were also collected during the soil investigation at Site 74 (including duplicate samples; equipment rinsate samples; and trip blanks). Table 2-10 summarizes field QA/QC sample types, sample frequencies, the number of QA/QC samples, and parameters analyzed. Field QA/QC samples were collected according to the procedures outlined in the USEPA Region IV SOPs (note that equipment rinsate samples were collected daily, but were analyzed every other day in accordance with USEPA Region IV SOPs).

2.3.3.6 Analytical Program

The analytical program initiated for the soil investigation at Site 74 focused on the suspected contaminants of concern which were based on previous disposal/operational practices. In general, soils collected from the background and grid FDA locations were analyzed for full TCL organics and TAL inorganics, CWM and thiodyglycol. Soil samples obtained from grids FPA and PDA were analyzed for full TCL organics and TAL inorganics. In addition, soil samples obtained from monitoring well installations were analyzed for full TCL organics and TAL inorganics. A summary of the sample/boring; numbers, depths, intervals, and parameters analyzed for Site 74 is provided in Table 2-9.

In addition to analyzing for the contaminants of concern, one boring/well installation was advanced for the collection of soils for analysis of engineering parameters (i.e., particle size, and Atterberg limits). Engineering parameter samples consisted of composites of individual grab samples collected from the ground surface to the water table. Note that the samples were prepared and handled as described in the previous paragraph (i.e., samples were thoroughly homogenized prior to filling the sample jars).

2.3.4 Groundwater Investigation

The groundwater investigation performed at Site 74 was intended to assess the nature and extent of contamination which may have resulted from previous disposal practices or site activities. Additionally, the investigation was performed to assess human health, ecological, and environmental risks associated with exposure to surface and subsurface soils. Drilling and well construction procedures, sample collection procedures, sample locations, and the analytical program are described in the following sections.

2.3.4.1 Monitoring Well Drilling and Construction

Six shallow Type II (i.e., wells installed without casing to seal off a confining layer) monitoring wells (74GW03A, 74GW04, 74GW05, 74GW06, 74GW07, and 74GW08) were installed at Site 74 between January 10, 1994, and February 18, 1994 at the locations shown on Figure 2-12. The shallow monitoring wells were installed to collect groundwater from the surficial aquifer for characterizing the nature and horizontal extent of potentially impacted groundwater. Selection for the placement of the wells was based on review of historical aerial photographs, Camp Lejeune records, and analytical data from previous investigations.

Shallow monitoring wells were installed following the procedures identified for Site 41 in Section 2.2.3.1. Well depths ranged from 17 to 26 feet bgs. In general, the wells were installed approximately 10 feet below where the water table was encountered during the initial drilling. The wells were installed at depths and with screen interception intervals sufficient to compensate for seasonal variations in the water table (known to fluctuate from 2 to 4 feet). Well construction details for the wells are summarized on Table 2-11, and well construction diagrams are shown on the Well Construction Records provided in Appendix C.

Shallow well construction for Site 74 follows the procedures already identified for Site 41. Typical shallow Type II well construction details are shown on Figure 2-4.

2.3.4.2 Well Development

Following well construction and curing of the bentonite seal, each newly-installed well was developed to remove fine-grained sediment from the screen and to establish interconnection between the well and the formation. The shallow wells were developed by a combination of surging and pumping (centrifugal pump). Typically, 50 gallons (approximately 3 to 5 borehole volumes) of water was evacuated from the shallow wells, followed by 10 minutes of surging, then continued pumping. Groundwater recovered during well development was temporarily stored in drums, then transferred into an on-site tanker (refer to Section 2.5 for IDW handling). Pumping hoses (constructed of flexible PVC) were dedicated for each well to minimize the potential for cross contamination.

Three to five borehole volumes were removed from each well (where conditions permitted) until the groundwater was essentially sediment-free. Measurements of pH, specific conductance, and temperature were recorded at each borehole volume to assist in determining well stabilization. Periodic flow and volume measurements were also recorded during development to evaluate flow rates of the shallow water-bearing zone. Well Development Forms summarizing this information are provided in Appendix E.

2.3.4.3 Water Level Measurements

Upon completion of well development activities, static water level measurements were collected from TOC reference points (marked on the PVC casing) at each existing and newly-installed well (refer to Section 3 of this RI Report for water level results). Complete rounds of the measurements were collected on February 22, March 1 and 2, and April 29, 1994. Groundwater measurements were recorded using an electric measuring tape. Measurements were recorded to the nearest 0.01 foot from TOC. Water level data was collected within a two hour period.

2.3.4.4 Groundwater Sampling Procedures

Groundwater samples were collected from the two existing shallow wells and the six newly-installed shallow wells. The locations of these wells are shown on Figure 2-12.

Prior to groundwater purging, water levels from each well were measured according to procedures outlined in previous paragraphs. The total well depth was also recorded from each well to the nearest 0.1 foot using a decontaminated steel tape. Water level and well depth measurements were used to calculate the volume of water in each well and minimum volume of water necessary to purge the well.

Following well volume calculations, a minimum of three to five well volumes were purged from each well prior to sampling. Water was purged from each well using a decontaminated teflon bailer. Measurements of pH, specific conductance, and temperature were made prior to purging and after each well volume was removed to ensure that the groundwater was stabilized before sampling. These measurements were recorded in a field logbook (refer to Section 4 of this RI Report for results). Purge water was contained and handled as described in Section 2.5.

Groundwater samples were collected using decontaminated teflon bailers (i.e., bottom loading bailer). The samples were introduced directly from the bailer into laboratory-prepared, preserved sample containers (where appropriate) and stored on ice. Sample bottles for volatile analysis were filled first, followed by semivolatile, pesticides/PCBs, CWMs, thiodyglycol, TAL metals (total and dissolved), and cyanide. Volatile samples were collected by slowly pouring water from the bailer into 40 ml vials to minimize volatilization. Samples analyzed for dissolved metals were first collected in laboratory-prepared bottles and filtered in the field prior to placement in bottles [preserved with nitric acid (HNO_3)]. The samples were filtered through a disposable 0.45 micron membrane which was attached to teflon tubing. A peristaltic pump was used for the filtering procedures.

To further investigate the effects of particulates in groundwater samples on total metal concentrations, two shallow monitoring wells from Site 74 were selected for sampling. These wells were purged prior to sampling using a low flow submersible pump. The pump was set approximately 2-3 feet below the top of the groundwater surface. The flow rate was adjusted to approximately 0.25 gallons per minute (gpm). Water quality measurements for pH, specific conductance, temperature, turbidity, and dissolved oxygen were taken to determine when the groundwater had reached a state of equilibrium. Samples were collected from the pump discharge immediately following purging at four of the eight wells. One well was purged and allowed to set overnight prior to sampling with a teflon bailer. Groundwater samples were analyzed for pesticides/PCBs, and total and dissolved metals. Pesticide/PCBs results were inconclusive for the low flow purging technique.

Preparation of groundwater samples incorporated similar procedures as to those described for soil samples. Sample collection information including well number, sample identification, time and date of sample collection, samplers, analytical parameters, and required laboratory turnaround time were recorded in a field logbook and on the sample labels. Chain-of-custody documentation (provided in Appendix D) accompanied the samples to GP.

2.3.4.5 Field Screening and Air Monitoring

Several air monitoring and field screening procedures were implemented during the groundwater sampling activities for health and safety and initial contaminant monitoring. Air monitoring and field screening procedures implemented at Site 74 are the same as previously mentioned in Section 2.2.2.5. Measurements obtained in the field were recorded in a field logbook. Note, prior to daily monitoring, the field instruments were calibrated and documentation was recorded in a field logbook and on calibration forms.

2.3.4.6 Quality Assurance and Quality Control Samples

Field QA/QC samples were also submitted during the groundwater investigation. These samples included trip blanks, equipment rinsates, and duplicates. Equipment rinsates were collected from the sampling bailers prior to usage. Table 2-12 summarizes the QA/QC sampling program employed for the groundwater investigation conducted at Site 74.

2.3.4.7 Analytical Program

One round of groundwater samples were analyzed from the two existing and six newly-installed shallow wells. During the round of sampling (conducted from February 16 through February 22, 1994) the groundwater samples were analyzed for volatiles, semivolatiles, pesticides/PCBs, CWMs, thiodyglycol, TAL metals (total and dissolved), and cyanide.

2.3.5 Surface Water and Sediment Investigation

This section discusses the surface water and sediment investigations conducted for Site 74. Included in this section are the sampling methodologies, procedures, locations, analytical requirements, and QA/QC sample types of the surface water and sediment investigations. Surface water and sediment samples were collected from Site 74 during other site related operations (i.e., surface waters and sediments were collected from Site 74 while drilling operations were ongoing).

2.3.5.1 Surface Water and Sediment Sampling Locations

Three surface water and three sediment samples were obtained from Henderson Pond. Henderson Pond is located to the south east of the potential disposal area. Surface water and sediment sampling locations are shown on Figure 2-13. Two of the surface water and sediment locations were placed in areas that had possible surface run-off drainage, the third surface water and sediment sample location was placed at the end of Henderson Pond by the dam as a background location. Surface water samples are designated with an SW (i.e., 74-PDA-SW01 represents Site 74, surface water station 01). Sediment samples are designated with an SD. Sediment locations, depth of sample, sampling interval, and analytical parameters for Site 74 are provided on Table 2-13.

2.3.5.2 Surface Water and Sediment Sampling Procedures

At all sampling stations, surface water samples were collected using the same procedures identified for Site 41 in Section 2.2.4.2. Most samples were collected at the approximate vertical mid-point by dipping the sample bottles directly into the water. Samples analyzed for volatiles were obtained prior to any other sample collection. Care was taken to avoid excessive agitation that could result in loss of VOCs.

Sediment samples were collected using the same procedures identified for Site 41. At each station, sediment samples were collected from the surface to 0.5 feet bgs.

All samples were collected in clean containers provided by the laboratory. Bottles for surface water sample collection containing a preservative (i.e., nitric acid), a transfer bottle was utilized for sample collection.

All of the surface water samples were collected from the Henderson Pond where the water contained minimal flow. This was the case throughout many of the surface water features due to the small amount of precipitation incurred during the field investigation. Sediment samples were collected following collection of the surface water samples to minimize sediment resuspension.

All sample locations were displayed by placing a pin flag at the nearest bank or shore. The sample number was marked on the pin flag with indelible ink.

2.3.5.3 Field Screening and Air Monitoring

Several air monitoring and field screening procedures were implemented for the surface water and sediment sampling activities for health and safety and initial contaminant monitoring. Air monitoring and field screening procedures implemented at Site 74 are the same as previously mentioned for Site 41. Measurements obtained in the field were recorded in a field logbook. Note, prior to daily monitoring, the field instruments were calibrated and documentation was recorded in a field logbook and on calibration forms.

2.3.5.4 Quality Assurance and Quality Control Samples

Field QA/QC samples were also collected during the surface water and sediment investigations including duplicate samples, equipment rinsate samples, and trip blanks. The QA/QC sample collection frequencies are the same as those described in Section 2.2.2.5. Table 2-14 summarizes field QA/QC samples collected for the surface water and sediment program.

2.3.5.5 Surface Water and Sediment Analytical Program

The analytical program initiated for the surface water and sediment investigation at Site 74 focused on suspected contaminants of concern and the overall surface water/sediment quality. The surface water and sediment investigation conducted at Site 74 was undertaken to accurately assess any impacts resulting from potentially former disposal operations conducted near the pest control area (i.e., surface runoff of pesticide contaminated soil). Both surface water and sediment samples were analyzed for TCL organics and TAL inorganics.

2.4 Decontamination Procedures

Decontamination procedures performed in the field were initiated in accordance with USEPA Region IV SOPs. Sampling and drilling equipment were divided into two decontamination groups, heavy equipment and routine sample collection equipment. Heavy equipment included: the drill rig, hollow-stem augers, drill and sampling rods. Routine sample collection included: split spoons, stainless steel spoons and bowls, hand augers (buckets and extension poles), and bailers.

For heavy equipment, the following procedures were implemented:

- Removal of caked-on soil with brush
- Steam clean with high-pressure steam
- Air dry

For routine sample collection equipment, the following procedures were implemented:

- Clean with distilled water and laboratory detergent (Liquinox soap solution)
- Rinse thoroughly with distilled water
- Rinse twice with pesticide-grade isopropanol alcohol
- Air dry
- Wrap in aluminum foil, if appropriate

Temporary decontamination pads, constructed of wood and plastic, were constructed to minimize spillage onto the ground surface. Decontamination fluids generated during the field program were containerized and handled according to the procedures outlined in Section 2.5.

2.5 Investigation Derived Waste (IDW) Handling

Field investigation activities at Sites 41 and 74 resulted in the generation of various IDW. This IDW included drilling mud, soil cuttings, well development and purge water, and solutions used to decontaminate non-disposable sampling equipment. The general management techniques utilized for the IDW were:

1. Collection and containerization of IDW material.

2. Temporary storage of IDW while awaiting analytical data on characterization from sampling conducted from January 3 to March 4, 1994.

3. Final disposal of aqueous and solid IDW material.

The management of the IDW was performed in accordance with guidelines developed by the USEPA Office of Emergency and Remedial Response, Hazardous Site Control Division.

Both non-contaminated and contaminated wastewater were sent off site to a licensed treatment, storage, and disposal facility (TSDF). The IDW soils were returned to the source area since the analytical data indicated that they were nonhazardous, and that returning the soil to the site posed no additional human health or ecological risk. Appendix F provides information on the management and disposal of the IDW.

SECTION 2.0 TABLES

TABLE 2-1

SUMMARY OF REMEDIAL INVESTIGATION OBJECTIVES
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Medium or Area of Concern	RI Objective	Criteria for Meeting Objective	Investigation/Study
1. Soil	1a. Identify the geologic subsurface boundaries and buried metal at the site.	Characterize subsurface soil and metallic debris depositions.	Geophysical Investigation
	1b. Assess the extent of soil contamination at the former landfill area.	Characterize contaminant levels in surface and subsurface soils at landfill area.	Soil Investigation
	1c. Assess the extent of overland surface runoff to downslope areas.	Characterize contaminant levels in downslope soils along the surrounding hillsides.	Soil Investigation
	1d. Assess the possible migration of buried wastes to subsurface site.	Characterize contaminant levels at areas associated with surficial waste disposal and buried wastes.	Soil Investigation
	1e. Assess human health and ecological risks associated with exposure to surface soils at the site.	Characterize contaminant levels in surface and subsurface soils at the site.	Soil Investigation Risk Assessment
2. Groundwater	2a. Assess health risks posed by potential future usage of both the shallow and deep groundwater.	Evaluate groundwater quality and compare to ARARs and health-based action levels.	Groundwater Investigation Risk Assessment
	2b. Evaluate hydrogeologic characteristics for fate and transport evaluation and remedial technology evaluation, if required.	Estimate hydrogeologic characteristics of the shallow and deep aquifers (flow direction, transmissivity, storativity, etc).	Groundwater Investigation (Field Investigation/ Review of Existing Data)
	2c. Determine whether shallow and deep groundwater is contaminated with site-related constituents.	Evaluate groundwater quality and compare to ARARs.	Groundwater Investigation
3. Sediment	3a. Assess human health and ecological risks associated with exposure to contaminated sediments.	Characterize the nature and extent of contamination in sediment.	Sediment Investigation in both the Unnamed and Tank Creeks Risk Assessment

TABLE 2-1 (Continued)

SUMMARY OF REMEDIAL INVESTIGATION OBJECTIVES
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Medium or Area of Concern	RI Objective	Criteria for Meeting Objective	Investigation/Study
	3b. Assess potential ecological impacts posed by contaminated sediments.	Qualitatively evaluate stress to benthic and fish communities.	Sediment Investigation in both the Unnamed and Tank Creeks
	3c. Determine the extent of sediment contamination for purposes of identifying areas potentially requiring remediation.	Identify extent of sediment contamination where contaminant levels exceed risk-based action levels or EPA Region IV TBCs for sediment.	Sediment Investigation in both the Unnamed and Tank Creeks Risk Assessment
4. Surface Water	4a. Assess the presence or absence of surface water contamination in both the unnamed and tank creek.	Determine surface water quality in both the unnamed and tank creeks.	Surface Water Investigation
	4b. Assess potential ecological impacts posed by contaminated surface water.	Qualitatively evaluate stress to benthic and fish communities.	Surface Water Investigation in both the Unnamed and Tank Creeks

TABLE 2-2

SUMMARY OF REMEDIAL INVESTIGATION OBJECTIVES
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Medium or Area of Concern	RI Objective	Criteria for Meeting Objective	Investigation/Study
1. Soil	1a. Identify the former grease pit geologic subsurface soil boundaries and buried metal at the site.	Characterize the contaminant levels in surface and subsurface soils.	Geophysical Investigation at the Grease Pit Disposal Area
	1b. Assess the horizontal and vertical extent of soil contamination at both the pit disposal area and former pest control area.	Characterize contaminant levels in surface and subsurface soils.	Soil Investigation
	1c. Assess the extent of surface soil runoff from Site 74 off site.	Characterize contaminant levels in surface soils.	Soil Investigation
	1d. Assess the possible migration of buried wastes to subsurface soils.	Characterize contaminant levels at areas associated with surficial waste disposal and buried wastes.	Soil Investigation
	1e. Assess human health and ecological risks associated with exposure to surface soils at both the grease pit disposal and former pest control areas.	Characterize contaminant levels in surface and subsurface soils.	Soil Investigation Risk Assessment
2. Groundwater	2a. Assess health risks posed by potential future usage of the shallow groundwater.	Evaluate groundwater quality and compare to ARARs and health-based action levels.	Groundwater Investigation Risk Assessment
	2b. Evaluate hydrogeologic characteristics for fate and transport evaluation and remedial technology evaluation, if required.	Estimate hydrogeologic characteristics of the shallow aquifer (flow direction, transmissivity, storativity, etc).	Groundwater Investigation (Field Investigation/ Review of existing data)
	2c. Determine whether shallow groundwater is contaminated with site related constituents.	Evaluate groundwater quality and compare to ARARs.	Groundwater Investigation

TABLE 2-2 (Continued)

SUMMARY OF REMEDIAL INVESTIGATION OBJECTIVES
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Medium or Area of Concern	RI Objective	Criteria for Meeting Objective	Investigation/Study
3. Sediment	3a. Assess human health and ecological risks associated with exposure to contaminated sediments.	Characterize the nature and extent of contamination in sediment.	Sediment Investigation in Henderson Pond Risk Assessment
	3b. Assess potential ecological impacts posed by contaminated sediments.	Qualitatively evaluate stress to benthic and fish communities.	Sediment Investigation
	3c. Determine the extent of sediment contamination for purposes of identifying areas of possible remediation.	Identify extent of sediment contamination where contaminant levels exceed risk-based action levels or EPA Region IV TBCs for sediment.	Sediment Investigation Risk Assessment
4. Surface Water	4a. Assess the presence or absence of surface water contamination in Henderson Pond.	Determine surface water quality in Henderson Pond.	Surface Water Investigation
	4b. Assess potential ecological impacts posed by contaminated surface water.	Qualitatively evaluate stress to benthic and fish communities.	Surface Water Investigation
	4c. Assess the potential direct contact with surface water by recreational users and wildlife.	Evaluate surface water quality in Henderson Pond.	Surface Water Investigation

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-OS-SB01	13.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
		9.0 - 11.0	X	X	X	X	X	X	X	X	X			
41-OS-SB02	9.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			(3)
		0.0 - 1.0	X	X	X	X	X	X	X	X	X			(2)
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
		5.0 - 7.0	X	X	X	X	X	X	X	X	X			
41-OS-SB03	5.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB04	9.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
		5.0 - 7.0	X	X	X	X	X	X	X	X	X			
41-OS-SB05	5.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB-06	9.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		5.0 - 7.0	X	X	X	X	X	X	X	X	X			

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-OS-SB07	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
41-OS-SB08	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB09	3.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-OS-SB10	5.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		0.0 - 1.0	X	X	X	X	X	X	X	X	X			(2)
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB11	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB12	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
41-OS-SB13	3.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-OS-SB14	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-OS-SB15	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
41-OS-SB16	5.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB17	9.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
41-OS-SB18	4.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			[3]
		0.0 - 1.0	X	X	X	X	X	X	X	X	X			[2]
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB19	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB20	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-OS-SB21	5.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-OS-SB22	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		5.0 - 7.0	X	X	X	X	X	X	X	X	X			
41-OS-SB23	3.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
41-OS-SB24	7.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
		1.0 - 3.0	X	X	X	X	X	X	X	X	X			
		3.0 - 5.0	X	X	X	X	X	X	X	X	X			
41-OS-SB25	3.5	0.0 - 1.0	X	X	X	X								
		2.5 - 3.5	X	X	X	X								
41-OS-SB26	1.5	0.0 - 1.0	X	X	X	X								
		1.0 - 1.5	X	X	X	X								
41-OS-SB27	3.5	0.0 - 1.0	X	X	X	X								
		2.5 - 3.5	X	X	X	X								
41-OS-SB28	3.5	0.0 - 1.0	X	X	X	X								
		2.0 - 3.1	X	X	X	X								
41-OS-SB29	3.1	0.0 - 1.0	X	X	X	X								
		2.0 - 3.1	X	X	X	X								

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-OS-SB30	3.0	0.0 - 1.0	X	X	X	X								
		2.0 - 3.0	X	X	X	X								
41-OS-SB31	3.0	0.0 - 1.0	X	X	X	X								
		2.0 - 3.0	X	X	X	X								
41-OS-SB32	3.5	0.0 - 1.0	X	X	X	X								
		2.5 - 3.5	X	X	X	X								[3]
		2.5 - 3.5	X	X	X	X								[2]
41-OS-SB33	2.0	0.0 - 1.0	X	X	X	X								
		1.0 - 2.0	X	X	X	X								
41-OS-SB34	3.0	0.0 - 1.0	X	X	X	X								
		2.0 - 3.0	X	X	X	X								
41-DS-SB01	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB02	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB03	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			[3]
		0.0 - 1.0	X	X	X	X	X	X	X	X	X			[2]
41-DS-SB04	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB05	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-DS-SB06	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB07	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB08	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			(3)
		0.0 - 1.0	X	X	X	X	X	X	X	X	X			(2)
41-DS-SB09	1.0	0.0 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB10	1.0	0.0 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB11	1.0	0.0 1.0	X	X	X	X	X	X	X	X	X			
41-DS-SB12	1.0	0.0 1.0	X	X	X	X	X	X	X	X	X			
41-BB-SB01	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-BB-SB02	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-BB-SB03	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-BB-SB04	1.0	0.0 - 1.0	X	X	X	X	X	X	X	X	X			
41-GW04DW	42.0	0.0 - 2.0	X	X	X	X								
		2.0 - 4.0	X	X	X	X								
41-GW06DW	42.0	2.0 - 4.0	X	X	X	X								
		4.0 - 6.0	X	X	X	X								

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters(1)	Comments
41-GW07	21.0	0.0 - 2.0	X	X	X	X								(3)
		0.0 - 2.0	X	X	X	X								(2)
		6.0 - 8.0	X	X	X	X								(3)
		6.0 - 8.0	X	X	X	X								(2)
41-GW07DW	45.0	2.0 - 4.0	X	X	X	X								
		2.0 - 4.0	X	X	X	X								(2)
		10.0 - 12.0	X	X	X	X								
		10.0 - 12.0	X	X	X	X								(2)
41-GW08	16.0	0.0 - 2.0	X	X	X	X								
		2.0 - 4.0	X	X	X	X								
41-GW09	21.0	2.0 - 4.0	X	X	X	X								
		6.0 - 8.0	X	X	X	X								
41-GW09DW	45.0	2.0 - 4.0	X	X	X	X								
		9.0 - 11.0	X	X	X	X								
41-GW10	14.0	0.0 - 2.0	X	X	X	X						X	X	
41-GW11	16.0	0.0 - 2.0	X	X	X	X								
		4.0 - 6.0	X	X	X	X						X	X	
41-GW11DW	52.0	0.0 - 2.0	X	X	X	X								
		10. 0 - 12.0	X	X	X	X								

TABLE 2-3

SOIL SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
41-GW12	17.0	0.0 - 2.0	X	X	X	X								
		2.0 - 4.0	X	X	X	X								
41-GW12DW	40.0	2.0 - 4.0	X	X	X	X								
		4.0 - 6.0	X	X	X	X								
41-GW13	18.0	0.0 - 2.0	X	X	X	X								
		4.0 - 6.0	X	X	X	X								

Notes: [1] Engineering Parameters includes Particle Size and Atterberg limits
[2] Duplicate
[3] MS/MSD

TABLE 2-4

SUMMARY OF FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLING PROGRAM FOR THE SOIL INVESTIGATION SITE 41 REMEDIAL INVESTIGATION, CTO-0212 MCB CAMP LEJEUNE, NORTH CAROLINA

QA/QC Sample[1]	Frequency of Collection	Number of Samples	Analytical Parameters [3]
Trip Blanks[2]	One per Cooler	7	TCL Volatiles
Field Blanks[4]	One per Event	0	TCL Organics/TAL Inorganics/ CSM/Thiodiglycol/Mirex/ Ordnance/Cyanide
Equipment Rinsates[5]	One per Day	4	TCL Organics/TAL Inorganics/ CSM/Thiodiglycol/Mirex/ Ordnance/Cyanide
Field Duplicates	10% of Sample Frequency	10	TCL Organics/TAL Inorganics/ CSM/Thiodiglycol/Mirex/ Ordnance/Cyanide

Notes:
(1) QA/QC sample types defined in Section 2.2.2.1 in text.
(2) Trip blanks submitted with coolers which contained samples for volatile analysis. Samples analyzed for TCL volatiles only.
(3) Parameters analyzed according to CLP Protocol.
(4) Field blank collected during Site 69 investigation.
(5) Equipment rinsates collected from various sampling equipment (e.g., split spoons, stainless steel spoons, hollow stem augers, etc.). Note that samples were collected daily but were analyzed every other day of sampling event. Accordingly, the number of samples presented represents the number of samples analyzed.

TABLE 2-5

SUMMARY OF WELL CONSTRUCTION DETAILS
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Date Installed	Top of PVC Casing Elevation (feet, above msl)(1)	Ground Surface Elevation (feet, above msl)	Boring Depth (feet, below ground surface)	Well Depth (feet, below ground surface)	Screen Interval Depth (feet, below ground surface)	Sand Pack Interval Depth (feet, below ground surface)	Bentonite Interval Depth (feet, below ground surface)	Stick-Up (feet, above ground surface)
41-GW04DW	02/08/94	12.89	10.30	42.0	40.0	30.0 - 40.0	28.0 - 42.0	26.0 - 28.0	2.59
41-GW06DW	02/16/94	25.31	22.70	42.0	40.0	30.0 - 40.0	28.0 - 42.0	26.0 - 28.0	2.61
41-GW07	02/05/94	22.73	20.50	21.0	20.5	10.5 - 20.5	9.0 - 21.0	6.0 - 9.0	2.23
41-GW07DW	02/06/94	22.88	20.50	45.0	44.0	34.0 - 44.0	32.0 - 45.0	30.0 - 32.0	2.38
41-GW08	02/07/94	19.48	17.10	16.0	15.0	5.0 - 15.0	3.0 - 16.0	0.5 - 3.0	2.38
41-GW09	02/02/94	25.98	24.00	21.0	21.0	11.0 - 21.0	8.5 - 21.0	6.5 - 8.5	1.98
41-GW09DW	02/03/94	26.95	24.00	46.0	45.0	35.0 - 45.0	32.5 - 46.0	30.0 - 32.5	2.95
41-GW10	02/04/94	13.93	12.10	14.0	13.0	3.0 - 13.0	1.5 - 14.0	0.5 - 1.5	1.83
41-GW11	02/06/94	24.69	21.50	16.0	15.0	5.0 - 15.0	3.0 - 16.0	0.5 - 3.0	3.19
41-GW11DW	02/07/94	23.63	21.50	52.0	50.0	40.0 - 50.0	37.0 - 52.0	35.0 - 37.0	2.13
41-GW12	02/08/94	8.41	6.40	17.0	16.0	6.0 - 16.0	4.0 - 17.0	2.0 - 4.0	2.01
41-GW12DW	02/15/94	9.08	6.50	40.0	37.0	27.0 - 37.0	25.0 - 40.0	22.5 - 25.0	2.58
41-GW13	02/08/94	16.19	13.80	18.0	17.0	7.0 - 17.0	5.0 - 18.0	2.0 - 5.0	2.39

Notes: (1) msl - mean sea level
Horizontal positions are referenced to N.C. State Plane Coordinate System (NAD 27) CF = 0.9999163 from NCGS Two Way.
Vertical datum NGVD 29.

TABLE 2-6

SUMMARY OF FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLING PROGRAM FOR THE GROUNDWATER SAMPLING SITE 41 REMEDIAL INVESTIGATION, CTO-0212 MCB CAMP LEJEUNE, NORTH CAROLINA

QA/QC Sample(1)	Frequency of Collection	Number of Samples	Analytical Parameters(3)
Trip Blanks(2)	One per Cooler	4	TCL Volatiles
Field Blanks(4)	One per Event	0	TCL Organics/TAL Inorganics
Equipment Rinsates(5)	One per Day	3	TCL Organics/TAL Inorganics
Field Duplicates	10% of Sample Frequency	2	TCL Organics/TAL Inorganics

Notes:
(1) QA/QC sample types defined in Section 2.2.2.1 in text.
(2) Trip blanks submitted with coolers which contained samples for volatile analysis. Samples analyzed for volatiles only.
(3) Volatiles analyzed according to EPA Method 524.2; all other parameters analyzed according to CLP Protocol.
(4) Note field blanks were collected during the soil investigation at Site 69.
(5) Equipment rinsates collected from various sampling equipment (e.g., bailer). Note that samples were collected daily but were analyzed every other day of sampling event. Accordingly, the number of samples presented represents the number of samples analyzed.

TABLE 2-7

SEDIMENT SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters	Comments
41-UN-SD01	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD02	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD03	1.0	0.0 - 0.5	X	X	X	X			X	X				(2)
		0.0 - 0.5	X	X	X	X			X	X				(1)
		0.5 - 1.0	X	X	X	X			X	X				(2)
		0.5 - 1.0	X	X	X	X			X	X				(1)
41-UN-SD04	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-NE-SD05	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-TC-SD06	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-TC-SD07	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				

TABLE 2-7

SEDIMENT SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters	Comments
41-TC-SD08	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-TC-SD09	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD10	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD11	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD12	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD13	1.0	0.0 - 0.5	X	X	X	X			X	X				
		0.5 - 1.0	X	X	X	X			X	X				
41-UN-SD14	1.0	0.0 - 0.5	X	X	X	X			X	X				(2)
		0.0 - 0.5	X	X	X	X			X	X				(1)
		0.5 - 1.0	X	X	X	X			X	X				(2)
		0.5 - 1.0	X	X	X	X			X	X				(1)
41-UN-SD15	0.5	0.0 - 0.5			X	X								
41-UN-SD16	0.5	0.0 - 0.5			X	X								
41-UN-SD17	0.5	0.0 - 0.5			X	X								
41-UN-SD18	0.5	0.0 - 0.5			X	X								
41-UN-SD19	0.5	0.0 - 0.5			X	X								

TABLE 2-7

SEDIMENT SAMPLING SUMMARY
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodiglycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters	Comments
41-UN-SD20	0.5	0.0 - 0.5			X	X								
41-UN-SD21	0.5	0.0 - 0.5			X	X								
41-UN-SD22	0.5	0.0 - 0.5			X	X								
41-UN-SD23	0.5	0.0 - 0.5			X	X								
41-UN-SD24	0.5	0.0 - 0.5			X	X								
41-UN-SD25	0.5	0.0 - 0.5			X	X								
41-UN-SD26	0.5	0.0 - 0.5			X	X								
41-UN-SD27	0.5	0.0 - 0.5			X	X								
41-UN-SD28	0.5	0.0 - 0.5			X	X								

Notes: (1) Duplicate
(2) MS/MSD

TABLE 2-8

SUMMARY OF FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLING PROGRAM FOR THE SURFACE WATER AND SEDIMENT INVESTIGATION SITE 41 REMEDIAL INVESTIGATION, CTO-0212 MCB CAMP LEJEUNE, NORTH CAROLINA

QA/QC Sample[1]	Frequency of Collection	Number of Samples	Analytical Parameters[3]
Trip Blanks[2]	One per Cooler	7	TCL Volatiles
Equipment Rinsates[4]	One per Day	2	TCL Organics/TAL Inorganics/ Mirex/Ordnance
Field Duplicates	10% of Sample Frequency	5	TCL Organics/TAL Inorganics/ Mirex/Ordnance

Notes:
(1) QA/QC sample types defined in Section 2.2.2.1 in text.
(2) Trip blanks submitted with coolers which contained samples for volatile analysis. Samples analyzed for TCL volatiles only.
(3) Parameters analyzed according to CLP Protocol.
(4) Equipment rinsates collected from various sampling equipment (e.g., split spoons, stainless steel spoons, hollow stem augers, etc.). Note that samples were collected daily but were analyzed every other day of sampling event. Accordingly, the number of samples presented represents the number of samples analyzed.

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
74-FDA-SB01	11.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
74-FDA-SB02	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB03	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
		11.0 - 13.0	X	X	X	X	X	X			X			
74-FDA-SB04	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB05	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB06	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB07	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB08	15.0	0.0 - 1.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
		11.0 - 13.0	X	X	X	X	X	X			X			
74-FDA-SB09	11.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters(1)	Comments
74-FDA-SB10	17.0	0.0 - 1.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
		13.0 - 15.0	X	X	X	X	X	X			X			
74-FDA-SB11	13.0	0.0 - 1.0	X	X	X	X	X	X			X			(3)
		0.0 - 1.0	X	X	X	X	X	X			X			(2)
		3.0 - 5.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB12	15.0	0.0 - 1.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
		11.0 - 13.0	X	X	X	X	X	X			X			
74-FDA-SB13	11.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
74-FDA-SB14	19.0	0.0 - 1.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
		15.0 - 17.0	X	X	X	X	X	X			X			
74-FDA-SB15	17.0	0.0 - 1.0	X	X	X	X	X	X			X			(3)
		0.0 - 1.0	X	X	X	X	X	X			X			(2)
		5.0 - 7.0	X	X	X	X	X	X			X			
		13.0 - 15.0	X	X	X	X	X	X			X			
74-FDA-SB16	15.0	0.0 - 1.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
		11.0 - 13.0	X	X	X	X	X	X			X			
74-FDA-SB17	11.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		5.0 -7.0	X	X	X	X	X	X			X			

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
74-FDA-SB18	11.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
74-FDA-SB19	13.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		9.0 - 11.0	X	X	X	X	X	X			X			
74-FDA-SB20	19.0	0.0 - 1.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
		15.0 - 17.0	X	X	X	X	X	X			X			
74-FDA-SB21	9.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
74-FDA-SB22	9.0	0.0 - 1.0	X	X	X	X	X	X			X			
		0.0 - 1.0	X	X	X	X	X	X			X			(2)
		1.0 - 3.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
74-FDA-SB23	9.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
74-FDA-SB24	11.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		7.0 - 9.0	X	X	X	X	X	X			X			
74-FDA-SB25	9.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters(1)	Comments
74-FDA-SB26	9.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
74-FDA-SB27	7.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
74-FDA-SB28	9.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
74-FDA-SB29	5.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
74-FDA-SB30	5.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
74-FDA-SB31	7.0	0.0 - 1.0	X	X	X	X	X	X			X			
		1.0 - 3.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
74-FDA-SB32	7.0	0.0 - 1.0	X	X	X	X	X	X			X			
		3.0 - 5.0	X	X	X	X	X	X			X			
		5.0 - 7.0	X	X	X	X	X	X			X			
74-FDA-SB33	1.0	0.0 - 1.0	X	X	X	X	X	X			X			(3)
		0.0 - 1.0	X	X	X	X	X	X			X			(2)
74-FDS-SB34	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-FDS-SB35	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-FDS-SB36	1.0	0.0 - 1.0	X	X	X	X	X	X			X			

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
74-FDS-SB37	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-BB-SB01	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-BB-SB02	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-BB-SB03	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-BB-SB04	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-GW03A	18.5	4.0 - 6.0	X	X	X	X					X			
		6.0 - 7.0	X	X	X	X					X			
74-GW04	20.0	4.0 - 6.0	X	X	X	X					X			(3)
		4.0 - 6.0	X	X	X	X					X			(2)
		8.0 - 10.0	X	X	X	X					X			
74-GW05	19.0	0.0 - 2.0	X	X	X	X					X			
		6.0 - 8.0	X	X	X	X					X	X	X	
74-GW06	26.0	2.0 - 4.0	X	X	X	X					X			
		8.0 - 10.0	X	X	X	X					X			
74-GW07	17.0	0.0 - 2.0	X	X	X	X					X			
		2.0 - 4.0	X	X	X	X					X			
74-GW08	24.0	4.0 - 6.0	X	X	X	X					X			
		10.0 - 12.0	X	X	X	X					X			
74-FPA-SB01	17.0	0.0 - 1.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
		13.0 - 15.0	X	X	X	X					X			
74-FPA-SB02	17.0	0.0 - 1.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
		11.0 - 13.0	X	X	X	X					X			

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters(1)	Comments
74-FPA-SB03	15.0	0.0 - 1.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
		11.0 - 13.0	X	X	X	X					X			
74-FPA-SB04	19.0	0.0 - 1.0	X	X	X	X					X			
		7.0 - 9.0	X	X	X	X					X			
		15.0 - 17.0	X	X	X	X					X			
74-FPA-SB05	15.0	0.0 - 1.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
		11.0 - 13.0	X	X	X	X					X			
74-FPA-SB06	13.0	0.0 - 1.0	X	X	X	X					X			(3)
		0.0 - 1.0	X	X	X	X					X			(2)
		5.0 - 7.0	X	X	X	X					X			
		9.0 - 11.0	X	X	X	X					X			
74-FPA-SB07	17.0	0.0 - 1.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
		13.0 - 15.0	X	X	X	X					X			
74-FPA-SB08	17.0	0.0 - 1.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
		13.0 - 15.0	X	X	X	X					X			
74-FPA-SB09	17.0	0.0 - 1.0	X	X	X	X					X			
		7.0 - 9.0	X	X	X	X					X			
		13.0 - 15.0	X	X	X	X					X			
74-PDA-SB01	7.0	0.0 - 1.0	X	X	X	X					X			
		1.0 - 3.0	X	X	X	X					X			
		3.0 - 5.0	X	X	X	X					X			

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters(1)	Comments
74-PDA-SB02	9.0	0.0 - 1.0	X	X	X	X					X			
		1.0 - 3.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
74-PDA-SB03	11.0	0.0 - 1.0	X	X	X	X					X			
		3.0 - 5.0	X	X	X	X					X			
		7.0 - 9.0	X	X	X	X					X			
74-PDA-SB04	15.0	0.0 - 1.0	X	X	X	X					X			
		9.0 - 11.0	X	X	X	X					X			
		9.0 - 11.0	X	X	X	X					X			(2)
		11.0 - 13.0	X	X	X	X					X			
74-PDA-SB05	9.0	0.0 - 1.0	X	X	X	X					X			
		1.0 - 3.0	X	X	X	X					X			
		5.0 - 7.0	X	X	X	X					X			
74-PDA-SB06	11.0	0.0 - 1.0	X	X	X	X					X			(3)
		0.0 - 1.0	X	X	X	X					X			(2)
		3.0 - 5.0	X	X	X	X					X			
		7.0 - 9.0	X	X	X	X					X			
74-PDA-SB07	13.0	0.0 - 1.0	X	X	X	X					X			
		1.0 - 3.0	X	X	X	X					X			
		9.0 - 11.0	X	X	X	X					X			
74-PDA-SB08	11.0	0.0 - 1.0	X	X	X	X					X			
		3.0 - 5.0	X	X	X	X					X			
		7.0 - 9.0	X	X	X	X					X			
74-PDA-SB09	15.0	0.0 - 1.0												
		5.0 - 7.0												
		11.0 - 13.0												

TABLE 2-9

SOIL SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals	CSM (Deg. Products)	Thiodi-glycol	Mirex	Ordnance	Cyanide	TOC	Engineering Parameters[1]	Comments
74-PDA-SB10	19.0	0.0 - 1.0												
		7.0 - 9.0												
		15.0 - 17.0												
74-PDA-SB11	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-PDA-SB12	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-PDA-SB13	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-PDA-SB14	1.0	0.0 - 1.0	X	X	X	X	X	X			X			
74-PDA-SB15	1.0	0.0 - 1.0	X	X	X	X	X	X			X			

Notes: [1] Engineering Parameters includes Particle Size and Atterberg limits
[2] Duplicate
[3] MS/MSD

TABLE 2-10

SUMMARY OF FIELD QUALITY ASSURANCE/QUALITY CONTROL
SAMPLING PROGRAM FOR THE SOIL INVESTIGATION
SITE 74
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

QA/QC Sample[1]	Frequency of Collection	Number of Samples	Analytical Parameters [3]
Trip Blanks[2]	One per Cooler	17	TCL Volatiles
Field Blanks[4]	One per Event	0	TCL Organics/TAL Inorganics/ CSM/Thiodyglycol
Equipment Rinsates[5]	One per Day	6	TCL Organics/TAL Inorganics/ CSM/Thiodyglycol
Field Duplicates	10% of Sample Frequency	8	TCL Organics/TAL Inorganics/ CSM/Thiodyglycol

Notes:
(1) QA/QC sample types defined in Section 2.2.2.1 in text.
(2) Trip blanks submitted with coolers which contained samples for volatile analysis. Samples analyzed for TCL volatiles only.
(3) Parameters analyzed according to CLP Protocol.
(4) Field blank collected during Site 69 investigation.
(5) Equipment rinsates collected from various sampling equipment (e.g., split spoons, stainless steel spoons, hollow stem augers, etc.). Note that samples were collected daily but were analyzed every other day of sampling event. Accordingly, the number of samples presented represents the number of samples analyzed.

TABLE 2-11

SUMMARY OF WELL CONSTRUCTION DETAILS
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Date Installed	Top of PVC Casing Elevation (feet, above msl)(1)	Ground Surface Elevation (feet, above msl)	Boring Depth (feet, below ground surface)	Well Depth (feet, below ground surface)	Screen Interval Depth (feet, below ground surface)	Sand Pack Interval Depth (feet, below ground surface)	Bentonite Interval Depth (feet, below ground surface)	Stick-Up (feet, above ground surface)
74-GW03A	01/18/94	36.14	33.4	18.5	18.0	8.0 - 18.0	6.0 - 18.5	4.0 - 6.0	2.74
74-GW04	01/18/94	35.37	32.7	20.0	19.5	9.5 - 19.5	7.5 - 20.0	4.5 - 7.5	2.67
74-GW05	01/11/94	34.30	32.8	19.0	16.5	6.0 - 16.5	4.5 - 19.0	0.0 - 4.5	1.50
74-GW06	01/11/94	33.12	31.6	26.0	26.0	15.5 - 26.0	12.0 - 26.0	9.5 - 12.0	1.52
74-GW07	02/18/94	34.52	32.4	17.0	16.5	6.5 - 16.5	3.5 - 17.0	1.5 - 3.5	2.12
74-GW08	02/18/94	30.55	28.4	24.0	23.0	13.0 - 23.0	11.0 - 24.0	9.0 - 11.0	2.15

Notes: (1) msl - mean sea level
Horizontal positions are referenced to N.C. State Plane Coordinate System (NAD 27) CF = 0.9999216 from USMC Monument Toney.
Vertical datum NGVD 29.

TABLE 2-12

SUMMARY OF FIELD QUALITY ASSURANCE/QUALITY CONTROL
SAMPLING PROGRAM FOR THE GROUNDWATER INVESTIGATION
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

QA/QC Sample[1]	Frequency of Collection	Number of Samples	Analytical Parameters[3]
Trip Blanks[2]	One per Cooler	3	TCL Volatiles
Field Blanks[4]	One per Event	0	TCL Organics/TAL Inorganics
Equipment Rinsates[5]	One per Day	2	TCL Organics/TAL Inorganics
Field Duplicates	10% of Sample Frequency	1	TCL Organics/TAL Inorganics

Notes:
(1) QA/QC sample types defined in Section 2.2.2.1 in text.
(2) Trip blanks submitted with coolers which contained samples for volatile analysis. Samples analyzed for volatiles only.
(3) Volatiles analyzed according to EPA Method 524.2; all other parameters analyzed according to CLP Protocol.
(4) Note field blanks were collected during the soil investigation at Site 69.
(5) Equipment rinsates collected from various sampling equipment (e.g., bailer). Note that samples were collected daily but were analyzed every other day of sampling event. Accordingly, the number of samples presented represents the number of samples analyzed.

TABLE 2-13

SEDIMENT SAMPLING SUMMARY
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Depth of Borehole (feet, bgs)	Sampling Interval (feet, bgs)	TCL VOAs	TCL SVOAs	TCL Pest./PCBs	TAL Metals
74-PDA-SD01	0.5	0.0 - 0.5	X	X	X	X
74-PDA-SD02	0.5	0.0 - 0.5	X	X	X	X
74-PDA-SD03	0.5	0.0 - 0.5	X	X	X	X

TABLE 2-14

SUMMARY OF FIELD QUALITY ASSURANCE/QUALITY CONTROL
SAMPLING PROGRAM FOR THE SURFACE WATER AND SEDIMENT INVESTIGATION
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

QA/QC Sample[1]	Frequency of Collection	Number of Samples	Analytical Parameters[3]
Trip Blanks[2]	One per Cooler	1	TCL Volatiles
Equipment Rinsates[4]	One per Day	1	TCL Organics/TAL Inorganics/ Cyanide
Field Duplicates	10% of Sample Frequency	0	TCL Organics/TAL Inorganics/ Cyanide

Notes:
(1) QA/QC sample types defined in Section 2.2.2.1 in text.
(2) Trip blanks submitted with coolers which contained samples for volatile analysis. Samples analyzed for TCL volatiles only.
(3) Parameters analyzed according to CLP Protocol.
(4) Equipment rinsates collected from various sampling equipment (e.g., split spoons, stainless steel spoons, hollow stem augers, etc.). Note that samples were collected daily but were analyzed every other day of sampling event. Accordingly, the number of samples presented represents the number of samples analyzed.

SECTION 2.0 FIGURES

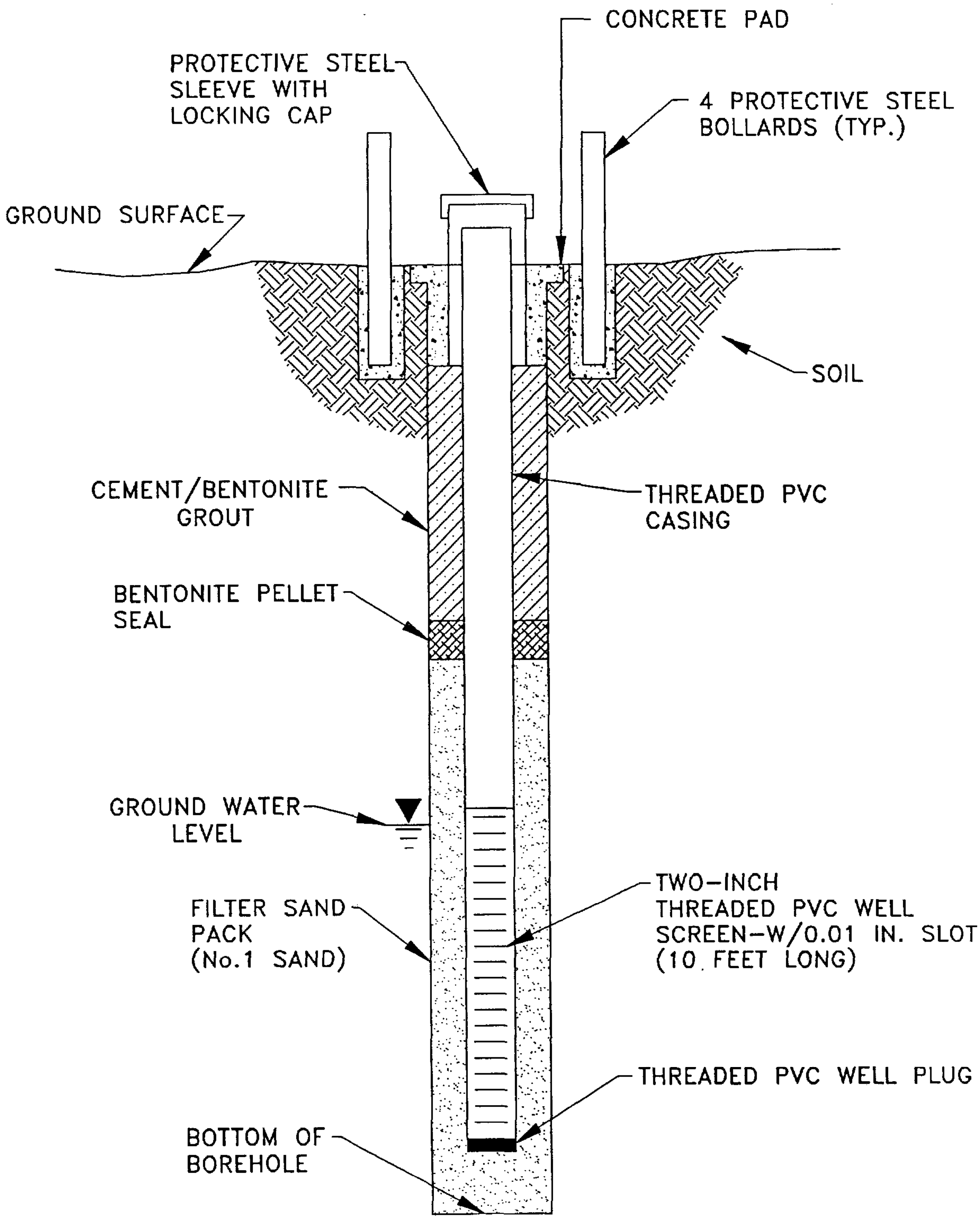


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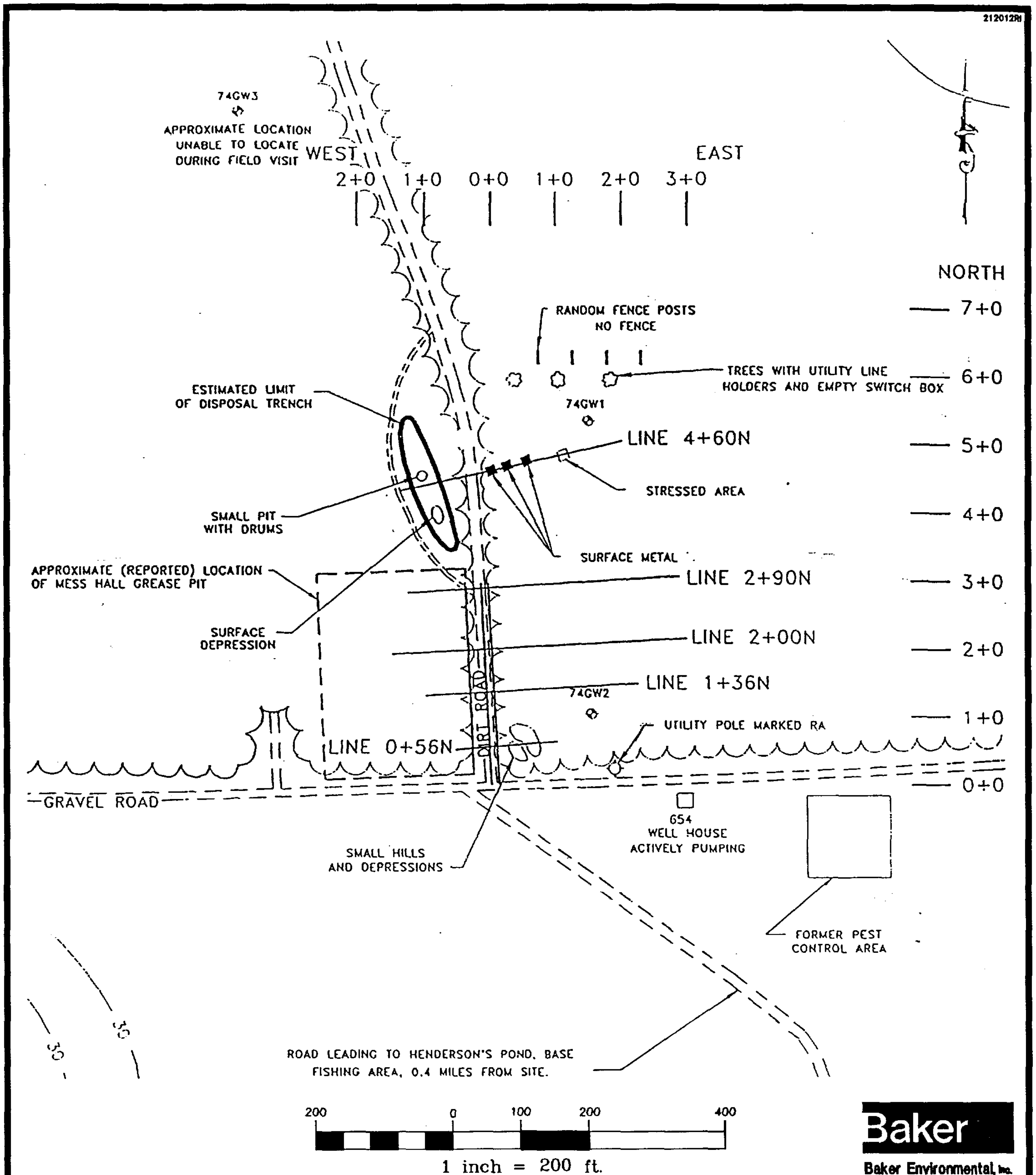
FIGURE 2-4
TYPICAL TYPE II GROUNDWATER
MONITORING WELL CONSTRUCTION DIAGRAM
REMEDIAL INVESTIGATION CTO-0212

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



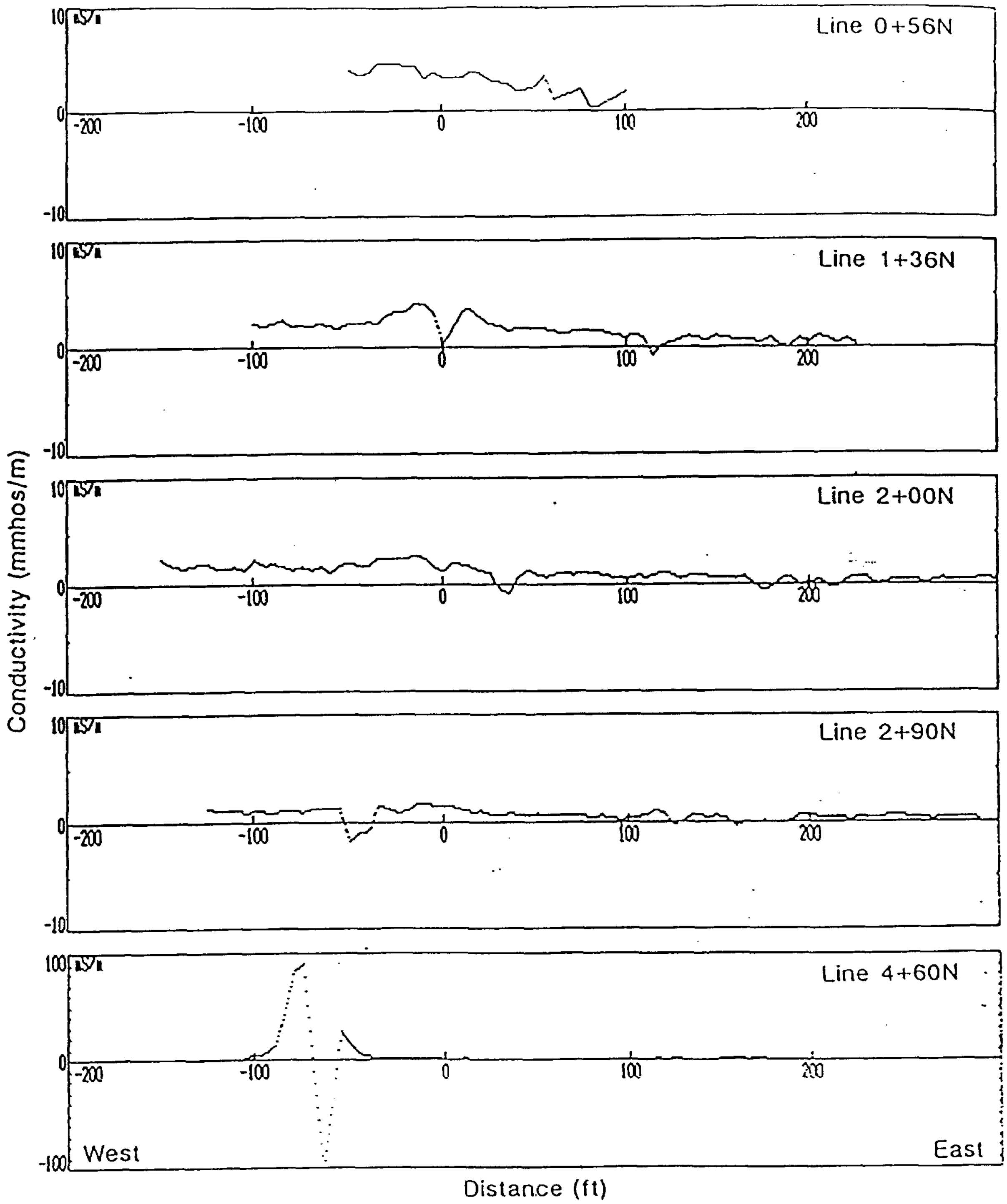
LEGEND

EM AND GPR SURVEY LINE

SOURCE: LANTDIV, FEB. 1992

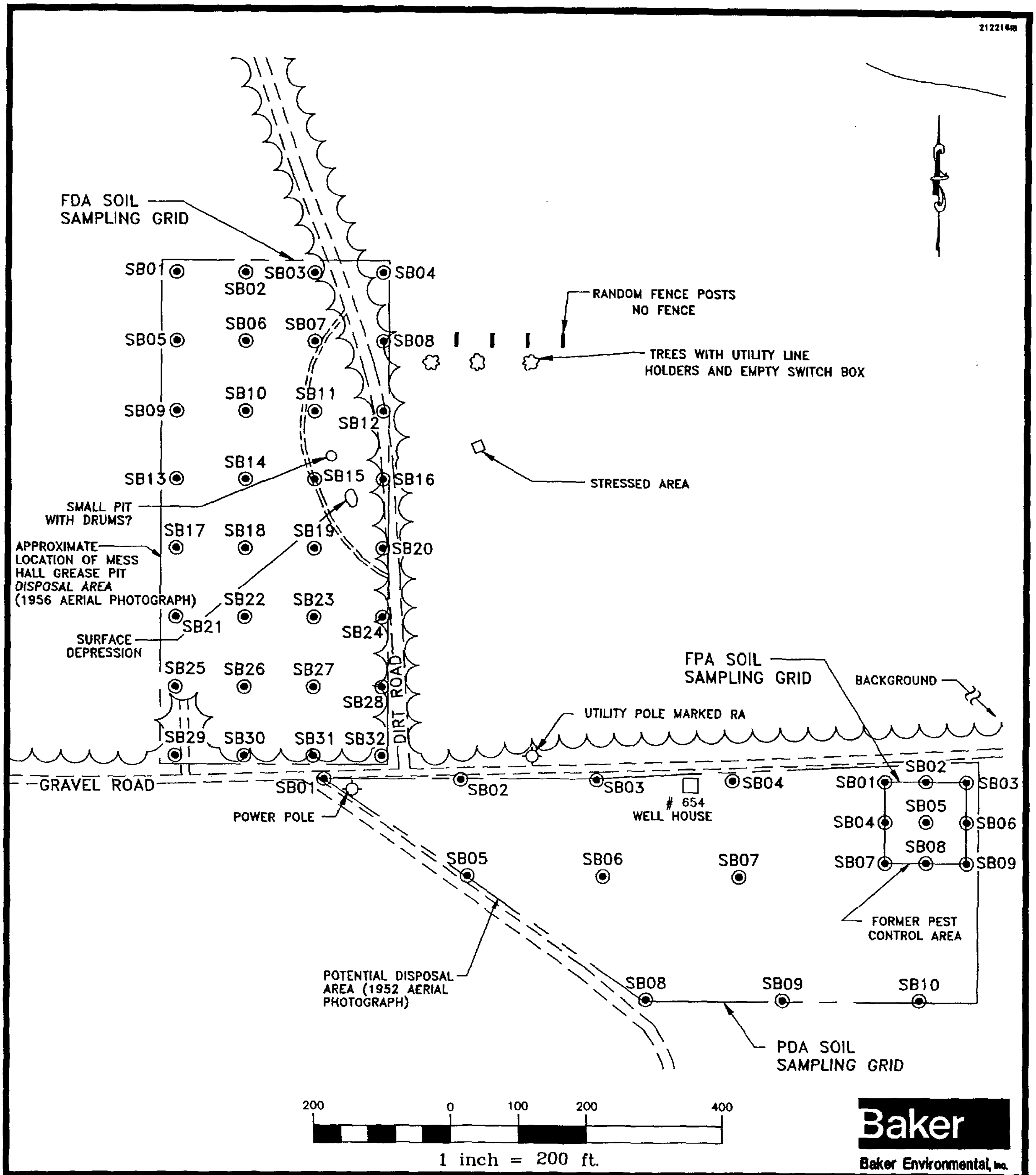
FIGURE 2-7
GEOPHYSICAL GRID RESULTS
SITE 74 – MESS HALL GREASE
PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

212013RI



Baker
Baker Environmental, Inc.

FIGURE 2-8
EM CONDUCTIVITY PROFILE PRINTOUTS
SITE 74 - MESS HALL
GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



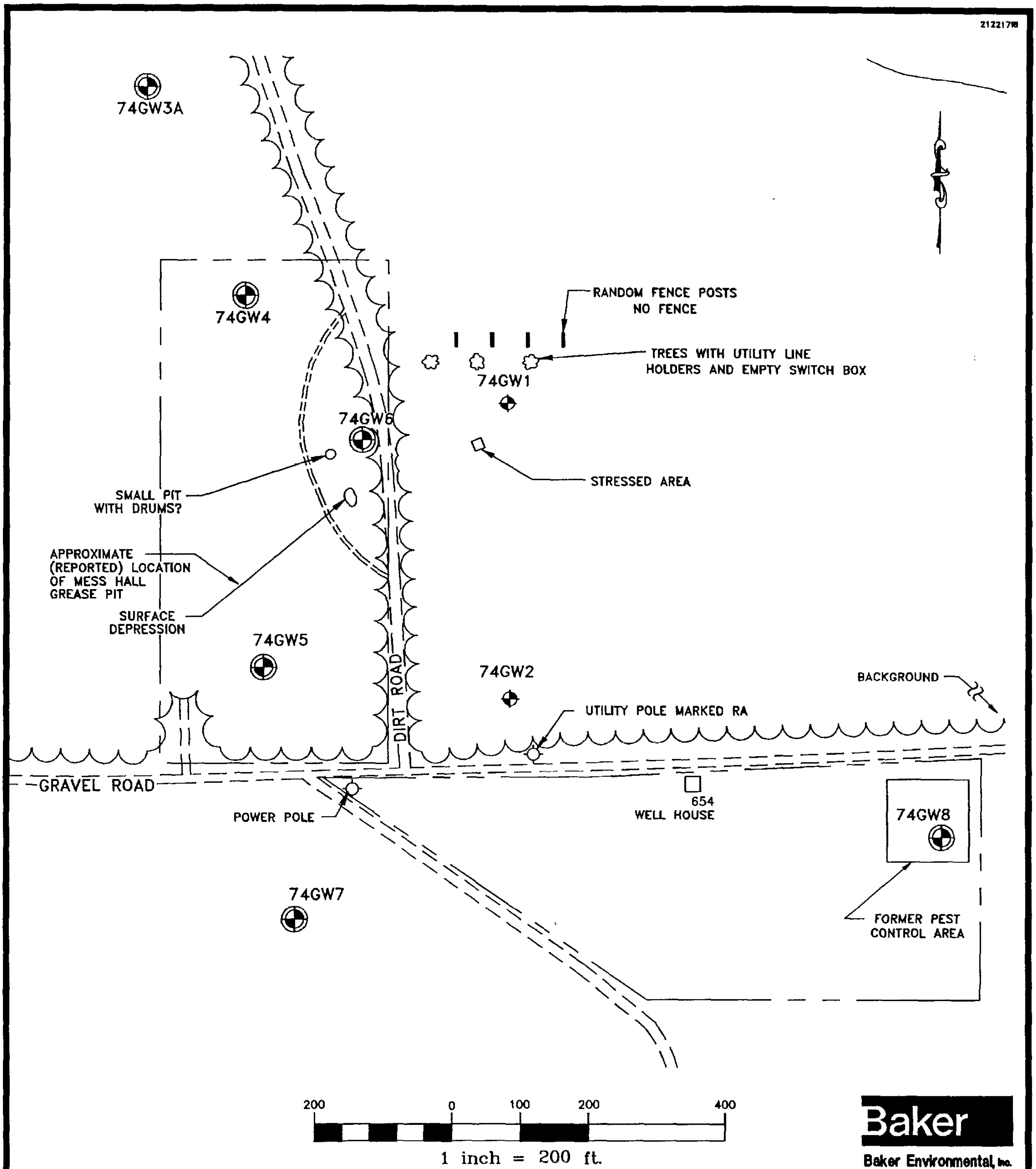
LEGEND

◉ SOIL BORING SAMPLING LOCATIONS

==== ROAD (UNIMPROVED)

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 2-9
PROPOSED SOIL SAMPLING LOCATIONS
SITE 74 – MESS HALL
GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



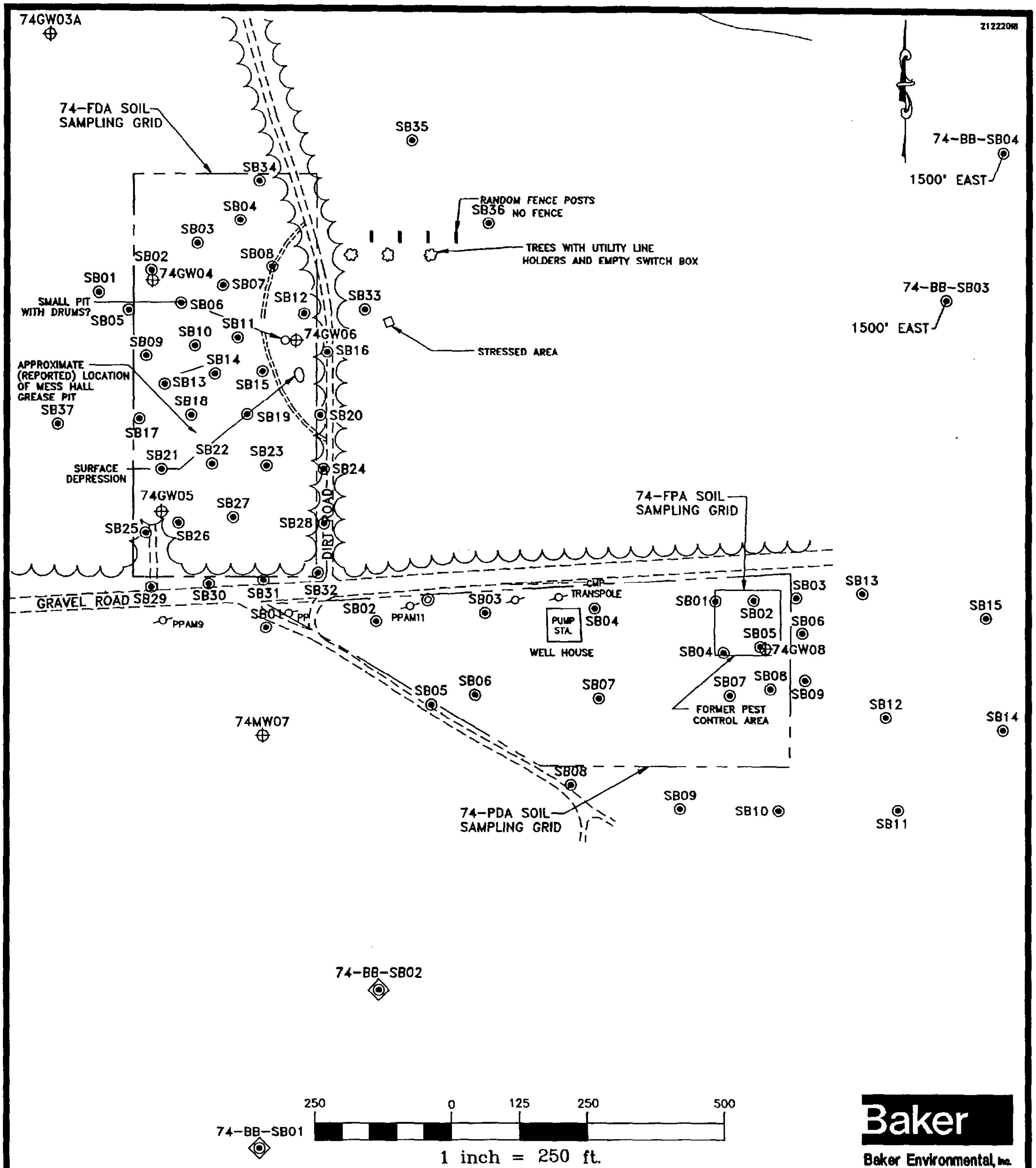
LEGEND

74GW1
- EXISTING SHALLOW WELL

- PROPOSED SHALLOW MONITORING WELL
74GW4

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 2-10
PROPOSED SHALLOW WELL LOCATIONS
SITE 74 - MESS HALL
GREASE DISPOSAL PIT AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

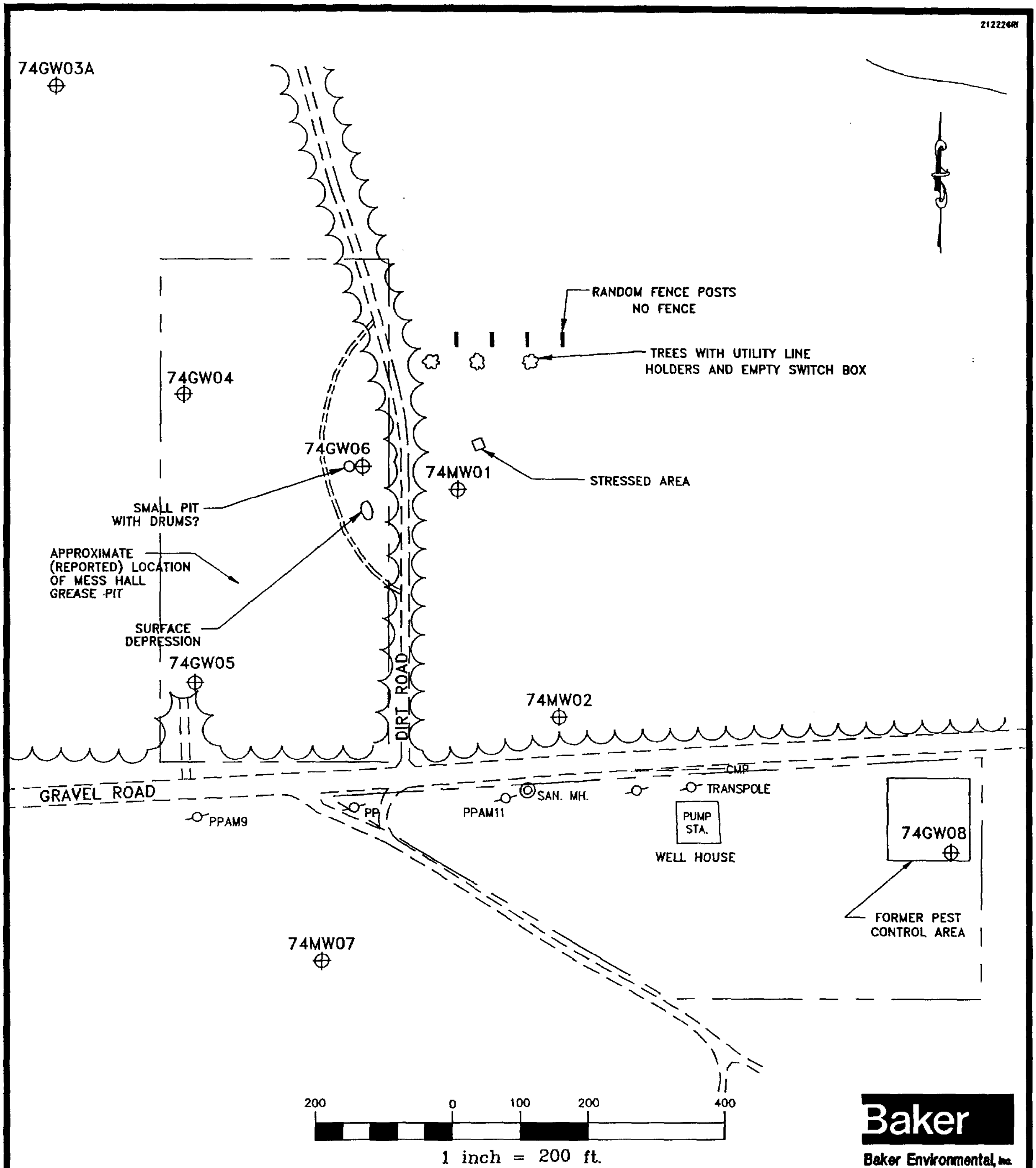


LEGEND

74GW03A	SHALLOW MONITORING WELL LOCATION
SB01	SOIL BORING LOCATION
74-BB-SB02	BACKGROUND SOIL BORING LOCATION

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 2-11
SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

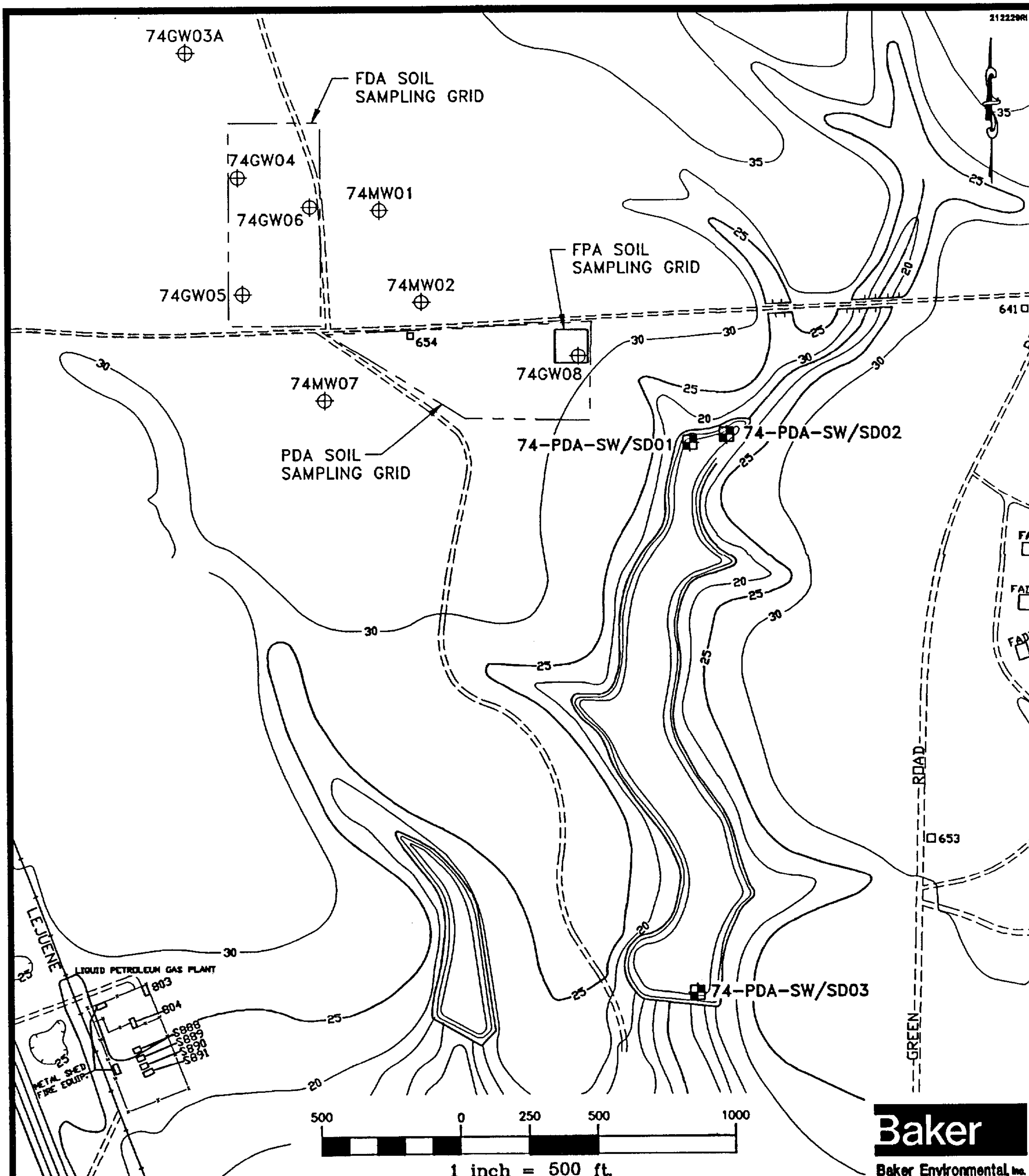


LEGEND

74GW01 SHALLOW MONITORING WELL

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 2-12
SHALLOW MONITORING WELL LOCATIONS
SITE 74 – MESS HALL GREASE
PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74-PDA-SW/SD01	SURFACE WATER/SEDIMENT SAMPLING STATION
30	TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)

SOURCE: LANTDIV, FEB. 1994

FIGURE 2-13
SURFACE WATER/SEDIMENT SAMPLING LOCATIONS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section describes the regional and site-specific environmental setting. A discussion of topography, surface hydrology and drainage, geology, hydrogeology, ecology, land use and demographics, climate/meteorology, and water supplies is presented for MCB, Camp Lejeune and Sites 41 and 74. The tables and figures for Section 3 are contained at the back of the section.

3.1 Topography and Surface Features

The generally flat topography of MCB, Camp Lejeune is typical of the seaward portions of the North Carolina coastal plain. Elevations on the base vary from sea level to 72 feet above mean sea level (msl); however, the elevation of most of MCB, Camp Lejeune is between 20 and 40 feet above msl. All elevations (i.e., topographic and groundwater) are presented as feet, and referenced to mean sea level.

Site 41, the former dump, is situated at a local high area with an elevation of approximately 20 feet msl. The study area itself is relatively flat. The area surrounding the former dump is comprised of moderate to steep hillsides which slope toward the unnamed tributary to the north and east, and to Tank Creek to the south and southwest (refer to Figure 3-1). Site 41 is moderately to lightly wooded. The areas east, south, and west of the site are comprised of swamps.

The land is primarily flat at Site 74. A low area is present at the location of the former grease pit, west of the dirt access road. This low area is occasionally ponded during periods of heavy precipitation. Most of the area is moderately wooded. Henderson Pond is located approximately one quarter mile to the south/southeast of the former pesticide storage/handling area. The pond area is located downgradient from the potential disposal area and the pest control area. Figure 3-2 depicts the surface features for Site 74.

3.2 Surface Water Hydrology

The following summary of surface water hydrology was originally presented in the IAS report (Water and Air Research, 1983).

The dominant surface water feature of MCB, Camp Lejeune is the New River. It receives drainage from most of the base. The New River is short, with a course of approximately 50 miles on the central coastal plain of North Carolina. Over most of its course, the New River is confined to a relatively narrow channel entrenched in the Eocene and Oligocene limestones. South of Jacksonville, the river widens dramatically as it flows across less resistant sands, clays and marls. At MCB, Camp Lejeune, the New River flows in a southerly direction into the Atlantic Ocean through the New River Inlet. Several small coastal creeks drain the area of MCB, Camp Lejeune that are not associated with the New River and its tributaries. These creeks flow into the Intracoastal Waterway, which is connected to the Atlantic Ocean by Bear Inlet, Brown's Inlet, and the New River Inlet. The New River, the Intracoastal Waterway, and the Atlantic Ocean meet at the New River Inlet.

Water quality criteria for surface waters in North Carolina have been published under Title 15 of the North Carolina Administrative Code. At MCB, Camp Lejeune, the New River falls into two classifications: SC (estuarine waters not suited for body contact sports or commercial shellfishing) and SA (estuarine waters suited for commercial shellfishing). The SC classification applies to three areas of the New River at MCB, Camp Lejeune. The area of the New River in the area of the Rifle Range is classified as SC. The rest of the New River at MCB, Camp Lejeune falls into the SA classification.

Drainage at MCB, Camp Lejeune is generally toward the New River, except in areas near the coast, which drain through the Intracoastal Waterway. In developed areas, natural drainage has been altered by asphalt cover, storm sewers, and drainage ditches. Approximately 70 percent of MCB, Camp Lejeune is situated in broad, flat interstream areas. Drainage is poor in these areas.

The U.S. Corp of Engineers has mapped the limits of the 100-year floodplain at Camp Lejeune at 7 feet above msl in the upper reaches of the New River.

Site 41

The dominant surface water features at Site 41 are the unnamed tributary to the north and east, and Tank Creek to the south/southeast of the site. Because the site is located on a topographic high, surface runoff radially flows towards both the unnamed tributary and Tank Creek. Both of these surface water bodies flow in a southeast direction and then discharges into Southwest Creek. Southwest Creek flows towards the south/southeast and discharges into the New River.

Site 74

Henderson Pond, located south/southeast of the former pesticide storage/handling area, is the only surface water feature in the area of Site 74. There are some shallow drainage pathways which lead to Henderson Pond from the former pesticide storage/handling area. As stated in Section 3.1, Site 74 is relatively flat, and ponding of water occurs during periods of heavy precipitation. Another major surface water feature is Wallace Creek, located approximately one mile south of the site. No major drainage pathways run directly from Site 74 to Wallace Creek; however, overflow from Henderson Pond flows to Wallace Creek.

3.3 Geology and Soils

3.3.1 Regional Geology and Soils

MCB, Camp Lejeune is located in the Atlantic Coastal Plain Physiographic Province. The sediments of the Atlantic Coastal Plain consist of interbedded sands, clays, calcareous clays, shell beds, sandstone, and limestone. These sediments lay in interfingering beds and lenses that gently dip and thicken to the southeast (ESE, 1992). These sediments were deposited in marine or near-marine environments, range in age from early Cretaceous to Quaternary time, and overlie igneous and metamorphic basement rocks of pre-Cretaceous age. Table 3-1 presents a generalized stratigraphic column of geologic and hydrogeologic units for this area.

United States Geological Survey (USGS) studies at MCB, Camp Lejeune indicate that the Base is underlain by seven sand and limestone aquifers separated by confining units of silt and clay. These include the water table (i.e., surficial, water-bearing layer), Castle Hayne, Beaufort, Peedee, Black Creek, and upper and lower Cape Fear aquifers. The combined thickness of these sediments is approximately 1,500 feet. Less permeable clay and silt beds function as confining units or semiconfining units which separate the aquifers and impede the flow of groundwater between aquifers. Figure 3-3 depicts the locations of hydrogeologic cross-sections of MCB Camp Lejeune area. The cross-sections illustrating the relationship between aquifers in this area are presented on Figure 3-4.

3.3.2 Site Specific Geology and Soils

3.3.2.1 Site 41

The site is primarily underlain by silty sand, with discontinuous layers of sand, clayey sand, sandy clay, silt, and clay, and underlain by shelly sand (Castle Hayne Aquifer). Seven shallow wells and six deep wells were installed during the field program. The location of the cross-sections are shown on Figure 3-5. Figure 3-6 presents cross-section A-A' from a south to north direction at Site 41. The geologic cross-section in a south to north direction (B-B') is presented as Figure 3-7. Figure 3-8 presents cross-section C-C' from a west to east direction.

The silty sand, clayey sand, sand, sandy clay, silt, and clay are all part of the Quaternary "undifferentiated" Formation that characterizes the shallow water table aquifer. The silty sand ranged in depth from 11 to 29 feet bgs. No apparent groundwater retarding layers were encountered, as only discontinuous sandy clay and silty clay layers were identified. These layers were generally less than 3 feet thick. The top of the upper unit of the Castle Hayne appears to be relatively flat across the site at an approximate elevation of -6 msl..

Relative densities indicate the shallow soils to be very loose to medium dense. The shelly sands encountered at depth, the upper unit of the Castle Hayne, are medium dense to very dense. Unified Soil Classification System (USCS) classification for the shallow soils identified at the site are SM (silty sand), SP (poorly graded sands with little to no fines), CL (sandy clay and clays), and ML (silts). The shelly sands are classified as a SP soil.

Two samples (41-GW10, 0 to 2 feet; and 41-GW11, 4 to 6 feet) were submitted for grain size and Atterberg limits analyses. The laboratory data classified the sample from location 41-GW10 as a sand/loamy sand, and from location 41-GW11 as a loamy sand. These classifications generally correlate with the field descriptions for the shallow soils.

3.3.2.2 Site 74

Site 74 is underlain primarily by sand and silty sand. A total of nine shallow monitoring wells have been installed to date during previous investigations and the subject RI investigation. New shallow wells were installed at six locations; one of which was a replacement well (74-GW03A) for well 74-GW03 which could not be found. No deep wells have been installed at Site 74. The locations of geologic cross-sections for Site 74 are shown on Figure 3-9. Cross-sections illustrating the stratigraphy beneath Site 74 are provided on Figures 3-10 (northeast to southwest) and 3-11 (northwest to southeast).

The shallow sands and silty sands are part of the Quaternary age "undifferentiated" Formation which characterizes the shallow water table aquifer. The silty sand unit was encountered at the ground surface in all but one monitoring well soil boring (74-GW02) and extended to depths ranging from one foot to greater than 26 feet. Relative soil densities obtained from standard penetration tests indicate the shallow soils to be very loose to dense. The sand and silty sand units are classified as SP (poorly graded sands, little to no fines) and SM (silty sands) under the USCS. A soil sample from monitoring well soil boring 74-GW05 (6 to 8 feet) was submitted for grain size and Atterberg limits. Laboratory data classified the sample as a loamy sand, which generally correlates with the field description of a silty sand. No apparent groundwater retarding layers were encountered during the RI field program; however, a sandy clay layer was identified at the bottom of soil boring 74-GW03A (17 to 18.5 foot depth) in the northern area of the site. This unit was not encountered in any other boring location. The monitoring wells installed during the RI did not extend into the Castle Hayne. Monitoring wells were not installed in the upper portion of the Castle Hayne Formation due to the fact that Base supply well HP-654 is located near Site 74 and has been periodically sampled and analyzed for full organics and inorganics with no contamination detected to date.

3.4 Hydrogeology

3.4.1 Regional Hydrogeology

The following summary of regional hydrogeology was originally presented in Harned et al. (1989) and reevaluated by Cardinell, et al. (1993).

The surficial water table aquifer consists of a series of sediments, primarily sand and clay, which commonly extend to depths of 75 feet. This unit is not used as a water supply on the Base.

The principal water supply for the Base is found in the series of sand and limestone beds that occur between 50 and 300 feet below land surface (bls). This series of sediments generally is known as the Castle Hayne Formation, associated with the Castle Hayne Aquifer. This aquifer is about 150 to 400 feet thick in the area and is the most productive aquifer in North Carolina.

Clay layers occur in both of the aquifers. However, the layers are thin and discontinuous in most of the area, and no continuous clay layer separates the surficial aquifer from the Castle Hayne Aquifer. The clay layers range from 10 to 15 feet thick and comprise between 15 and 24 percent of the combined thickness of the two aquifers. The clay layers appear to be thicker and more continuous in the northwestern part of the Base, particularly in the area of the MCAS. It is inferred from their generally thin and discontinuous nature that considerable leakage of groundwater occurs across and around the clay layers, particularly in the upper part of the Castle Hayne aquifer.

Onslow County and MCB, Camp Lejeune lie in an area where the Castle Hayne Aquifer contains freshwater, although the proximity of saltwater in deeper layers just below the aquifer and in the New River estuary is of concern in managing water withdrawals. Overpumping of the deeper parts of the aquifer could cause encroachment of saltwater. The aquifer contains water having less than 250 milligrams per liter (mg/L) chloride throughout the area of the Base.

The aquifers below the Castle Hayne Aquifer lie in a thick sequence of sand and clay. Although some of these aquifers are used for water supply elsewhere in the Coastal Plain, they contain saltwater in the MCB, Camp Lejeune area and are not used.

Rainfall in the MCB, Camp Lejeune area enters the ground in recharge areas, infiltrates the soil, and moves downward until it reaches the water table, which is the top of the saturated zone. In the saturated zone, groundwater flows in the direction of lower hydraulic head, moving through the system to discharge areas like the New River and its tributaries, or the ocean.

The water table varies seasonally. The water table receives more recharge in the winter and summer than in the fall and spring when much of the water evaporates or is transpired by plants before it can reach the water table. Therefore, the water table generally is highest in the winter/summer months and lowest in spring/fall.

In confined aquifers, water is under excess hydraulic (i.e., head) pressure and the level to which it rises in a tightly cased well is called the potentiometric surface. The hydraulic head in a confined or semiconfined aquifer, such as the Castle Hayne, shows a different pattern of variation over time than in an unconfined aquifer. Some seasonal variation also is common in the water levels of the Castle Hayne Aquifer, but the changes tend to be slower and over a smaller range than for water table wells.

According to the North Carolina Administrative Code, Title 15, Subchapter 2L, "Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina", the surficial water table aquifer and the Castle Hayne Aquifer are classified as GA; for existing or potential sources of drinking water supplies for humans with a chloride concentration equal to or less than 250 mg/L. This groundwater classification is for waters which are considered suitable for drinking in their natural state.

3.4.2 Site Specific Hydrogeology

3.4.2.1 Site 41

Groundwater was encountered during the RI at depths ranging from 2.09 to 8.99 feet bgs (elevation 15.01 to 4.31 msl). Measured shallow groundwater levels for Site 41 are presented on Table 3-2. A groundwater contour map for the shallow aquifer on February 22, 1994 is presented on Figure 3-12. The contour map indicates a slight mound effect in the central portion of the site in the area of monitoring well 41-GW11. Shallow groundwater flow is axial and radial for the site, but the predominant flow direction appears to be towards the southeast (same flow direction as the unnamed tributary and Tank Creek), with radial flow towards the north/northeast and south/southwest. The high groundwater area appears to be a recharge zone for the central portion of the site. The area to the northwest is also a groundwater recharge area for the site, as the axial flow direction is from the northwest across the site. A shallow groundwater gradient measured from well 41-GW11 to well 41-GW013 in the south for February 22, 1994 was 0.007 ft/ft. Shallow groundwater discharges to the swampy areas east, south and west of the site, and to the unnamed tributary and Tank Creek.

Groundwater contours for the shallow aquifer for the Round Two groundwater sampling on April 26 - 28, 1994 at Site 41 are presented on Figure 3-13. Indications of the high groundwater elevations within the central portion of the site are evident, with axial/radial flow similar to what was observed in February 1994. There was an anomalous groundwater level for well 41-GW02 (2 foot lower in groundwater level change than other well readings that day) for which there is no discernable reason. Due to this anomalous reading, this groundwater level was not used in preparing the contour map. The shallow groundwater gradient between wells 41-GW11 and 41-GW13 for that day was 0.01 ft/ft to the south.

The shallow aquifer at Site 41 was characterized by performing in situ rising and falling head slug tests in monitoring wells 41-GW07, 41-GW08, 41-GW09, 41-GW10, and 41-GW12. The tests were performed on April 30 and May 1, 1994. An electronic data logger (In Situ Hermit Model SE2000) and pressure transducer assembly were used to record the recovery of groundwater in these monitoring wells to static level. All data was recorded on a logarithmic scale to closely monitor the initial changes in groundwater elevation. The data resulting from the slug tests were converted into time (in minutes) and the corresponding change in water level displacement (in feet). Only the results from the rising head slug tests were analyzed, using Geraghty & Miller's AQTESOLV computer program for performing quantitative groundwater assessments, due to the fact that the shallow wells were screened across the groundwater table thus making the falling head test invalid. The Bouwer and Rice solution for slug tests in unconfined aquifers was used to evaluate all test data. The input parameters and plots generated from the slug tests are contained in Appendix G.

Table 3-3 lists the K values obtained from the data analysis, the average hydraulic gradient from the two shallow groundwater contour maps, the assumed effective porosity, and the calculated value for groundwater velocity. The average of the estimated K values from the five wells was 2.1 feet/day (7.4×10^{-4} cm/sec), which is within the typical range for silty sands (Freeze/Cherry, 1979). The hydraulic gradient from groundwater measurements between wells 41-GW11 and 41-GW13 on February 22, 1994 was 0.007 ft/ft. Published effective porosity values indicate a range of 25 to 50 percent for sands and silts (Freeze/Cherry, 1979). Due to the silty nature of the sands, a value of 35 percent was used for effective porosity. The estimated average linear groundwater velocity was calculated by using the following formula:

$$V = Ki/n$$

Where: V = groundwater velocity
K = hydraulic conductivity
i = hydraulic gradient
n = effective porosity

Using these variables, the groundwater velocity (V) in a north to south direction is estimated to be 0.04 feet/day (15 feet/year). This is a conservative estimate because of the nature of the silty sand and the variability in the estimated K values from the slug tests. An approximate transmissivity value (T) can be obtained from the hydraulic conductivity (K) and the saturated thickness (b) of the aquifer. Using a saturated thickness of 16 feet above the Castle Hayne formation for the shallow aquifer, an approximate T value for the shallow aquifer in this direction is 33.6 feet^2/day. A recent hydrogeologic investigation conducted by Baker in the Camp Geiger area (1994), which included an aquifer pump test within the shallow water-bearing zone (approximately 25 foot depth), indicated T and K values of 94.92 ft^2/day (7.1×10^2 gallons/day/ft) and 6.3 feet/day (2.2×10^{-3} cm/sec), respectively. Values for T determined from a pump test performed at Hadnot Point on the opposite side of the New River from Camp Geiger were 75 feet^2/day (5.61×10^2 gallons/day/ft). The average transmissivity value for these two pump tests is 85 feet^2/day. The calculated transmissivity value of 33.6 feet^2/day from slug tests is of the same order of magnitude as the average pump test value.

Groundwater levels in the deep monitoring wells are presented on Table 3-4. Depths to groundwater ranged from 4.80 to 13.54 feet bgs (elevation 15.09 to 3.10 feet msl). Figures 3-14 and 3-15 present the groundwater contour maps for the deep aquifer on February 22, 1994 and April 26-28, 1994, respectively. Groundwater flow within the deep aquifer is generally linear, as seen on the groundwater contour maps, and in a southeasterly direction at an average hydraulic gradient of 0.006 ft/ft, measured between wells 41-GW09DW and 41-GW11DW for the February 22 and April 26-28, 1994 groundwater measurements. The recharge area for the deep aquifer is from the northwest. An evaluation of groundwater levels within well nests at Site 41 indicate that there is a potential vertical gradient upward in the northwest area of the site (well locations 41-GW07 and 41-GW09) and downward in the central and southern areas of the site (well locations 41-GW11 and 41-GW12, respectively). The potential vertical gradients ranged from 0.001 to 0.114 ft/ft. The deep aquifer would appear to discharge at an off site location, possibly the New River, where the Castle Hayne formation is near surface.

In situ rising head and falling head slug tests were performed in three deep monitoring wells installed at Site 41 (41-GW06DW, 41-GW07DW, and 41-GW12DW) during April 30 and May 1, 1994. Both the rising and falling head test data was analyzed for these wells using Geraghty & Miller's AQTESOLV program, as with the shallow aquifer tests. The input parameters and plots generated for the deep wells are contained in Appendix G. Table 3-5 lists the K values obtained from the data analysis, the average hydraulic gradient from the two deep groundwater contour maps, the assumed effective porosity, and the calculated value for groundwater velocity. The average of the estimated K values from the three wells was 2.2 feet/day (7.8 x 10^{-4} cm/sec). The average K value is within the typical range for silty sands (Freeze/Cherry, 1979). Average calculated hydraulic gradient from the groundwater measurements was 0.006 ft/ft. Published effective porosity values indicate a range of 25 to 50 percent for sands and silts (Freeze/Cherry, 1979). Due to the silty nature of the sands, a value of 35 percent was used for effective porosity. The estimated average linear groundwater velocity was calculated by using the following formula:

$$V = Ki/n$$

Using the variables listed previously for the shallow aquifer, the groundwater velocity (V) for the deep aquifer is estimated to be 0.04 feet/day (15 feet/year). This is a conservative estimate because of the nature of the silty sand and the variability in the estimated K values from the slug test data. Using an estimated saturated aquifer thickness of 200 feet, an estimated T value of 396 $feet^2$/day (3 x 10^3 gallons/day/foot) was obtained. A Wellhead Management Program Engineering Study (Geophex, Ltd., 1991) was conducted in 1990 at Camp Lejeune which states a transmissivity value of 8,000 $feet^2$/day (6 x 10^4 gallons/day/foot) for the Marine Corps Air Station (MCAS). The estimated T value calculated from the slug test data is representative of the 35 to 55 foot depth in the area of Site 41, as opposed to the deep water supply zones (100 to 200 feet).

The lithology does not indicate a confining or semiconfining layer between the surficial water table aquifer and the Castle Hayne Aquifer. This is substantiated by the similarity in groundwater flow direction, elevations, and gradient between the two aquifers. The differentiation between the two water bearing zones is based on lithology, groundwater parameters as seen from the evaluation of slug test data, and usage (the surficial aquifer is not used as a water supply on the base). Evaluation of groundwater elevations indicates a potential vertical gradient between the two aquifers.

3.4.2.2 Site 74

The shallow groundwater lies within the silty sand at a depth of between 4.36 to 19.06 feet bgs (elevation 28.04 to 12.52 msl). Table 3-6 presents the groundwater levels measured during the RI field program. Groundwater contour maps for February 22, March 1, and April 29, 1994 are presented on Figures 3-16, 3-17, and 3-18, respectively. The contour maps indicate groundwater within the shallow aquifer at Site 74 flows in a east/northeast direction. Groundwater flow is at a hydraulic gradient of 0.03 ft/ft, measured from well 74-GW07 to well 74-GW02. Groundwater in well 74-GW06 continually exhibited slightly lower groundwater levels than nearby wells. There is no apparent reason for these anomalous levels. The groundwater contour maps indicate a generally linear flow across the site with recharge from the west/southwest of the site. There is no apparent discharge area for the shallow aquifer in the vicinity of the site. No deep monitoring wells were installed during this investigation because the RI focused on the shallow aquifer since the nearby deep supply well HP-654, located across the access road from the site, is periodically sampled for full organic and inorganic analysis and no contamination has been detected to date.

The shallow aquifer at Site 74 was characterized by performing rising and falling head in situ slug tests in monitoring wells 74-GW03A, 74-GW06, and 74-GW08. The tests were performed on April 29, 1994 employing the same methods and equipment described in Section 3.4.2.1. Only the rising head test data was analyzed using Geraghty & Miller's AQTESOLV computer program for groundwater assessments, due to the wells being screened across the groundwater surface thus making the falling head test invalid. The Bouwer and Rice solution for slug tests in unconfined aquifers was used to evaluate all test data. The input parameters and plots generated from the slug tests are contained in Appendix H.

Table 3-7 lists the K values obtained from the data analysis, the hydraulic gradient, the assumed effective porosity, and the calculated value for groundwater velocity. The average estimated K value from all three wells is 3.5 feet/day (1.2 x 10^{-3} cm/sec), which is within the typical range for silty sands (Freeze/Cherry, 1979). The hydraulic gradient from groundwater measurements between wells 74-GW07 and 74-GW02 on February 22, 1994 was 0.03 ft/ft. Published effective porosity values indicate a range of 25 to 50 percent for sands and silts (Freeze/Cherry, 1979). Due to the silty nature of the sands, a value of 35 percent was used for effective porosity. The estimated average linear velocity was calculated by using the formula:

$$V = Ki/n$$

Using the variables listed in Section 3.4.2.1, the groundwater velocity (V) of the shallow aquifer in a southwest to northeast direction at Site 74 is estimated to be 0.3 feet/day (110 feet/year). This is a conservative estimate because of the nature of the silty sand and the variability in the estimated K values from the slug test data. An approximate transmissivity value (T) can be obtained from the hydraulic conductivity (K) and the saturated thickness (b) of the aquifer. Using a saturated thickness of 19 feet within the monitoring wells, an approximate T value for the shallow aquifer would be 66 feet^2/day (5 x 10^2 gallons/day/foot), which is comparable to the average value referenced from the Baker aquifer pump tests in Section 3.4.2.1.

3.5 Land Use Demographics

3.5.1 Regional

Present military population of MCB, Camp Lejeune is approximately 40,928 active duty personnel. The military dependent community is in excess of 32,081. About 36,086 of these personnel and dependents reside in base housing units. The remaining personnel and dependents live off Base and have had dramatic effects on the surrounding area. An additional 4,412 civilian employees perform facilities management and support functions. The population of Onslow County has grown from 17,739 in 1940, prior to the formation of the Base, to its present population of 121,350 (Master Plan, Camp Lejeune Complex, North Carolina, 1988).

The existing land use pattern for the various developed geographic areas within the MCB are listed, per geographic area, on Table 3-8. In addition, the number of acres comprising each land use category has been estimated and provided on the table. Site 41 is located in the northwestern region of the MCAS southwest of Camp Geiger. Site 74 is located in the north central part of the base at Lot 204.

3.5.2 Site 41

Site 41 (Camp Geiger Dump Near Former Trailer Park) is located adjacent to U.S. Highway 17 in a heavily wooded area away from residential and/or support areas. Training is conducted on a periodic basis through the area. The area encompassing Site 41 also is occasionally used for military training exercises. The site is not fenced; therefore, access is not restricted from within the base or U.S. Highway 17. The closest military complex is Camp Geiger, located approximately two miles northeast of the site. Future land use is reserved for military training. Hunting is permitted in the area via permission from the base command.

A mixture of old and new facilities exist at Camp Geiger, the result of which is a patchwork of buildings arranged in a north to south configuration. The development of the approximately 216 acres has resulted in facilities that are not interrelated, physically or functionally.

Supply and storage, concentrated along the eastern edge of the developed area and in the central portion, covers about 50 acres of land. Maintenance facilities, which cover about 19 acres, are located adjacent to the supply/storage areas. Combined supply/storage and maintenance areas account for nearly 32 percent of the developed land in Camp Geiger.

No family housing exists at Camp Geiger. Troop housing situated on 54 acres is located in three areas, interspersed with community and commercial facilities. Training tends to be conveniently accessible by foot from troop housing although less accessible from community buildings, such as the dining facilities. The 16 acres of recreational areas are scarce in terms of number and inconvenient in terms of access.

Downslope of the site is a wooded wetland or swamp area. There may be sensitive ecological receptors in this area which will be further evaluated as part of the ecological risk assessment.

3.5.3 Site 74

The area around Site 74 is occasionally used for military training. The closest military complex is associated with a water treatment plant and administrative building located about one-half mile west of the site. Midway Park, a large housing development, is located about one mile northwest of the site. Future land use of the area is reserved for military training. Hunting is permitted in the area; however, passes must be issued so that hunting activities do not conflict with military training.

The upper reaches of Wallace Creek, located approximately two miles southeast of the site, is designated as a natural area. There are no sensitive ecological populations reported to inhabit the site.

3.6 Climate and Meteorology

MCB, Camp Lejeune experiences mild winters, and hot and humid summers. The average yearly rainfall is greater than 50 inches, and the potential evapotranspiration in the region varies from 34 to 36 inches of rainfall equivalent per year. The winter and summer seasons usually receive the most precipitation. Temperature ranges are reported to be 33 to 53 degrees Fahrenheit (°F) in the winter (i.e., January) and 71 to 88°F in the summer (i.e., July). Winds are generally south-southwesterly in the summer and north-northwesterly in the winter (Water and Air Research, 1983). Table 3-9 presents a climatic summary for the MCAS New River. Tidal data for the New River in Jacksonville, North Carolina is presented in Table 3-10.

3.7 Water Supply

MCB, Camp Lejeune water is supplied entirely from groundwater obtained from approximately 90 water supply wells and treated. There are eight water treatment plants with a total capacity of 15.821 million gallons per day (MGD). Groundwater usage is estimated at over 7 MGD (Harned, et al., 1989).

The water supply wells are all located within the boundaries of the base. The average water supply well at the base has a depth of 162 feet, a casing diameter of 8 inches, and yields 174 gallons per minute (gpm) (Harned, et al., 1989)

All of the water supply wells utilize the Castle Hayne Aquifer. The Castle Hayne Aquifer is a highly permeable, semiconfined aquifer that is capable of yielding several hundred to 1,000 gpm in municipal and industrial wells in the MCB, Camp Lejeune area. The water retrieved is typically a hard, calcium bicarbonate type.

Table 3-11 and 3-12 present summaries of water supply wells within a one-mile radius of Site 41 and Site 74, respectively. Figure 3-19 shows the locations of the operational water supply wells within a one-mile radius of Sites 41 and 74.

No base supply wells were sampled during this investigation. Specific supply wells are periodically sampled for full organic and inorganic analysis. Supply wells located near Site 41 do not appear to be potentially impacted by this site because they are not located downgradient from the site. Base water supply well HP654 is located approximately one-quarter mile from Site 74, and downgradient of the site. This well is routinely sampled by Base personnel for organics and metals analyses. Site 74 may have a potential impact on Supply Wells HP-629 and HP-621 which are located downgradient. These wells, however, are approximately one quarter mile from the site and slightly north of the groundwater flow direction.

SECTION 3.0 TABLES

TABLE 3-1

GEOLOGIC AND HYDROGEOLOGIC UNITS IN THE COASTAL PLAIN OF NORTH CAROLINA REMEDIAL INVESTIGATION, CTO-0212 MCB CAMP LEJEUNE, NORTH CAROLINA

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
System	Series	Formation	Aquifer and Confining Unit
Quaternary	Holocene/Pleistocene	Undifferentiated	Surficial aquifer
Tertiary	Pliocene	Yorktown Formation(1)	Yorktown confining unit Yorktown Aquifer
	Miocene	Eastover Formation(1)	
		Pungo River Formation(1)	Pungo River confining unit Pungo River Aquifer
		Belgrade Formation(2)	Castle Hayne confining unit
	Oligocene	River Bend Formation	Castle Hayne Aquifer
	Eocene	Castle Hayne Formation	Beaufort confining unit(3)
	Paleocene	Beaufort Formation	Beaufort Aquifer Peedee confining unit
Cretaceous	Upper Cretaceous	Peedee Formation	Peedee Aquifer
		Black Creek and Middendorf Formations	Black Creek confining unit Black Creek Aquifer
		Cape Fear Formation	Upper Cape Fear confining unit Upper Cape Fear Aquifer Lower Cape Fear confining unit Lower Cape Fear Aquifer
	Lower Cretaceous(1)	Unnamed deposits(1)	Lower Cretaceous confining unit Lower Cretaceous Aquifer(1)
Pre-Cretaceous basement rocks		--	--

(1) Geologic and hydrologic units probably not present beneath MCB, Camp Lejeune.
(2) Constitutes part of the surficial aquifer and Castle Hayne confining unit in the study area.
(3) Estimated to be confined to deposits of Paleocene age in the study area.

Source: Harned et al., 1989.

TABLE 3-2

SUMMARY OF WATER LEVEL MEASUREMENTS FROM SHALLOW MONITORING WELLS ON FEBRUARY 14-19, 1994, FEBRUARY 22, 1994, MARCH 1, 1994, AND APRIL 26-28, 1994
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Top of PVC Casing Elevation(1) (feet, above msl)	Depth to Groundwater (feet, below top of casing) (02/14/94 - 02/19/94)	Groundwater Elevation (feet, above msl) (02/14/94 - 02/19/94)	Depth to Groundwater (feet, below top of casing) (02/22/94)	Groundwater Elevation (feet, above msl) (02/22/94)	Depth to Groundwater (feet, below top of casing) (03/01/94)	Groundwater Elevation (feet, above msl) (03/01/94)	Depth to Groundwater (feet, below top of casing) (04/26/94 - 04/28/94)	Groundwater Elevation (feet, above msl) (04/26/94 - 04/28/94)
41-GW01(2)	22.60	22.18	0.42	8.50	14.10	7.36	15.24	8.42	14.18
41-GW02(2)	14.63	4.00	10.63	4.59	10.04	3.97	10.66	7.66	6.97
41-GW03(2)	19.23	10.25	8.98	10.41	8.82	9.74	9.49	11.27	7.96
41-GW04(2)	11.99	6.34	5.65	8.25	3.74	5.85	6.14	6.99	5.00
41-GW05(2)	26.59	10.53	16.06	10.80	15.70	10.35	16.24	11.21	15.38
41-GW07(3)	22.73	10.40	12.33	10.33	12.40	9.15	13.58	10.68	12.05
41-GW08(3)	19.48	7.26	12.22	7.34	12.14	7.06	12.42	7.88	11.60
41-GW09(3)	25.98	10.97	15.01	10.56	15.42	10.31	15.67	10.66	15.32
41-GW10(3)	13.93	5.54	8.39	5.60	8.33	4.81	9.12	6.62	7.31
41-GW11(3)	24.69	10.14	14.55	9.45	15.24	9.38	15.31	9.58	15.11
41-GW12(3)	8.41	4.10	4.31	4.24	4.17	3.47	4.94	5.37	3.04
41-GW13(3)	16.19	8.80	7.39	7.95	8.24	9.37	6.82	10.20	5.99

Notes: (1) Mean sea level
(2) Existing monitoring well installed by ESE, Inc., November 1986.
(3) Phase I monitoring well installed by Baker Environmental, Inc., February 1994.

TABLE 3-3

AQUIFER CHARACTERISTICS - SHALLOW MONITORING WELLS
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Hydraulic Conductivity (K) (feet/day)	Hydraulic Gradient (i) (feet/feet)	Effective Porosity[1] (n)	Groundwater Velocity (V) (feet/day)
41-GW07	1.1507	0.007	0.35	0.02
41-GW08	0.1378	0.007	0.35	0.003
41-GW09	3.6720	0.007	0.35	0.07
41-GW10	0.9442	0.007	0.35	0.02
41-GW12	4.5749	0.007	0.35	0.09

(1) Freeze/Cherry, 1979 - Groundwater

TABLE 3-4

SUMMARY OF WATER LEVEL MEASUREMENTS FROM DEEP MONITORING WELLS ON
FEBRUARY 14-19, 1994, FEBRUARY 22, 1994, MARCH 1, 1994 AND APRIL 26-28, 1994
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Top of PVC Casing Elevation(1) (feet, above msl)	Depth to Groundwater (feet, below top of casing) (02/14-19/94)	Groundwater Elevation (feet, above msl) (02/14-19/94)	Depth to Groundwater (feet, below top of casing) (02/22/94)	Groundwater Elevation (feet, above msl) (02/22/94)	Depth to Groundwater (feet, below top of casing) (03/01/94)	Groundwater Elevation (feet, above msl) (03/01/94)	Depth to Groundwater (feet, above msl) (04/26/94-04/28/94)	Groundwater Elevation (feet, above msl) (04/26/94-04/28/94)
41-GW04DW	12.89	7.15	5.74	7.17	5.72	6.81	6.08	7.40	5.49
41-GW06DW	25.31	11.80	13.51	11.80	13.51	11.21	14.10	12.30	13.01
41-GW07DW	22.88	10.30	12.58	10.35	12.53	9.33	13.55	11.06	11.82
41-GW09DW	26.95	11.88	15.07	11.86	15.09	11.13	15.82	11.86	15.09
41-GW11DW	23.63	13.08	10.55	13.12	10.51	12.46	11.17	13.54	10.09
41-GW12DW	9.08	4.80	4.28	5.50	3.58	4.82	4.26	5.98	3.10

Notes: (1) Mean sea level

TABLE 3-5

AQUIFER CHARACTERISTICS - DEEP MONITORING WELLS
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Hydraulic Conductivity (K) (feet/day)	Hydraulic Gradient (i) (feet/feet)	Effective Porosity(i) (n)	Groundwater Velocity (V) (feet/day)
41-GW06DW	2.1917	0.006	0.35	0.04
41-GW07DW	2.4250	0.006	0.35	0.04
41-GW12DW	1.8562	0.006	0.35	0.03

(1) Freeze/Cherry, 1979 - Groundwater

TABLE 3-6

SUMMARY OF WATER LEVEL MEASUREMENTS FROM SHALLOW MONITORING WELLS ON
FEBRUARY 22, 1994, MARCH 1, 1994, MARCH 2, 1994, AND APRIL 29, 1994
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Top of PVC Casing Elevation[1] (feet, above msl)	Depth to Groundwater (feet, below top of casing) (02/22/94)	Groundwater Elevation (feet, above msl) (02/22/94)	Depth to Groundwater (feet, below top of casing) (03/01/94)	Groundwater Elevation (feet, above msl) (03/01/94)	Depth to Groundwater (feet, below top of casing) (03/02/94)	Groundwater Elevation (feet, above msl) (03/02/94)	Depth to Groundwater (feet, above msl) (04/29/94)	Groundwater Elevation (feet, above msl) (04/29/94)
74-GW01[2]	35.88	22.40	13.48	21.94	13.94	21.24	14.64	20.43	15.45
74-GW02[2]	35.23	20.62	14.61	21.43	13.80	21.00	14.23	19.17	16.06
74-GW03A[3]	36.14	8.34	27.80	8.38	27.76	8.28	27.86	7.86	28.28
74-GW04[3]	35.37	13.82	21.55	13.62	21.75	13.58	21.79	11.38	23.49
74-GW05[3]	34.30	7.29	27.01	7.38	26.92	7.28	27.02	7.30	27.00
74-GW06[3]	33.12	20.58	12.54	19.61	13.51	19.26	13.86	18.08	15.04
74-GW07[3]	34.52	6.48	28.04	6.43	28.09	6.30	28.22	6.49	28.03
74-GW08[3]	30.55	17.34	13.21	17.02	13.53	16.76	13.79	14.95	15.60

Notes: (1) Mean sea level
(2) Existing monitoring well installed by ESE, Inc., November 1986.
(3) Phase I monitoring well installed by Baker Environmental, Inc., January-February 1994.

TABLE 3-7

AQUIFER CHARACTERISTICS - MONITORING WELLS
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	Hydraulic Conductivity (K) (feet/day)	Hydraulic Gradient (i) (feet/feet)	Effective Porosity (n)	Groundwater Velocity (V) (feet/day)
74-GW03A	0.5907	0.03	0.35	0.05
74-GW06	6.3302	0.03	0.35	0.54
74-GW08	3.5496	0.03	0.35	0.30

TABLE 8

LAND UTILIZATION: DEVELOPED AREAS ACRES/LAND USE (PERCENT)
REMEDIAL INVESTIGATION, CTO-0212
MCB, CAMP LEJEUNE, NORTH CAROLINA

Geographic Area	Oper.	Training (Instruc.)	Maint.	Supply/ Storage	Medical	Admin.	Family Housing	Troop Housing	CM	CO	Recreat.	Utility	Total
Hadnot Point	31 (2.9)	15 (1.4)	154 (14.3)	157 (14.4)	10 (0.9)	122 (11.3)	22 (2.0)	196 (18.1)	115 (10.7)	36 (3.3)	182 (16.9)	40 (3.7)	1,080 (100)
Paradise Point	1 (0)		3 (0.4)	1 (0)			343 (34)	19 (1.9)	31 (3.1)		610 (60.4)	2 (0.2)	1,010 (100)
Berkeley Manor/ Watkins Village							406 (80)		41 (8.1)	1 (0.2)	57 (11.2)	2 (0.5)	507 (100)
Midway Park		1 (0.4)		2 (0.7)		2 (0.7)	248 (92.2)		8 (3.0)	3 (1.1)	4 (1.5)	1 (0.4)	269 (100)
Tarawa Terrace I and II			3 (0.5)			1 (0.3)	428 (77.4)		55 (9.9)	11 (2.0)	47 (8.5)	8 (1.4)	553 (100)
Knox Trailer							57 (100)						57 (100)
French Creek	8 (1.4)	1 (0.2)	74 (12.7)	266 (45.6)	3 (0.5)	7 (1.2)		122 (20.9)	22 (3.8)	6 (1.0)	74 (12.7)		583 (100)
Courthouse Bay		73 (28.6)	28 (10.9)	14 (5.5)		12 (4.7)	12 (4.7)	43 (16.9)	15 (5.9)	4 (1.6)	43 (16.9)	11 (4.3)	255 (100)
Onslow Beach	6 (9.8)	1 (1.6)	3 (4.8)	2 (3.2)	1 (1.6)	2 (3.2)		2 (3.2)	12 (19.3)		25 (40.3)	8 (13.0)	62 (100)
Rifle Range		1 (1.3)	1 (1.3)	7 (8.8)	1 (1.3)	5 (6.3)	7 (8.8)	30 (37.5)	5 (6.3)	1 (1.3)	9 (11.3)	13 (16.3)	80 (100)
Camp Geiger	4 (1.9)	15 (6.9)	19 (8.8)	50 (23.1)		23 (10.6)		54 (25.0)	27 (12.5)	2 (1.0)	16 (7.4)	6 (2.8)	216 (100)
Montford Point	6 (2.6)	48 (20.5)	2 (0.9)	4 (1.7)	2 (0.9)	9 (3.9)		82 (35.2)	20 (8.6)	1 (0.4)	49 (21.0)	10 (4.3)	233 (100)
Base-wide Misc.	1 (0.8)			87 (68.0)		3 (2.3)			19 (14.8)			18 (14.1)	128 (100)
TOTAL	**57 (1.1)**	**155 (3.1)**	**287 (5.7)**	**590 (11.7)**	**17 (0.38)**	**186 (3.7)**	**1,523 (30.2)**	**548 (10.8)**	**370 (7.4)**	**65 (1.3)**	**1.116 (22.2)**	**119 (2.4)**	**5,033 (100)**

TABLE 3-9

CLIMATIC DATA SUMMARY FOR MCAS NEW RIVER
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Temperature (Celsius)			Relative Humidity (Percent)	Temperature (Fahrenheit)			Mean Number of Days With				
								Precipitation		Temperature		
	Maximum	Minimum	Average		Maximum	Minimum	Average	>=0.01"	>=0.5"	>=90F	>=75F	<=32F
January	7.5	1.4	4.2	76	54	34	44	11	2	0	1	14
February	7.0	1.5	3.8	74	57	36	46	9	3	0	1	11
March	8.0	0.8	3.5	78	64	42	53	10	2	0	5	7
April	6.5	0.5	3.0	79	73	51	62	8	2	--	14	--
May	8.4	1.7	4.3	86	80	60	70	10	3	2	25	0
June	11.8	2.4	5.8	85	85	67	76	11	4	6	19	0
July	14.3	4.5	8.0	85	88	72	80	14	5	12	31	0
August	12.6	1.7	6.1	87	87	71	80	12	4	11	31	0
September	12.2	1.4	4.7	87	83	66	75	9	3	3	27	0
October	6.5	0.7	2.8	82	74	54	64	7	2	--	16	--
November	5.7	0.6	2.6	80	66	44	55	7	1	0	6	4
December	6.1	0.4	4.0	77	58	37	48	9	2	0	2	11
Annual	14.3	0.4	52.8	81	72	53	63	117	33	34	188	47

-- Less than 0.5 days
Source: Naval Oceanography Command Detachment, Asheville, North Carolina. Measurements obtained from January 1955 to December 1982.

TABLE 3-10

TIDE DATA FOR THE NEW RIVER IN JACKSONVILLE, NORTH CAROLINA
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Date	High Tide Time	High Tide Hgt (ft)	Low Tide Time	Low Tide Hgt (ft)
08/01/92	13	1.7	7.9	0.88
	NA	NA	20.3	0.92
08/02/92	1.5	1.62	NA	NA
	14.1	1.62	8.8	0.84
	NA	NA	21.2	0.9
08/03/92	2.5	1.55	9.5	0.93
	15.0	1.64	22.2	0.92
08/04/92	3.3	1.5	10.1	0.95
	16.5	1.67	22.6	1.05
08/05/92	4.5	1.54	11.4	1.05
	16.9	1.62	NA	NA
08/06/92	NA	NA	0.4	1.02
	5.4	1.47	12.4	1.03
	18.1	1.59	NA	NA
08/07/92	NA	NA	1.3	1.04
	6.3	1.49	13.3	1.04
	19.0	1.59	NA	NA
08/08/92	NA	NA	2.0	1.08
	7.3	1.47	14.4	1.02
	2.10	1.58	NA	NA
08/09/92	8.6	1.44	3.4	1.02
	20.8	1.55	15.4	1.03
08/10/92	9.6	1.5	4.1	1.02
	21.8	1.59	16.2	1.01
08/11/92	10.2	1.52	4.9	1.03
	NA	NA	16.9	1.02
08/12/92	0.3	1.72	NA	NA
	11.1	1.57	5.7	0.99
	22.8	1.59	17.6	0.96
08/13/92	11.4	1.59	6.1	1.02
	NA	NA	18.0	1.06
08/14/92	0.04	1.81	NA	NA
	11.9	1.76	6.4	1.19
	NA	NA	19.0	1.21
08/15/92	0.4	1.84	NA	NA
	12.6	1.79	8.0	1.27
	NA	NA	19.7	1.20
08/16/92	1.0	1.76	NA	NA
	13.0	1.73	7.7	1.22
	NA	NA	19.9	1.16
08/17/92	1.4	1.67	NA	NA
	13.7	1.66	8.2	1.11
	NA	NA	20.4	1.14
08/18/92	1.9	1.62	NA	NA
	14.5	1.65	8.6	1.09
	NA	NA	21.4	1.12
8/19/92	2.7	1.55	9.3	1.05
	15.2	1.64	22.2	1.13
08/20/92	3.7	1.54	10.0	1.12
	15.4	1.66	23.3	1.17
08/21/92	4.2	1.55	11.2	1.13
	16.6	1.64	NA	NA
08/22/92	NA	NA	0.2	1.14
	5.0	1.51	12.0	1.06
	17.6	1.58	NA	NA
08/23/92	NA	NA	0.9	1.07
	6.1	1.48	13.1	1.02
	18.7	1.60	NA	NA
08/24/92	NA	NA	2.0	1.05
	7.3	1.52	14.2	1.01
	20.0	1.64	NA	NA
08/25/92	NA	NA	3.1	1.02
	8.4	1.56	15.1	0.95
	21.0	1.65	NA	NA
08/26/92	9.2	1.59	4.0	0.95
	21.8	1.71	16.2	0.90
08/27/92	10.3	1.71	5.0	0.97
	22.5	1.74	17.3	0.95
08/28/92	11.2	1.73	6.0	0.95
	NA	NA	18.5	0.89
08/29/92	0.5	1.64	NA	NA
	12.5	1.81	6.9	0.97
	NA	NA	19.5	0.96
08/30/92	0.9	1.74	NA	NA
	12.9	1.75	7.7	0.96
	NA	NA	20.2	0.93
08/31/92	1.4	1.57	NA	NA
	14.1	1.61	8.5	0.84
	NA	NA	21.0	0.91
09/01/92	2.5	1.56	NA	NA
		NA	9.2	0.96
	14.8	1.65	21.9	1.00
09/02/92	3.1	1.52	10.4	0.94
	15.6	1.59	22.8	0.98
09/03/92	4.1	1.45	11.0	0.95
	16.7	1.55	NA	NA
09/04/92	NA	NA	0.2	1.02
	4.8	1.39	12.0	0.99
	17.7	1.53	NA	NA
09/05/92	NA	NA	0.7	1.02
	6.2	1.44	13.2	1.04
	18.8	1.58	NA	NA
09/06/92	NA	NA	1.7	1.15
	7.2	1.60	14.1	1.15
	19.9	1.68	NA	NA
09/07/92	NA	NA	2.7	1.23
	8.1	1.62	14.9	1.17
	20.4	1.66	NA	NA
09/08/92	8.8	1.55	3.4	1.12
	21.1	1.59	15.7	1.08
09/09/92	9.6	1.55	4.0	1.04
	21.9	1.57	16.5	1.04
09/10/92	10.4	1.54	4.8	0.99
	22.5	1.55	17.2	1.02
09/11/92	10.8	1.66	4.8	1.05
	23.3	1.66	18.1	1.12
09/12/92	11.4	1.71	6.1	1.14
	23.7	1.64	18.5	1.12
09/13/92	12.1	1.69	6.7	1.09
	NA	NA	18.9	1.10
09/14/92	0.3	1.64	NA	NA
	12.7	1.70	7.0	1.08
	NA	NA	19.8	1.11
09/15/92	0.9	1.61	NA	NA
	13.1	1.69	7.6	1.07
	NA	NA	20.2	1.11
09/16/92	1.4	1.58	NA	NA
	13.9	1.62	8.1	1.05
	NA	NA	21.0	1.04
09/17/92	2.2	1.50	9.1	1.00
	14.6	1.57	21.8	1.02
09/18/92	2.9	1.43	9.8	0.96
	15.4	1.56	22.8	1.03

Source: NOAA Tide Station ,Hampton Roads, VA
NA - Not Available

TABLE 3-11

SUMMARY OF WATER SUPPLY WELLS WITHIN A ONE-MILE RADIUS OF SITE 41[1]
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	USGS Identification Number	Total Depth (feet)	Screened Intervals (feet)	Specific Capacity (gal/min/foot)	Estimated Transmissivities ($feet^2$/day)	Approximate Distance/ Direction from Site[3] (feet)
Site 41: HP-613	3442290772020.1	150	60-70 90-95 115-120 130-135 145-150	[2]	[2]	3960/southwest
HP-616	3442470772028.1	170	95-115 130-150 160-170	[2]	[2]	4750/west
HP-629	3444520771912.1	240	60 - 70 125 - 140 160 - 170 220 - 230	5.7	7,900	2220/northeast
HP-641	3449220771922.1	178	108 - 118 128 - 150 158 - 168	[2]	[2]	2220/southeast
HP-647	3443030772017.1	200	105 - 115 138 - 143 175 - 190	9.8	18,700	4120/northwest
HP-648	3442510771848.1	265	107 - 122 245 - 260	2.9	5,600	3960/east
HP-653	3442100771925.1	270	[2]	[2]	[2]	3330/southeast
HP-654	3442270771953.1	250	[2]	[2]	[2]	2060/southwest
HP-705	3443060772000.1	160	120 - 160	9.0	13,100	3170/northwest

TABLE 3-11 (CONTINUED)

SUMMARY OF WATER SUPPLY WELLS WITHIN A ONE-MILE RADIUS OF SITE 41[1]
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	USGS Identification Number	Total Depth (feet)	Screened Intervals (feet)	Specific Capacity (gal/min/foot)	Estimated Transmissivities (feet^2/day)	Approximate Distance/ Direction from Site[3] (feet)
HP-706	3442580771930.1	176	126 - 176	3.8	4,700	1580/north
HP-709	3442130771859.1	140	70 - 90 110 - 140	4.4	8,500	4590/southeast
HP-710	3442110771843.1	140	70 - 90 110 - 140	5.1	9,900	4910/southeast
LCH-4007	3443110771953.1	145	50 - 60 89 - 99 120 - 130 140 - 145	11.8	13,700	3330/northwest

Notes: (1) Information obtained from "Assessment of Hydrogeologic and Hydraulic Data at Camp Lejeune Marine Corps Base, North Carolina," 1989.
(2) Information not available.
(3) Distance measured from site location mark on Figure 3-21.

TABLE 3-12

SUMMARY OF WATER SUPPLY WELLS WITHIN A ONE-MILE RADIUS OF SITE 74[1]
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No.	USGS Identification Number	Total Depth (feet)	Screened Intervals (feet)	Specific Capacity (gal/min/foot)	Estimated Transmissivities ($feet^2$/day)	Approximate Distance/ Direction from Site[3] (feet)
Site 74: TC-190	3443170772737.1	180	130-140 150-180	[2]	[2]	5280/northeast
TC-1000	3443430772825.1	137	86-96 116-136	[2]	[2]	4750/north
TC-1001	344270772729.1	100	70-100	[2]	[2]	5280/northeast
TC-1255	3443290772736.1	250	124-132 156-166 180-190	[2]	[2]	4750/northeast
TC-1258	344350772805.1	204	124-134 154-164 182-192	2.9	5,600	4750/northeast

Notes: [1] Information obtained from "Assessment of Hydrogeologic and Hydraulic Data at Camp Lejeune Marine Corps Base, North Carolina," 1989.
[2] Information not available.
[3] Distance measured from site location mark on Figure 3-21.

SECTION 3.0 FIGURES

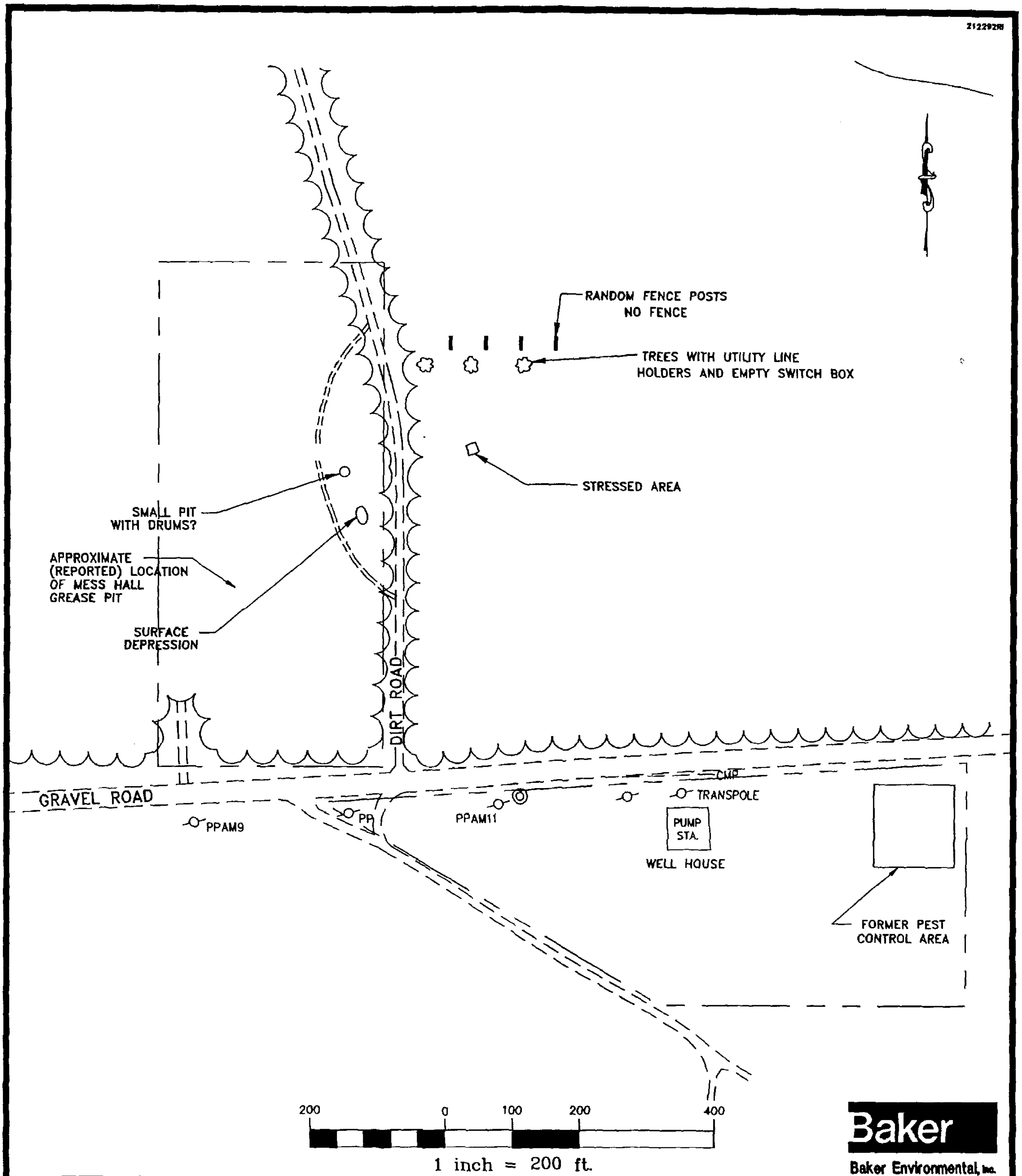
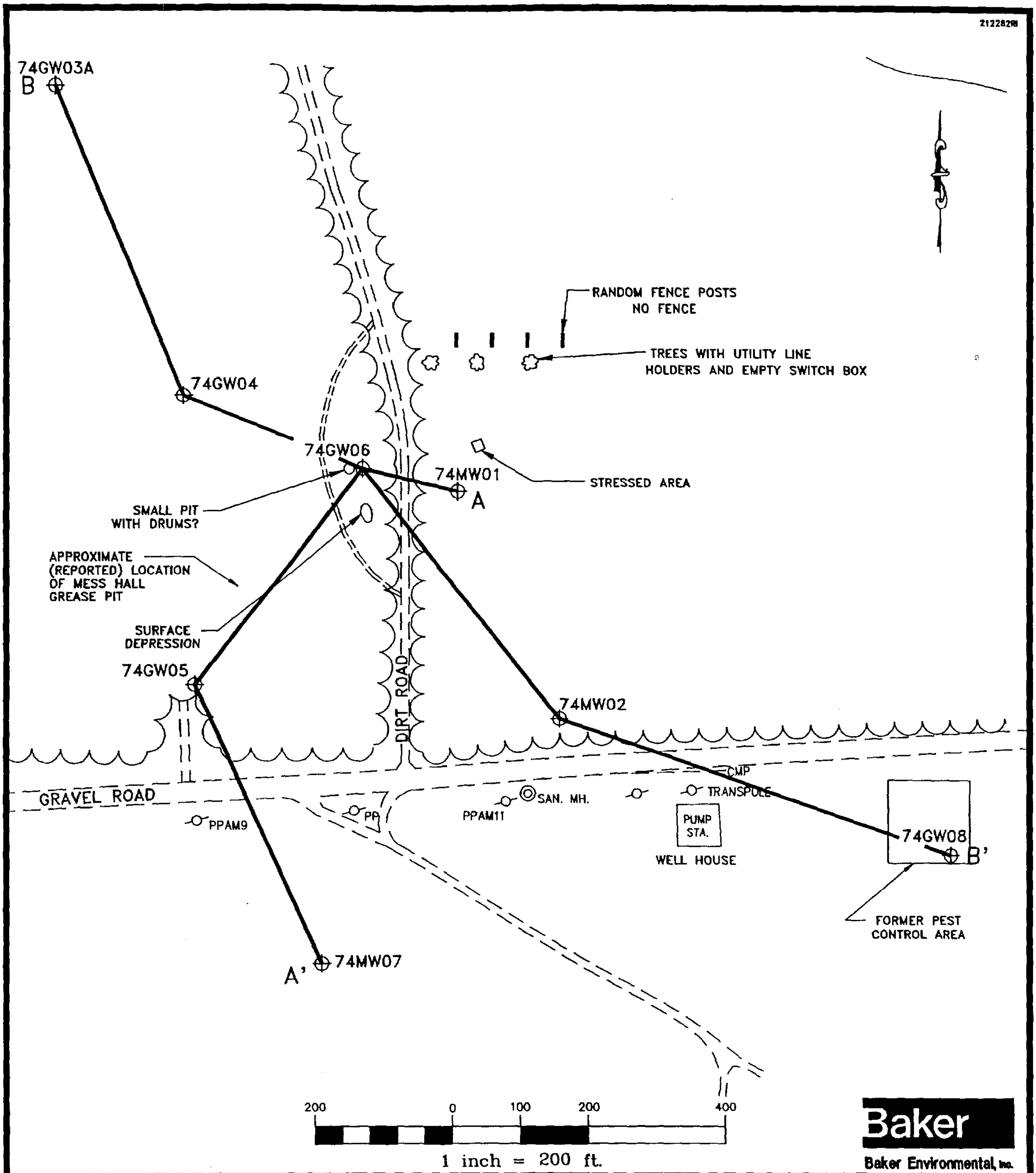


FIGURE 3-2
SURFACE FEATURES
SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: REVISED FROM LANTDIV. OCT. 1991



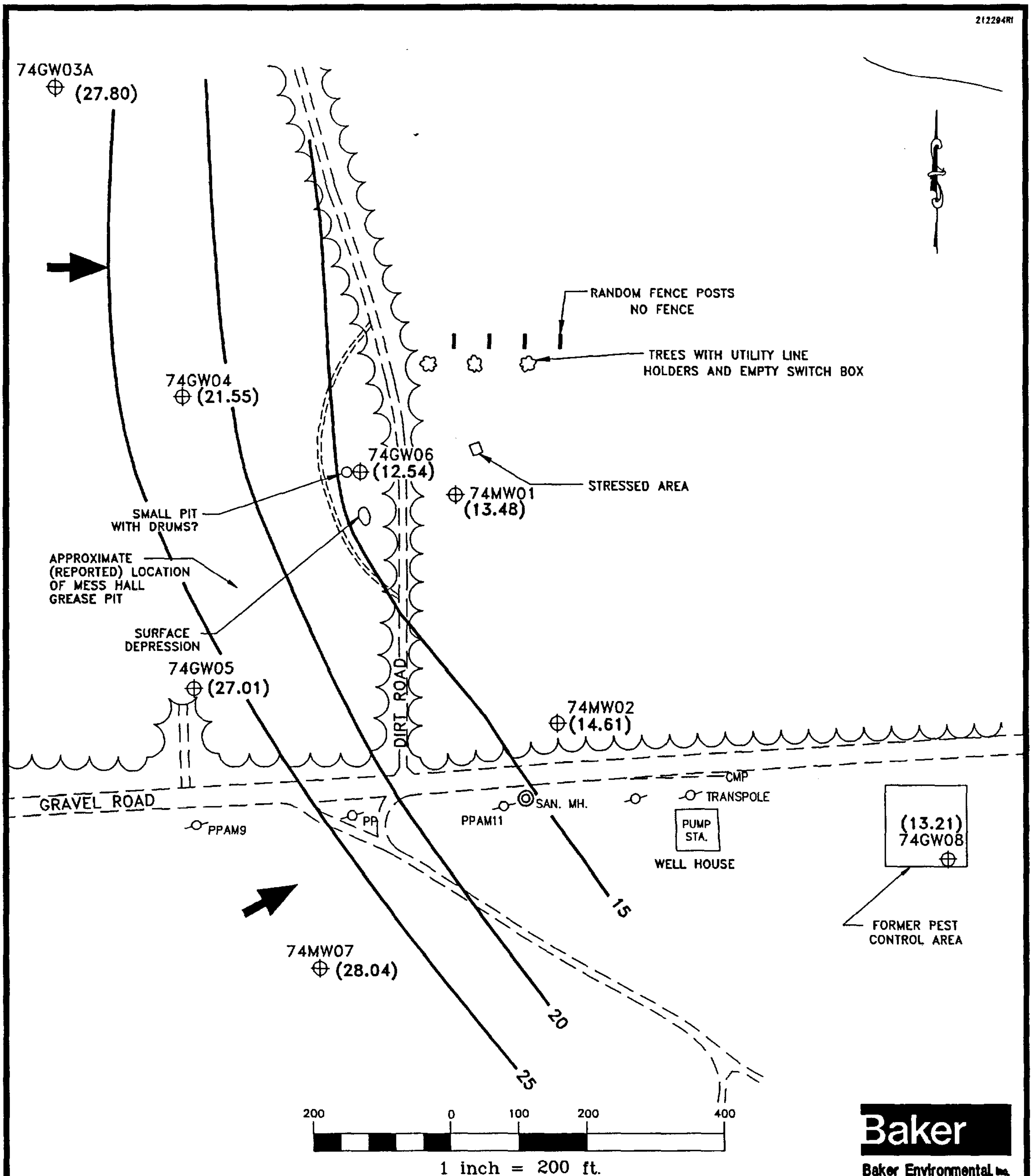
LEGEND

74GW01 ⊕ SHALLOW MONITORING WELL

A—A' CROSS-SECTION TRAVERSE

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 3-9
CROSS-SECTION LOCATION MAP
SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74GW01 SHALLOW MONITORING WELL

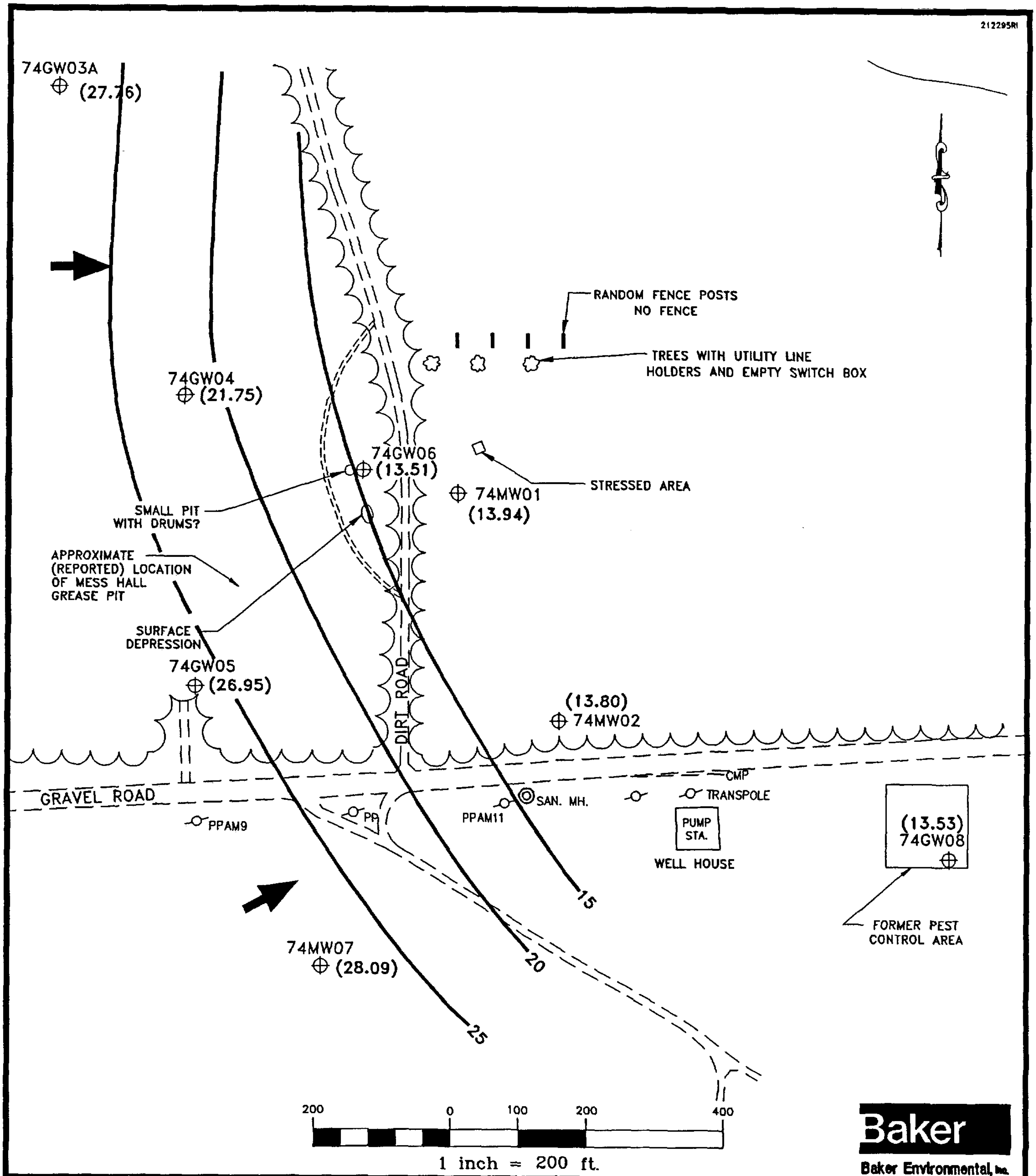
(28.09) GROUNDWATER ELEVATION (FEET, MEAN SEA LEVEL)

16 GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 3-16
SHALLOW GROUNDWATER ELEVATION CONTOURS-FEBRUARY 22, 1994-SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74GW01 SHALLOW MONITORING WELL

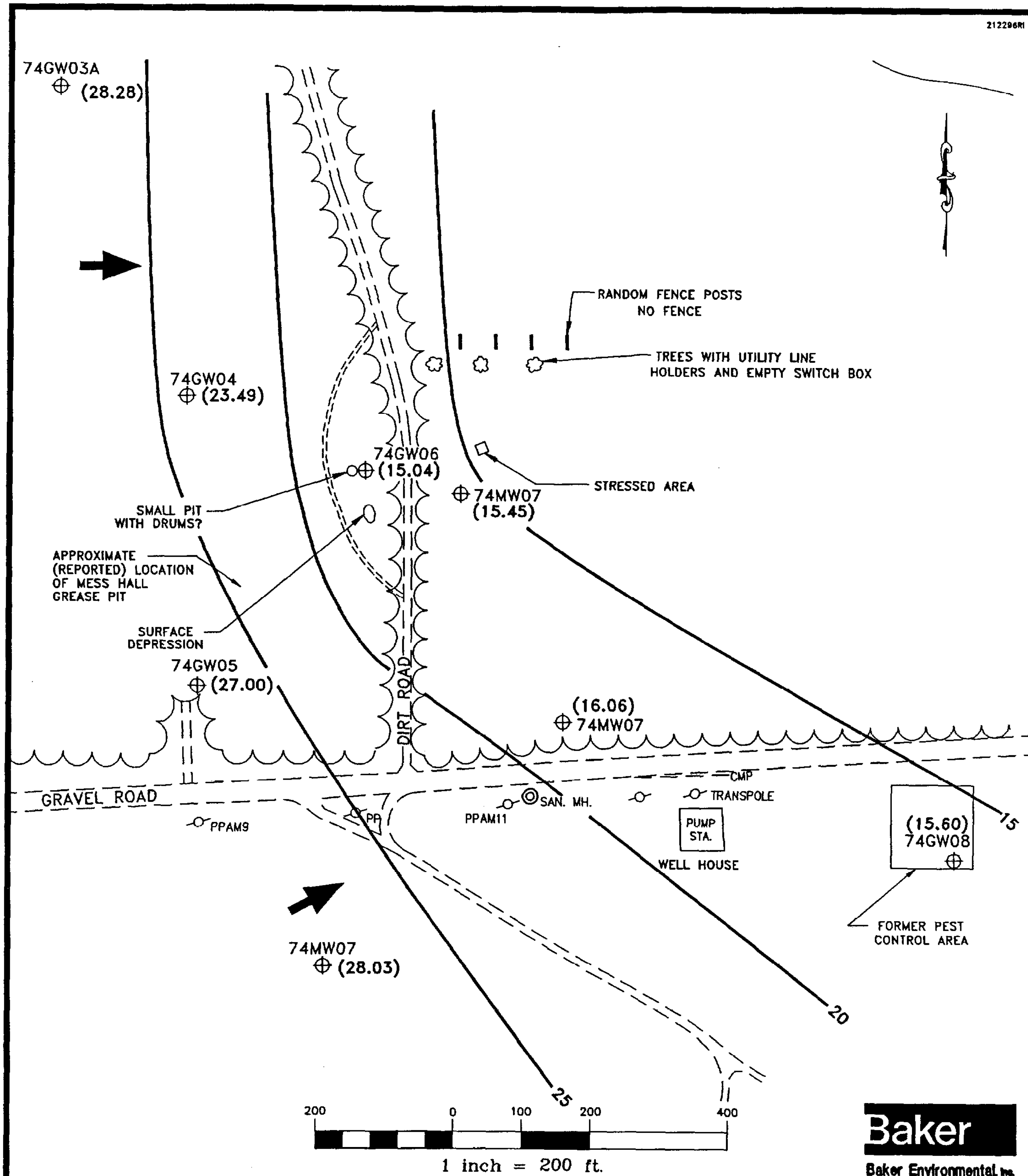
(28.09) GROUNDWATER ELEVATION (FEET, MEAN SEA LEVEL)

15 GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 3-17
SHALLOW GROUNDWATER ELEVATION CONTOURS-MARCH 1, 1994-SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74GW01 SHALLOW MONITORING WELL

(15.45) GROUNDWATER ELEVATION (FEET, MEAN SEA LEVEL)

15 GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 3-18
SHALLOW GROUNDWATER ELEVATION
CONTOUR-APRIL 29, 1994-SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents and evaluates the results of the remedial investigation performed at Operable Unit (OU) No. 4 (Sites 41 and 74). Results and evaluations for Sites 41 and 74 are each presented separately in Sections 4.1 and 4.2, respectively. The positive detection summary tables and detection figures referenced in this section for each site are presented at the end of Section 4. Appendices I through M present the Field Duplicate Summaries, TCLP Summary, Engineering Parameters Summary, Quality Assurance/Quality Control Summary, and Sampling Summaries of OU No. 4 for the various media. Appendix T presents Baker's Draft Report Evaluation of Metals in Groundwater, June 1994, prepared for the Department of the Navy, Atlantic Division Naval Facilities Engineering Command.

4.1 Data Quality

Analytical data generated during the RI was submitted for third-party validation to Chester Engineers, Inc. Procedures established by the National Functional Guidelines for Organic (USEPA, 1991a) and Inorganic (USEPA, 1988) Analyses were adhered to during the validation process. Validation of the analytical data, through established procedures, served to reduce the inherent uncertainties associated with its usability. Data qualified as "J" were retained as estimated. Estimated analytical results within a data set are common and considered usable by the USEPA. Data may be qualified as estimated for several reasons, including an exceedance of holding times, high or low surrogate recovery, or intra-sample variability. In addition, values may be assigned an estimated "J" qualifier if the reported value is below the Contract Required Detection Limit (CRDL) or the Contract Required Quantitation Limit (CRQL). Data assigned a rejected "R" qualifier were excluded from the usable data set.

Analyses for over 12,000 separate contaminants were included in the Site 41 evaluation. Over 9,000 separate contaminants were analyzed for during the Site 74 evaluation.

Additional data qualifiers were employed during the validation of data. The "NJ" qualifier denotes that a compound was tentatively identified, but the reported value may not be accurate or precise. Compounds which were not detected and had inaccurate or imprecise quantitation limits were assigned the "UJ" qualifier.

4.1.1 Data Management and Tracking

The management and tracking of data from the time of field collection to receipt of the validated electronic analytical results is of primary importance and reflects the overall quality of the analytical results. Field samples and their corresponding analytical tests were recorded on the chain-of-custody sheets, which are included as Appendix D. The chain-of-custody forms were checked against the Field Sampling and Analysis Plan (Baker, 1993) to determine if all designated samples were collected for the appropriate parameters. Upon receipt of the laboratory results, a comparison to the field information was made to determine if each sample received by the laboratory was analyzed for the correct parameters. Similarly, the validated information was compared to laboratory information as a final check. In summary, the tracking information was used to identify the following items:

- Identify sample discrepancies between the analysis plan and the field investigation.

- Verify that the laboratory received all samples, and analyzed for the correct parameters.

- Verify that the data validator received a complete data set.

- Ensure that a complete data set was available for each media of concern prior to entering results into the database.

4.2 Non-Site Related Analytical Results

Many of the organic and inorganic constituents detected in soil, groundwater, surface water, and sediments at Sites 41 and/or 74 are attributable to non-site related conditions or activities. Two primary sources of non-site related results include laboratory contaminants and naturally-occurring inorganic elements. In addition, non-site related operational activities and conditions may contribute to "on-site" contamination. A discussion of non-site related analytical results for Sites 41 and/or 74 is provided in the following subsections.

4.2.1 Laboratory Contaminants

Blank samples provide a measure of contamination that has been introduced into a sample set during the collection, transportation, preparation, and/or analysis of samples. To remove non-site related contaminants from further consideration, the concentrations of chemicals detected in blanks were compared with concentrations of the same chemicals detected in environmental samples.

Common laboratory contaminants (i.e., acetone, 2-butanone, chloroform, methylene chloride, toluene, and phthalate esters) were considered as positive results only when observed concentrations exceeded ten times the maximum concentration detected in any blank. If the concentration of a common laboratory contaminant was less than ten times the maximum blank concentration, then it was concluded that the chemical was not detected in that particular sample (USEPA, 1989). The maximum concentrations of detected common laboratory contaminants in blanks for Site 41 were as follows:

- acetone 2J µg/L
- methylene chloride 8J µg/L

The maximum concentrations of detected common laboratory contaminants in blanks for Site 74 were as follows:

- acetone 47J µg/L
- methylene chloride 8J µg/L
- di-n-butylphthalate 2J µg/L
- chloroform 10J µg/L

Organic constituents contained in blanks that are not considered common laboratory contaminants (i.e., all other TCL compounds) were considered as positive results only when observed concentrations exceeded five times the maximum concentration detected in any blank (USEPA, 1989a). All TCL compounds of less than five times the maximum level of contamination noted in any blank were considered to be not detected in that sample. The maximum concentrations of all other detected blank contaminants for Site 41 were as follows:

- heptachlor 0.03J µg/L

No contaminants were detected in blanks for Site 74 except those considered common laboratory contaminants.

A limited number of solid environmental samples that exhibited high concentrations of tentatively identified compounds (TICs) underwent an additional sample preparation. Medium level sample preparation provides a corrected Contract Required Quantitation Limit (CRQL) based on the volume of sample used for analysis. The corrected CRQL produces higher detection limits than the low level sample preparation. A comparison to laboratory blanks used in the medium level preparation was used to evaluate the relative amount of contamination within these samples.

4.2.2 Naturally-Occurring Inorganic Elements

In order to differentiate inorganic contamination due to site operations from naturally-occurring inorganic elements in site media, the results of the sample analyses were compared to information regarding background conditions at MCB, Camp Lejeune. The following guidelines were used for each media:

Soil:	MCB, Camp Lejeune Background Soil Samples
Groundwater:	MCB, Camp Lejeune Background Groundwater Samples
Surface Water:	MCB, Camp Lejeune Base Upgradient Levels
Sediments:	MCB, Camp Lejeune Base Upgradient Levels

The following subsections address the various comparison criteria used to evaluate the analytical results from soil, groundwater, surface water, and sediment samples collected at Site 41 and/or 74.

4.2.2.1 Soil

In general, chemical-specific ARARs are not available for soil. As a result, base-specific background concentrations have been compiled from a number of locations throughout MCB, Camp Lejeune to evaluate background levels of inorganic elements in the surface and subsurface soil. Organic contaminants, unlike inorganic elements, are not naturally-occurring. Therefore, it is probable that all organic contaminants detected in the surface and subsurface soil are attributable to activities which have or are currently taking place within or surrounding the study area.

Typical background concentration values for inorganic elements in soil at MCB, Camp Lejeune are presented in Table 4-4. These ranges are based on analytical results of background samples collected in areas not known to have been impacted by site operations or disposal activities at MCB, Camp Lejeune. In subsequent sections, which discuss the analytical results of samples collected during the soil investigation, only those inorganic parameters with concentrations exceeding these ranges will be considered.

4.2.2.2 Groundwater

Monitoring wells were located in upgradient directions of Sites 41 and 74 to provide groundwater data to assess background conditions in groundwater. Background wells are often installed to assess the natural state and quality of groundwater. Natural in this sense implies that the groundwater has not been altered due to human activity. In some cases, these monitoring wells provide data that is representative of naturally occurring conditions. In other cases, these wells may not be representative of naturally occurring conditions, if other base-related activities have altered the natural state of groundwater. In the latter cases, these wells would produce "control" samples. Control samples are samples which may not represent background conditions, but represent the current state of groundwater quality upgradient of the site. During the past four years, a number of background wells have been installed throughout the Base as part of individual site investigations. Most of the background wells installed throughout the base produce control samples. The data collected from these wells have generated data that is representative of "base-wide" groundwater quality.

Chemical-specific ARARs are available for evaluation of groundwater analytical results. In the subsequent sections, which address the analytical results of samples collected during the groundwater investigation, only those inorganic parameters with concentrations exceeding applicable Federal and/or State regulations will be discussed. In order to supplement comparison criteria, a number of base-specific background (i.e., upgradient) samples were compiled as part of a study to evaluate levels of inorganic elements in groundwater at MCB, Camp Lejeune (refer to Appendix T).

Groundwater samples were analyzed for total and dissolved (i.e., "filtered") inorganic parameters. Concentrations of dissolved inorganics were found to be generally lower than total inorganics for each sample, particularly for metals such as chromium, iron, lead and manganese. A 0.45-micron filter was used in the field to remove small particles of silt and clay that would otherwise be dissolved during sample preservation and generate an unrealistically high apparent value of metals in groundwater. The total metals, or unfiltered samples, thus reflect the concentrations of inorganics in the natural lithology and inorganic elements dissolved in the groundwater.

To more accurately represent total metals in groundwater, a "low-flow" purging technique has been adopted at MCB, Camp Lejeune. This technique allows for the purging of groundwater monitoring wells at a low rate prior to sampling. This reduces the amount of suspended solids in the groundwater sample which contributes to the overall concentration of metals. This "low-flow" purging allows for the collection of a much more representative sample. The procedures followed for this purging were based on discussions with the USEPA Region IV research office in Athens, Georgia. The USEPA is currently researching the use of "low-flow" purging and sampling, and anticipates issuing Standard Operating Procedures (SOPs) later this year.

Relatively high concentrations of metals in unfiltered groundwater are not considered abnormal, based on experience gained from several other studies at MCB, Camp Lejeune (see Appendix T). The difference between the two analytical results (i.e., total and filtered) is important in terms of understanding and separating naturally-occurring elements (e.g. lead) from contamination by site operations (e.g., lead in gasoline).

USEPA Region IV requires that unfiltered inorganic concentrations be used in evaluating ARARs and risk to human health and the environment. In the subsequent sections, which discuss the groundwater sample analytical results, both total and dissolved inorganics (which exceed applicable Federal and/or State standards) will be presented and discussed.

Groundwater in the MCB, Camp Lejeune area is naturally rich in iron and manganese. Iron and manganese concentrations (i.e., total and dissolved) in groundwater at MCB, Camp Lejeune often exceed the Federal MCLs and NCWQS of 300 and 50 μg/L, respectively. Elevated levels of iron and manganese, at concentrations above the NCWQS, were reported in samples collected from a number of base potable water supply wells which were installed at depths greater than 162 feet bgs (Greenhorne and O'Mara, 1992). Iron and manganese concentrations in several monitoring wells at Site 16 exceeded the MCLs and NCWQS but fell within the range of concentrations for samples collected elsewhere at MCB, Camp Lejeune. There is no record of any historical use of iron and manganese at Site 16. In light of this, it is assumed that iron and manganese are naturally-occurring inorganic elements in groundwater, and their prescence is not attributable to site operations.

4.2.2.3 Surface Water and Sediment

Surface water and sediment samples have been collected at four sites at MCB Camp Lejeune and the results summarized for metals. Samples were collected from the following areas:

Site 6 - Bearhead Creek
Wallace Creek

Site 78 - Beaver Dam Creek
Codgels Creek

Site 41 - unnamed tributary
Tank Creek
northeast tributary to unnamed tributary

Site 69 - Everett Creek
New River
unnamed tributary

Metal concentrations in surface water at the Base vary widely. A total of 94 samples had been analyzed for metals with aluminum, barium, calcium, iron, magnesium, manganese, potassium, and sodium detected in at least 75 percent of the samples. These metals exhibited the highest detected concentrations within the metals. Appendix U contains a summary of the frequency of detection with the calculated average for each metal.

The most detected metals in sediments include aluminum, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, potassium, sodium, vanadium, and zinc. These metals were detected in approximately 70 percent of the samples. Appendix U contains a summary of the frequency of detection with the calculated average for each metal.

4.3 State and Federal Criteria and Standards

Contaminant concentrations can be compared to contaminant-specific established State and Federal criteria and standards such as Maximum Contaminant Levels (MCLs) or Ambient Water Quality Criteria (AWQC).

The only enforceable Federal regulatory standards for water are the Federal MCLs. In addition to the Federal standards, the State of North Carolina has developed the North Carolina Water Quality Standards (NCWQS) for groundwater and surface water. Regulatory guidelines were used for comparative purposes to infer the potential health risks and environmental impacts when necessary. Revelant regulatory guidelines include AWQC and Health Advisories.

In general, chemical-specific criteria and standards are not available for soil. Therefore, base-specific background concentrations were compiled to evaluate background levels of inorganic constituents in the surface and subsurface soil. Organic contaminants were not detected in the base-specific background samples. Therefore, it is likely that all organic contaminants detected in the surface and subsurface soil, within OU No. 4, are attributable to the practices which have or are currently taking place within the areas of concern. Additionally, in order to evaluate soil concentrations, the risk-based concentrations (RBCs) for residential soil ingestion developed by USEPA (Region III) were used as guidance criteria to evaluate soil concentrations. The RBCs were used as a benchmark for evaluating site investigation data and to assist in predicting single-contaminant health risks. These values were used in conjunction with other criteria in the selection of the COPCs.

A brief explanation of the criteria and standards used for the comparison of site analytical results is presented below.

Maximum Contaminant Levels - MCLs are enforceable standards for public water supplies promulgated under the Safe Drinking Water Act and are designed for the protection of human health. MCLs are based on laboratory or epidemiological studies and apply to drinking water supplies consumed by a minimum of 25 persons. They are designed for prevention of human health effects associated with a lifetime exposure (70-year lifetime) of an average adult (70 kg) consuming 2 liters of water per day. MCLs also consider the technical feasibility of removing the contaminant from the public water supply.

North Carolina Water Quality Standards (Groundwater) - NCWQSs are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or which otherwise render the groundwater unsuitable for its intended purpose.

Ambient Water Quality Criteria - AWQCs are non-enforceable regulatory guidelines and are of primary utility in assessing acute and chronic toxic effects in aquatic systems. They may also be used for identifying the potential for human health risks. AWQCs consider acute and chronic effects in both freshwater and saltwater aquatic life, and potential carcinogenic and noncarcinogenic health effects in humans from ingestion of both water (2 liters/day) and aquatic organisms (6.5 grams/day), or from ingestion of water alone (2 liters/day). The AWQCs for the protection of human health for potential cacinogenic substances are based on the USEPA's specified incremental cancer risk range of one additional case of cancer in an exposed population of 10,000,000 to 100,000 (i.e., the 10E-7 to 10E-5 range).

North Carolina Water Quality Standards (Surface Water) - The NCWQSs for surface water are the standard concentrations, that either alone or in combination with other wastes, in surface waters that will not render waters injurious to aquatic life or wildlife, recreational activities, public health, or impair waters for any designated use.

Region IV Sediment Screening Values - Federal sediment quality criteria for the protection of aquatic life are being developed. In the interim, the EPA Region IV Waste Management Division recommends the use of sediment values compiled by the National Oceanic and Atmospheric Administration (NOAA) as screening values for evaluating the potential for chemical constituents in sediments to cause adverse biological effects. NOAA developed this screening method through evaluation of biological effects data for aquatic (marine and freshwater) organisms, obtained through equilibrium partitioning calculations, spiked-sediment bioassays, and concurrent biological and chemical field surveys. For each constituent having sufficient data available, the concentrations causing adverse biological effects were arrayed, and the lower 10 percentile (called an Effects Range-Low, or ER-L) and the median (called Effects Range-Median, or ER-M) were determined.

If sediment contaminant concentrations are above the ER-M, adverse effects on the biota are considered probable. If contaminant concentrations are between the ER-L and the ER-M, adverse effects are considered possible, and EPA recommends conducting sediment toxicity tests as a follow-up. If contaminant concentrations are below the ER-L, adverse effects are considered unlikely.

4.4 Site 41 - Camp Geiger Dump Near Former Trailer Park

The analytical results, the extent of contamination, and a summary of the findings for Site 41 surface soil, subsurface soil, groundwater, surface water, and sediment are presented in the following sections.

4.4.1 Surface Soil

4.4.1.1 Analytical Results

Surface soil positive detection summaries for organics and inorganics are presented in Tables 4-1 and 4-2, respectively.

Organics

Based on the analytical results for organics, semivolatile organic compounds (SVOCs) and pesticides were the most frequently detected contaminants in surface soil at Site 41. The concentrations of SVOCs ranged from very low to moderately high in surface soil at Site 41. The majority of SVOCs detected can be associated with the reported open burning activities and disposal of POL wastes. Detected SVOCs that are known laboratory contaminants were bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and di-n-octylphthalate.

Pesticide concentrations in surface soil were low. The volatile organic compound (VOC) toluene was detected at low levels in isolated areas of the site. Other VOC contaminants detected were methylene chloride and acetone, which are known artifacts that result from field decontamination procedures and laboratory procedures.

The ordnance compound 1,3-di-nitrobenzene was detected in one surface soil sample.

Summarized below are the organic compounds detected in surface soil at Site 41. This summary includes the range of positive detections [i.e., above the reported contract required quantitation level (CRQL)], the location where the maximum concentrations were detected, and the frequency of detection.

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Methylene Chloride	2J - 5J	41-OS-SB09-00	13/46
Acetone	3J - 2,800J	41-OS-SB19-00	11/46
Toluene	1J - 4J	41-OS-SB25-00	3/46
SEMIVOLATILES			
1,4-Dichlorobenzene	180J - 180J	41-OS-SB12-00	1/46
2-Methylnaphthalene	55J - 55J	41-OS-SB12-00	1/46
Acenaphthene	91J - 380J	41-OS-SB10-00	2/46
Anthracene	41J - 510	41-OS-SB10-00	3/46
Benzo(a)anthracene	130J - 2,400	41-OS-SB10-00	4/46
Benzo(a)pyrene	40J - 2,000	41-OS-SB10-00	5/46
Benzo(b)fluoroanthene	38J - 2,500	41-OS-SB10-00	6/46
Benzo(g,h,i)perylene	46J - 1,600	41-OS-SB10-00	4/46
Benzo(k)fluoranthene	50J - 1,700	41-OS-SB10-00	6/46
Bis(2-chloroethyl)ether	57J - 220J	41-OS-SB34-00	6/46
Bis(2-ethylhexyl)phthalate	42J - 580J	41-OS-SB12-00	12/46
Carbazole	44J - 330J	41-OS-SB10-00	2/46
Chrysene	49J - 2,300	41-OS-SB10-00	6/46
Dibenzofuran	130J - 130J	41-OS-SB10-00	1/46
Dibenzo(a,h)anthracene	57J - 57J	41-OS-SB12-00	1/46
Di-n-butylphthalate	42J - 230J	41-OS-SB02-00	13/46
Di-n-octylphthalate	40J - 200J	41-OS-SB18-00	6/46
Fluoranthene	40J - 2,500	41-OS-SB14-00	8/46
Fluorene	79J - 280J	41-OS-SB10-00	2/46
Indeno(1,2,3-cd)pyrene	71J - 76J	41-OS-SB20-00	2/46
Naphthalene	70J - 70J	41-OS-SB12-00	1/46
Phenanthrene	72J - 2,600	41-OS-SB10-00	6/46
Pyrene	50J - 2,300J	41-OS-SB14-00	7/46
PESTICIDES/PCBs			
beta-BHC	4.72NJ - 4.72NJ	41-DS-SB03-00	1/46
delta-BHC	0.03NJ - 0.03NJ	41-OS-SB26-00	1/46
Lindane (gamma-BHC)	0.22NJ - 0.22NJ	41-OS-SB32-00	1/46
Heptachlor	0.3NJ - 7.16	41-OS-SB03-00	5/46

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Heptachlor Epoxide	0.56J - 9.6J	41-OS-SB03-00	5/46
Dieldrin	0.2NJ - 13.03NJ	41-OS-SB08-00	17/46
4,4'-DDE	0.12J - 87.6J	41-OS-SB08-00	34/46
Endrin	1.47J - 2.93J	41-OS-SB03-00	5/46
Endosulfan II	0.45NJ - 5.01J	41-OS-SB22-00	13/46
4,4'-DDD	0.37J - 92J	41-OS-SB12-00	19/46
Endosulfan Sulfate	0.32J - 3.59J	41-OS-SB03-00	5/46
4,4'-DDT	0.37J - 277J	41-OS-SB14-00	29/46
Methoxychlor	1.41J - 3.28NJ	41-OS-SB03-00	3/46
Endrin Ketone	0.44NJ - 0.44NJ	41-OS-SB19-00	1/46
Endrin Aldehyde	0.61J - 1.37J	41-OS-SB12-00	7/46
Alpha-Chlordane	0.08J - 92.7J	41-OS-SB03-00	16/46
Gamma-Chlordane	0.06NJ - 93.5J	41-OS-SB03-00	16/46
Aroclor 1242	82.9J - 82.9J	41-OS-SB19-00	1/46
Aroclor 1260	58.4J - 58.4J	41-OS-SB23-00	1/46
ORDNANCE			
1,3-Di-nitrobenzene	824NJ - 824NJ	41-DS-SB03-00	1/46

Inorganics

Inorganics were detected in all surface soil samples at Site 41. The inorganics detected in surface soil are summarized below. The summary includes the range of positive detections, location of the highest concentration, and the frequency of detection. Thallium was the only inorganic not detected in the surface soil at Site 41.

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	878 - 17,400J	41-OS-SB12-00	46/46
Antimony	2.18J - 2.57	41-OS-SB11-00	2/46
Arsenic	0.671 - 4.42	41-OS-SB17-00	19/46
Barium	3.14 - 82.2	41-OS-SB12-00	46/46
Beryllium	0.187 - 0.344	41-OS-SB14-00	12/46
Cadmium	0.854 - 7.44	41-OS-SB12-00	5/46
Calcite	32.9 - 40,300	41-OS-SB17-00	42/46
Chromium	2.19 - 41.4	41-OS-SB12-00	41/46
Cobalt	6.46 - 6.46	41-OS-SB12-00	1/46
Copper	4.17 - 132	41-OS-SB12-00	15/46
Iron	397 - 91,600	41-OS-SB12-00	46/46
Lead	2.57J - 341J	41-OS-SB12-00	46/46
Magnesium	28.1 - 1,100	41-OS-SB17-00	46/46
Manganese	1.67J - 6,000J	41-OS-SB12-00	44/46
Mercury	0.073 - 0.768	41-OS-SB12-00	22/46
Nickel	7.36 - 35.3	41-OS-SB12-00	4/46
Potassium	184 - 547	41-OS-SB17-00	14/46
Selenium	0.357 - 0.596	41-OS-SB15-00	3/46
Silver	0.096 - 18.3J	41-DS-SB10-00	3/46
Sodium	84.7 - 230	41-OS-SB12-00	8/46
Vanadium	4.62 - 39.8	41-OS-SB14-00	31/46
Zinc	3.77J - 14,600	41-OS-SB12-00	42/46
Total Cyanide	1.09 - 1.57	41-DS-SB07-00	46/46

4.4.1.2 Background Surface Soils

Soil samples were collected from four background soil borings near Site 41. Site 41 background soil borings were located to the northeast of the site near the northeast tributary that discharges into the unnamed tributary (refer to Figure 4-1). Tables 4-3 and 4-4 present positive detection summaries for organics and inorganics, respectively for site background samples. Volatiles were not detected in any of the background samples. The semivolatile 2-chloronaphthalene was detected in sample 41-BB-SB02-00 at a concentration of 280.0J µg/kg.

Sample 41-BB-SB01-00 exhibited 4,4'-DDE (49.0J µg/kg), endosulfan II (2.76NJ µg/kg), 4,4'-DDD (34.2J µg/kg), 4,4'-DDT (6.33J µg/kg), and endrin ketone (1.70J µg/kg). 4,4'-DDE and 4,4'-DDT were detected in sample 41-BB-SB04-00 at concentrations of 2.62J µg/kg and 1.81J µg/kg, respectively. Background pesticides levels were low and within comparable values for soils at MCB Camp Lejeune.

No PCBs, chemical surety degradation compounds, or ordnance constituents were detected in background samples.

Fourteen of 24 inorganics were detected (arsenic, beryllium, cadmium, cobalt, nickel, selenium, silver, sodium, thallium, and vanadium were not detected) in background samples. Table 4-5 presents a comparison of site surface soils to site-specific and base background levels. Inorganic concentrations in the background soils are comparable to values reported at other sites at Camp Lejeune. There are isolated detections above the base averages for all detected inorganics.

4.4.1.3 Extent of Contamination

Toluene, methylene chloride, and acetone were the only volatiles detected in surface soils at Site 41. Toluene was detected at low concentrations in 3 surface soil samples at isolated locations (see Figure 4-1). Two of the detections were on the east side of the site, with the remaining location in the northwest area. No specific source for toluene has been identified at the site. The toluene detected in the surface and subsurface soils is likely associated with historical reports indicating that wastes consisting of petroleum, oils, and lubricants were disposed at the dump. These types of wastes may account for the presence of toluene in the soils. Methylene chloride and acetone were also detected in surface soil samples; however, the presence of these compounds are likely the result of laboratory contamination and/or field decontamination procedures.

Semivolatile organic compounds (SVOCs) in surface soils were generally present over the central portion of Site 41. Figure 4-2 presents the detected concentrations of semivolatiles. A total of 23 individual semivolatiles were detected in 14 soil sampling locations. Locations 41-OS-SB10, 41-OS-SB12, 41-OS-SB18, and 41-OS-SB20 exhibited the greatest frequency and highest concentrations of semivolatiles. These sampling locations are within the central portion of the site. Sample 41-OS-SB10-00 exhibited the highest concentrations for twelve semivolatiles. Samples 41-OS-SB12-00 and 41-OS-SB12-00 exhibited the highest concentrations. The downslope samples (generally located around the perimeter of the site) were either non-detect or had very low concentrations for only one or two semivolatiles.

The semivolatiles detected in the surface soils are primarily polycyclic aromatic hydrocarbons (PAHs). The presence of PAHs can be attributed to the POL wastes (i.e., petroleum, oil and lubricants) reported to have been disposed of at the site. In addition, the presence of PAHs in soil may be indicative of burning, which has been documented as a means for destroying the wastes prior to disposal (Water and Air Research, 1983). No information is available as to specific quantities of POLs disposed of at the site.

Pesticides were detected at low concentrations throughout the site area. No specific area at Site 41 exhibited elevated levels of pesticides. Figure 4-3 presents the extent of pesticide contamination within the surface soil at Site 41. Pesticides were generally detected at concentrations less than 5 μg/kg at low concentrations throughout. Concentrations detected were similar to base wide concentrations from the historical use of pesticides at Camp Lejeune. The highest concentrations were detected for dieldrin [13.03NJ μg/kg (41-OS-SB08-00)], 4,4'-DDE [87.6J μg/kg (41-OS-SB08-00)], 4,4'-DDD [92J μg/kg (41-OS-SB12-00)], 4,4'-DDT [277J μg/kg (41-OS-SB14-00)], alpha-chlordane [92.7J μg/kg (41-OS-SB03-00)], and gamma-chlordane [93.5J μg/kg (41-OS-SB03-00)].

The frequency and concentrations of pesticides were generally the same for on-site and down slope samples. Site 41 was reported to have been used for the disposal of the pesticide mirex; however, no mirex was detected in any of the samples. The absence of mirex in surface soils may indicate that the mirex was buried in trenches and/or burned (destroyed). Historical usage of pesticides at Camp Lejeune for pest control has been well documented (Water and Air Research, 1983).

Figure 4-4 presents the detected concentrations of PCBs in surface soils. The PCB aroclor 1242 was detected in sample 41-OS-SB19-00 at a concentration of 82.9J μg/kg. Sample 41-OS-SB23-00 exhibited a concentration of 58.4J μg/kg for aroclor 1260. Historical records do not indicate the disposal of PCBs; however, oils and lubricants disposed at the site may have contained PCBs which would account for the presence of these concentrations.

The ordnance compound 1,3-di-nitrobenzene was detected at a concentration of 824NJ μg/kg in sample 41-DS-SB03-00 (refer to Figure 4-5). Site 41 may have been used to periodically destroy ordnance, based on observations made at the site by unexploded ordnance field personnel knowledgeable with ordnance disposal practices.

Inorganic levels in surface soils were generally higher than those reported for the site-specific background samples, but within background averages for MCB Camp Lejeune. Table 4-5 presents a comparison of inorganic levels in surface soils to base background levels. Maximum detected concentrations for inorganics were above background levels. Aluminum, barium, calcium, iron, magnesium, manganese, and zinc were detected at concentrations well above background. The central portion of the site exhibited the maximum concentrations for metals. Isolated sampling locations to the northwest and south of the central portion exhibited a few maximum metal concentrations.

4.4.2 Subsurface Soils

4.4.2.1 Analytical Results

Positive detection summaries of subsurface soils for organics and inorganics are presented in Tables 4-6 and 4-7, respectively.

Organics

SVOCs and pesticides, as in the surface soil, were detected most frequently in the subsurface soil. Concentrations for SVOCs were elevated, but lower than those reported for the surface soil. The laboratory contaminants bis-(2-ethylhexyl)phthalate, butyl benzyl phthalate, diethylphthalate, di-n-butylphthalate, and di-n-octylphthalate were detected at elevated to moderately high levels in the subsurface soil. Pesticide concentrations were elevated and frequently higher than those reported for the surface soil. VOCs detected in the subsurface soil were indicative of reported disposal practices at the site. Other VOC contaminants detected were methylene chloride and acetone, which are known artifacts that result from field decontamination procedures and laboratory procedures.

The PCBs aroclor 1254 and 1260 were reported in five samples in the subsurface soil at very low levels (less than 1 ppm).

The chemical surety degradation compound acetophenone was detected in one sample in the subsurface soil.

Summarized below are the organic compounds detected in the subsurface soil at Site 41. This summary includes the range of positive detections above the CRQL, location of the highest concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Chloromethane	2J - 3J	41-OS-SB01-02	2/66
Methylene Chloride	2J - 26J	41-OS-SB14-01	18/66
Acetone	4J - 6,000J	41-GW07-01	34/66
2-Butanone	1J - 15J	41-OS-SB17-02	8/66
Trichloroethene	1J - 1J	41-OS-SB02-02	1/66
Benzene	1J - 1J	41-OS-SB07-02	1/66
Chlorobenzene	4J - 100	41-OS-SB22-03	5/66
Ethylbenzene	7J - 58	41-OS-SB22-03	2/66
SEMIVOLATILES			
1,4-Dichlorobenzene	49J - 49J	41-GW11DW-01	1/66
2-Methylnaphthalene	41J - 550	41-OS-SB22-03	4/66
4-Chloro-3-methylphenol	61J - 61J	41-GW13-03	1/66
4-Methylphenol	53J - 53J	41-OS-SB22-03	1/66
Acenaphthene	52J - 130J	41-OS-SB12-02	3/66
Benzo(a)anthracene	71J - 160	41-GW11DW-01	2/66
Benzo(a)pyrene	74J - 4,700J	41-OS-SB14-01	6/66
Benzo(b)fluoranthene	75J -150J	41-GW11DW-01	2/66
Benzo(g,h,i)perylene	41J - 4,600J	41-OS-SB14-01	5/66
Benzo(k)fluoranthene	80J - 109	41-GW11DW-01	2/66
Bis(2-chloroethyl)ether	79J - 800J	41-OS-SB03-01	3/66
Bis(2-ethylhexyl)phthalate	39J - 7,200	41-OS-SB14-01	33/66
Butyl benzyl phthalate	88J - 88J	41-GW13-03	1/66
Carbazole	66J -66J	41-GW13-03	1/66
Chrysene	43J - 170	41-GW11-01	4/66
Dibenzofuran	48J - 48J	41-GW13-03	1/66
Diethylphthalate	110J - 110J	41-GW13-03	1/66
Di-n-butylphthalate	40J - 230J	41-OS-SB02-02	26/66
Di-n-oxylphthalate	40J - 1,600	41-OS-SB17-02	9/66
Fluoranthene	46J - 260J	41-GW11DW-01	5/66

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Fluorene	44J - 120J	41-OS-SB12-02	4/66
Ideno(1,2,3-cd)pyrene	105J - 105J	41-GW11DW-01	1/66
Naphthalene	45J - 290	41-OS-SB22-03	5/66
N-nitrosodiphenylamine	240 - 240	41-GW11DW-06	1/66
Phenanthene	39J - 260	41-GW11DW-01	5/66
Pyrene	52J - 290	41-GW11DW-01	6/66
PESTICIDES/PCBs			
delta-BHC	0.91J - 0.91J	41-OS-SB19-01	1/66
Lindane (gamma-BHC)	11.9J - 11.9J	41-OS-SB06-03	1/66
Heptachlor	0.68J - 18	41-OS-SB03-01	9/66
Aldrin	0.7J - 12.8J	41-OS-SB06-03	5/66
Heptachlor epoxide	0.4J - 11.5J	41-OS-SB03-01	5/66
Endosulfan I	0.78NJ - 2.92J	41-OS-SB18-01	5/66
Dieldrin	0.32J - 60NJ	41-OS-SB18-01	17/66
4,4'-DDE	0.32NJ - 39.6J	41-OS-SB14-01	27/66
Endrin	0.35J - 28.3J	41-OS-SB06-03	11/66
Endosulfan II	0.5NJ - 25.2NJ	41-OS-SB11-01	14/66
4,4'-DDD	0.34NJ - 1060J	41-OS-SB22-03	26/66
4,4'-DDT	0.68NJ - 302J	41-OS-SB14-01	10/66
Methoxychlor	5.47NJ - 5.47NJ	41-OS-SB14-02	1/66
Endrin Ketone	0.86J - 0.86J	41-OS-SB06-03	1/66
Endrin Aldehyde	0.85NJ - 4.38J	41-OS-SB18-01	9/66
Alpha-Chlordane	0.28J - 160J	41-OS-SB03-01	17/66
gamma-Chlordane	0.31J - 170J	41-OS-SB03-01	13/66
Aroclor 1254	36.7J - 214J	41-GW11-03	5/66
Aroclor 1260	34.6J - 317J	41-OS-SB16-01	5/66
CHEMICAL SURETY DEGRADATION COMPOUND			
Acetophenone	120J - 120J	41-OS-SB21-01	1/66

Inorganics

Inorganics were detected in all subsurface soil samples at Site 41. The inorganics detected in subsurface soil are summarized below. The summary includes the range of positive detection above CRQL, location of the maximum concentration, and the frequency of detection. Thallium was the only inorganic not detected in the subsurface soil at Site 41.

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	486 - 13,500J	41-GW09DW-05	66/66
Antimony	1.92J - 2.94	41-OS-SB06-01	4/66
Arsenic	0.518 - 3.02	41-OS-SB03-01	33/66
Barium	3.15 - 186	41-OS-SB11-01	63/66
Beryllium	0.187 - 0.31	41-OS-SB30-01	10/66
Cadmium	1.32 - 4.73	41-OS-SB11-01	3/66
Calcium	37.3 - 18,900	41-OS-SB08-01	60/66
Chromium	2.1 - 40.5J	41-OS-SB11-01	64/66
Cobalt	4.53 - 4.53	41-OS-SB18-01	1/66
Copper	3.77 - 39.8	41-OS-SB11-01	15/66
Iron	115J - 41,100	41-OS-SB18-01	66/66
Lead	0.894J - 829	41-OS-SB03-01	66/66
Magnesium	18.4 - 567	41-GW09DW-05	65/66
Manganese	1.63 - 244	41-OS-SB18-01	60/66
Mercury	0.057 - 0.312	41-GW11-01	17/66
Nickel	7.56 - 12.9	41-OS-SB18-01	2/66
Potassium	123 - 562	41-GW09DW-05	26/66
Selenium	0.373J - 0.948	41-OS-SB17-01	11/66
Silver	0.202 - 9.71J	41-GW07DW-06	4/66
Sodium	59.3 - 486	41-OS-SB11-01	10/66
Vanadium	4.79 - 25.7	41-GW07-04	44/66
Zinc	2.81J - 481	41-OS-SB11-01	57/66
Total Cyanide	1.06 - 1.63	41-OS-SB30-01	66/66

4.4.2.2 Background Subsurface Soils

Inorganic concentrations for subsurface soils are generally higher than background levels established from the Base database for subsurface soils (refer to Table 4-8).

4.4.2.3 Extent of Contamination

Results indicate the presence of volatiles, semivolatiles, pesticides, PCBs, and metals in subsurface soils. Chemical surety degradation compounds were detected to a limited degree in subsurface soils. Ordnance constituents were not detected in subsurface soils.

In addition to the reported disposal of hazardous substances at Site 41, historical records indicate that construction debris was also disposed at the site. This was confirmed from field observations made during the RI and from the results of the geophysical survey performed as part of the RI. The geophysical survey determined that the east-central portion of the site was underlain by ferrous and non-ferrous metallic objects. Based on the types of debris noted on the ground surface, it is believed that the debris consists of: construction debris, steel reinforced concrete, drums, fencing, or general scrap metal. The area delineated by the geophysical survey as containing debris or possible landfilled material is located in the central portion of the site and defines the boundary of the site. This area occupies a topographic high and is designated as the "on-site" area. Monitoring well boring 41-GW11DW encountered approximately 10 feet of fill. The fill was comprised of trash consisting of plastic and wire. This material was not encountered in any other borings.

The highest concentrations of VOCs, albeit low, in subsurface soils were detected in the central portion of the site. Six VOCs were detected in the subsurface (refer to Figure 4-6) as compared to only one VOC (toluene) in the surface soil. Constituents of fuels (benzene, chlorobenzene and ethylbenzene) were detected in subsurface soils but not in the surface soils. No one location or area exhibited a "pattern" or characteristic that would be associated with a significant source or disposal area. The relatively low levels of VOCs may support the theory that past burning operations could have destroyed a majority of the solvents or fuels taken to Site 41 for disposal.

SVOCs in subsurface soils were generally detected within the central portion of the site at depths between 1 and 5 feet. The frequency and concentrations of semivolatiles in subsurface soils were less than those reported for surface soils. Figure 4-7 presents the detected semivolatiles and concentrations.

Sample 41-OS-SB14-01 (1 to 3 feet) exhibited the highest SVOC concentrations [benzo(a)pyrene (4700J µg/kg) and benzo(g,h,i)perylene (4600J µg/kg)]. Samples 41-OS-SB12-02, 41-OS-SB16-01, and 41-OS-SB18-01 exhibited numerous SVOCs but at relatively low levels. These locations, including 41-OS-SB14-01, are in a line across the central portion of the site, as shown on Figure 4-7. The high concentrations and greater frequency of constituents within the central area of the site would support the theory that this area received wastes.

Pesticides were detected in subsurface soils, generally within the 1 to 3 foot depth. Detected concentrations of pesticides were above those reported for the surface soils. The highest concentration was for 4,4'-DDD (1060J µg/kg) in subsurface soil sample 41-OS-SB22-03. This contaminant was detected at 8.46 µg/kg in the surface soils at the same location. Pesticides were most frequently detected in subsurface soil within the central area of the site, which followed the pattern seen in the surface soils. Figure 4-8 presents the detected pesticides and concentrations. The areas away from the central portion of the site exhibited pesticides at depth, but at a much lower frequency and concentration than what was observed in the surface soil.

Aroclor 1254 and aroclor 1260 were the only detected PCBs in subsurface soils (refer to Figure 4-9). Samples exhibiting PCBs in the subsurface soil were 41-OS-SB16-01 (aroclor 1260), 41-OS-SB19-01 (aroclor 1254), 41-OS-SB23-01 (aroclor 1260) and 41-GW11-03 (aroclor 1254). PCB concentrations in the subsurface soils were detected in the 1 to 3 foot depth and at higher concentrations than in the surface soils. PCBs in surface and subsurface soil were detected within the central portion of Site 41.

The only chemical surety degradation compound detected in subsurface soil was acetophenone. This constituent was detected in sample 41-OS-SB21-02 (depth 3 to 5 feet) at a concentration of 120 µg/kg (refer to Figure 4-10). Location 41-OS-SB21 is located in the southwestern portion of the site. This area exhibited high conductivity values by the geophysical survey. The high conductivity values may be indicative of landfill type materials.

Metals in concentrations subsurface soil were generally within background levels for MCB Camp Lejeune. Metals which were significantly above background levels include aluminum, calcium, iron, manganese, and zinc. These same metals were also identified in the surface soils above background levels. Table 4-6 presents a comparison of inorganic levels in subsurface soils to base background levels. Inorganics were primarily present within the subsurface soils of the central portion of the site.

4.4.3 Groundwater

Two rounds of groundwater samples were collected and analyzed for all monitoring wells installed at Site 41. The first round was collected in February 1994 and the second round was collected in April 1994. In August 1994, a third round of samples were collected from four shallow monitoring wells (41-GW02, 41-GW07, 41-GW10, and 41-GW11) using a low-flow purging technique. This technique was employed to reduce or eliminate suspended solids, which were believed to contribute to elevated total metal concentrations.

For the third sampling event, samples were analyzed for pesticides/PCBs, and total and dissolved metals. The results from the low flow purge sampling have been incorporated into the positive detection summary tables for Site 41. To incorporate the analytical results, it was necessary to add the sample as a separate column in the organics summary tables. Since only pesticides/PCBs were analyzed in the third round, the other organics are listed as not analyzed (NA). For the Round Two sample, pesticides/PCBs are listed as "NA". This allowed for the calculation of frequency and average to remain consistent for the human health risk assessment. For inorganics, the analytical results were directly substituted for the Round Two results.

4.4.3.1 Analytical Results

Summary of Round One

Round One shallow and deep groundwater analytical results for Site 41 are provided in Table 4-9 for organics, and Tables 4-10 and 4-11 for metals (total and dissolved metals, respectively).

Shallow Aquifer

Organics

VOCs were the most frequently detected organic compounds in the shallow aquifer at Site 41. Concentrations for VOCs were low. The detected VOCs were consistent with reported disposal practices at the site. SVOC contaminates included naphthalene in one well, and the known artifacts associated with laboratory procedures of bis(2-ethylhexyl)phthalate and di-n-butylphthalate. These VOCs were detected at low concentrations.

Pesticides were detected at low concentrations and in isolated wells.

No PCBs chemical surety degradation compounds, or ordnance compounds were detected in the shallow aquifer at Site 41.

Presented below is a summary of the detected organic compounds above the CRQL. This summary includes the Federal and State drinking water standards, the range of positive detections or organics, the location of the highest concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
Chloroform	100	0.19	1.36J - 3.17J	41-GW10	2/12
Bromodichloromethane	100	--	1.05J - 1.05J	41-GW09	1/12
Dibromodichloromethane	--	--	1.95J - 1.95J	41-GW09	1/12
Benzene	5	1	2.67J - 2.67J	41-GW11	1/12
Bromoform	100	0.19	1.33 - 1.33	41-GW09	1/12
Chlorobenzene	--	50	1.49J - 1.49J	41-GW11	1/12
SEMIVOLATILES					
Bis(2-ethylhexyl) phthalate	--	--	1J - 1J	41-GW13	1/12
Di-n-butylphthalate	--	700	1J - 2J	41-GW03/ 41-GW04	3/12
Naphthalene	--	--	3J - 3J	41-GW11	1/12
PESTICIDES					
alpha-BHC	--	--	0.01J - 0.01J	41-GW09	1/12
beta-BHC	--	--	0.04J - 0.08J	41-GW09	2/12
4,4'-DDD	--	--	0.01NJ - 0.01NJ	41-GW11	1/12

Inorganics

Metals were detected in all surficial groundwater samples at Site 41. The total and dissolved metals detected above Federal and/or State drinking water standards in the surficial aquifer are summarized below. The summary includes the applicable Federal and State standards, the range of positive detections above standards, location of the maximum concentration, and the frequency of detection.

Metals Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Antimony	6	--	17.9J - 17.9J	41-GW11	1/12
Beryllium	4	--	4.53 - 42.8	41-GW12	6/12
Cadmium	5	5	6.26 - 110	41-GW11	6/12
Chromium	100	50	54.4 - 176	41-GW10	9/12
Copper	1,000	1,000	1,030 - 1,030	41-GW11	1/12
Iron	300	300	13,600 - 160,000	41-GW12	12/12
Lead	15	15	19.8 - 9,340	41-GW11	10/12
Manganese	50	50	56.6 - 2,110	41-GW11	12/12
Nickel	100	--	68.1J - 137	41-GW11	2/12
Silver	--	50	63.4J - 63.4J	41-GW13	1/12
Zinc	--	2,100	5,180 - 5,180	41-GW11	1/12
DISSOLVED METALS					
Antimony	6	--	11.4 - 19.1	41-GW07	5/12
Iron	300	300	313J -42,400	41-GW04	5/12
Manganese	50	50	129 - 521	41-GW11	6/12

<u>*Castle Hayne Aquifer*</u>

Organics

Three VOCs were detected in the Castle Hayne Aquifer at Site 41. Concentrations of the VOCs were low and reported for only one location, respectively. The only SVOC detected was nitrobenzene in one well. The pesticide beta-BHC was detected in two wells at low concentrations.

No PCBs, chemical surety degradation compounds, or ordnance were detected in the Castle Hayne Aquifer at Site 41.

Presented below is a summary of the detected organic compounds. This summary includes the Federal and State drinking water standards, the range of positive detections of organics, the location of the highest detected concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Standards (µg/L) Federal MCL	NCWQS	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
VOLATILES					
1,2-Dichloroethene (total)	--	--	1.22J - 1.22J	41-GW11DW	1/6
Chloroform	100	0.19	1.02J - 1.02J	41-GW12DW	1/6
Dibromodichloro-methane	--	--	1.27J - 1.27J	41-GW12DW	1/6
SEMIVOLATILES					
Nitrobenzene	--	--	4J - 4J	41-GW09DW	1/6
PESTICIDES/PCBs					
beta-BHC	--	--	00.4J - 0.06J	41-GW04DW	2/6

Inorganics

Metals were detected in all Castle Hayne groundwater samples at Site 41. The total and dissolved metals detected above Federal and/or State standards in the Castle Hayne Aquifer are summarized below. The summary includes the applicable Federal and State standards, the range of positive detections above standards, location of the maximum concentration, and the frequency of detection.

Metals Detected Above CRQL	Standards (µg/L) Federal MCL	NCWQS	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
TOTAL METALS					
Iron	300	300	691J - 15,300	41-GW06DW	6/6
Manganese	50	50	87.5 -101	41-GW06DW	2/6
Silver	--	50	62.8J - 62.8J	41-GW12DW	1/6
DISSOLVED METALS					
Antimony	6	--	11.4 - 15.6	41-GW06DW	5/6
Manganese	50	50	94 - 94	41-GW11DW	1/6

Groundwater field parameter results for pH, temperature, and specific conductance are presented in Table 4-12. These values represent all field measurements obtained during Round One groundwater sampling activities (i.e., from each well volume purged). Reviewing the last readings obtained for each well, which are representative of groundwater conditions following purging, pH values ranged from 7.30 to 8.15 s.u., specific conductance values ranged from 295 to 1383 micromhos/cm, and temperature values ranged from 16.5 to 20.5°C. Specific conductance values appear to be within the range of natural waters, which is 50 to 500 micromhos/cm (Pagenkopf, 1978), except for the readings at wells 41-GW11DW and 41-GW12DW. pH values are within the range of Federal Secondary Drinking Water MCLs (6.5 to 8.5 s.u.) with the exception of one reading at well 41-GW-6DW (8.56 s.u.).

Summary of Round Two

A second round of groundwater samples were collected and analyzed to confirm and better define the metal concentrations detected during the initial round of sampling and analysis.

This section summarizes the results of the Round Two groundwater sampling investigation. Round Two shallow and deep groundwater analytical results for Site 41 are provided in Table 4-13 for organics, and Tables 4-14 and 4-15 for metals (total and dissolved, respectively).

Surficial Aquifer

Organics

Only VOCs associated with fuels were detected in the second sampling round. These VOCs were detected at low concentrations and within the same well (41-GW11). Acetone, associated with decontamination procedures was detected in the same well.

Summarized below are the VOCs detected in the surficial aquifer during the second sampling round at Site 41. This summary includes the Federal and State standards, the range of positive detections, the location of the maximum concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
Acetone	--	700	4J - 12J	41-GW11	3/12
Benzene	5	1	2J - 2J	41-GW11	1/12
Chlorobenzene	--	50	2J - 2J	41-GW11	1/12

Inorganics

Metals were detected in all surficial groundwater samples during the second round at Site 41. The total and dissolved metals detected above Federal and/or State standards are summarized below. This summary includes the applicable Federal and State standards, the range of positive detections above these standards, the location of the highest concentration, and the frequency of detection.

Metals Detected Above CRQL	Standards (µg/L) Federal MCL	NCWQS	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
TOTAL METALS					
Beryllium	4	--	5.25 - 37.4	41-GW12	5/12
Cadmium	5	5	6.49 - 37.5	41-GW05	4/12
Chromium	100	50	67.1 - 166	41-GW03	7/12
Iron	300	300	890 - 199,000	41-GW05	12/12
Lead	15	15	16.1 - 145	41-GW08	7/12
Manganese	50	50	64.3 - 766	41-GW05	11/12
Nickel	100	--	177 - 177	41-GW05	1/12
DISSOLVED METALS					
Antimony	6	--	7.3 - 7.3	41-GW04	1/12
Iron	300	300	789 - 29,500	41-GW04	4/12
Manganese	50	50	73.8 - 352	41-GW02	7/12

Castle Hayne Aquifer

Organics

1,1,1-Trichloroethane was the only VOC detected during the second round of sampling in the Castle Hayne at Site 41. The following table summarizes the organic compound detected in the Castle Hayne, including the Federal and State drinking water standard, the detected concentration, the location of the detection.

Organic Compounds Detected Above CRQL	Standards (µg/L) Federal MCL	NCWQS	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
VOLATILES					
1,1,1-Trichloroethane	200	200	19 - 19	41-GW11DW	1/6

Inorganics

Metals were detected in all samples from the Castle Hayne during the second round of sampling. The total and dissolved metals detected above Federal and State standards are presented in the table below. This table includes the applicable Federal and State drinking water standards, the range of detections above these standards, the location of the highest detected concentration, and the frequency of detection.

Metals Detected Above CRQL	Standards (μg/L)		Range of Positive Detections (μg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Cadmium	5	5	5.38 - 8.68	41-GW09DW	3/6
Chromium	100	50	81 - 81	41-GW09DW	1/6
Iron	300	300	3,900 - 34,100	41-GW09DW	6/6
Lead	15	15	15.2 - 34.8	41-GW09DW	3/6
Manganese	50	50	66.8 - 367	41-GW09DW	4/6
DISSOLVED METALS					
Antimony	6	--	19.3 - 19.3	41-GW06DW	1/6
Manganese	50	50	119 - 119	41-GW11DW	1/6

Groundwater field parameter results for pH, temperature, and specific conductance are presented in Table 4-16. These values represent all field measurements obtained during Round Two groundwater sampling activities (i.e., from each well volume purged). Reviewing the last readings obtained from each well, which are representative of groundwater conditions following purging, pH values ranged from 6.76 to 8.69 s.u., specific conductance values ranged from 242 to 1704 micromhos/cm, and temperature values ranged from 18.0 to 21.5°C. Specific conductance values appear to be within the range of natural waters, which is 50 to 500 micromhos/cm (Pangenkopf, 1978), except for the readings at wells 41-GW11DW and 41-GW12DW. pH values are within the range of Federal Secondary Drinking Water MCLs (6.5 to 8.5 s.u.).

Comparison of Round One and Round Two Results

Groundwater analytical comparisons of Round One and Round Two results for Site 41 are summarized for organics, total metals, and dissolved metals on Tables 4-17, 4-18, and 4-19, respectively.

<u>Surficial Aquifer</u>

The data for the shallow groundwater indicates a decrease in organic contaminants between the first and second rounds of samples. Benzene and chlorobenzene were detected in well 41-GW11 at concentrations similar to those detected during the first round. No semivolatiles or pesticides/PCBs were detected during Round Two. The groundwater measurements for the second round were slightly lower than those for the first round (generally less than 2 feet).

Detected total and dissolved metals for the second round were similar to those detected in the first round (see Tables 4-18 and 4-19, respectively). The maximum detected concentration for those total metals above Federal primary or secondary MCLs and/or NCWQS were slightly higher in the second round, but generally within the same order of magnitude. Lead concentrations in well 41-GW11 increased from 9340 μg/L to 12600 μg/L between the first and second rounds.

The analytical results for the Round Three sampling lowered the maximum detection for total cadmium and lead. Lead was lowered from a maximum of 12,600 μg/L to 145 μg/L. Tables 4-20 and 4-21 present comparison of the three rounds of results from wells 41-GW02, 41-GW07, 41-GW10, and 41-GW11 for total and dissolved metals, respectively. There was a significant decrease in total metal concentrations between the first and second rounds and the third round. This was on the order of 2 to 3 magnitudes. Dissolved metals did not exhibit a decrease in the third round.

Castle Hayne Aquifer

The only volatile detected during the second round was 1,1,1-trichloroethane in well 41-GW11DW (located in the central portion of the site) at a concentration of 19.0 μg/L. 1,1,1-trichloroethane was not detected during Round One. No semivolatiles or pesticides/PCBs were detected in the second round.

Detected total and dissolved metals for Round Two were similar to those for Round One (see Tables 4-17 and 4-18, respectively). Cadmium and lead were detected during the second round of sampling above Federal MCLs and/or NCWQS but were not detected above standards during the first round.

4.4.3.2 Background

Surficial Aquifer - Monitoring well 41-GW05 is located upgradient, towards the northwest, from Site 41. Organic concentrations in well 41-GW05 were below Federal and/or State criteria and standards. Inorganic concentrations detected in well 41-GW05 were above state or federal drinking water standards for arsenic, beryllium, cadmium, chromium, iron, lead, manganese and nickel. Inorganic levels were generally lower than values detected in onsite shallow monitoring wells.

Castle Hayne Aquifer - Monitoring well 41-GW06DW was installed upgradient from Site 41. No organics were detected above Federal and/or State criteria and standards in this well. This well exhibited the highest levels of iron and manganese (total) than any of the onsite wells.

4.4.3.3 Extent of Contamination

Volatiles were detected at low levels in the surficial aquifer at Site 41 during Round One sampling. Samples collected from shallow monitoring wells 41-GW09 and 41-GW10 exhibited the most frequent and highest concentrations of volatiles. Chloroform was detected in both wells at concentrations ranging from 1.36J μg/L (41-GW09) to 3.17J μg/L (41-GW10). Monitoring well 41-GW10, which exhibited the highest chloroform concentration, is located downgradient from the central area of the site. Monitoring well 41-GW09 is situated in the northwest corner of the study area, outside the former disposal area and in an apparent upgradient direction.

Round Two results indicated fewer detected volatiles; however, well 41-GW11 exhibited low concentrations of benzene (2.00J μg/L) and chlorobenzene (2.00J μg/L), which were not detected in the first round of sampling. Figures 4-11 and 4-12 presents the detected volatile concentrations above Federal MCLs and/or NCWQS for Round One and Round Two, respectively. The apparent source area for chloroform could be in the central portion of the site with shallow groundwater flow from 41-GW11 north/northeast to 41-GW10.

Low levels of chloroform (1.02J µg/L) and dibromochloromethane (1.27J µg/L) were detected in deep well 41-GW12DW during Round One. 1,2-dichloroethene (total) was detected at a concentration of 1.22J µg/L in well 41-GW11DW. These contaminants were not detected during Round Two. Shallow wells 41-GW12 and 41-GW11 did not exhibit concentrations of the detected deep constituents during either the first or second round. Deep monitoring well 41-GW11DW exhibited a 1,1,1-trichloroethane concentration of 19.0J µg/L in Round Two. Volatile concentrations detected in well 41-GW11DW (located in the central portion of the disposal area) may be indicative of a localized source within the fill material. The inconsistencies between Round One and Round Two results observed in the detected volatiles may be do to variations in groundwater flow rates or elevations through the aquifer, which may increase or decrease the amount of contaminant reaching the well. The only volatile detected above the Federal MCL and/or NCWQS was chloroform (refer to Figure 4-13).

Naphthalene was the only semivolatile detected during Round One in the shallow groundwater. It was detected at a low concentration of 3J µg/L in monitoring well 41-GW11, which is located in the center of the dump site. Nitrobenzene [4J µg/L (41-GW09DW-01)] was the only semivolatile detected in the deep aquifer. The presence of both naphthalene and nitrobenzene may be due to POL disposal, which was reported to have occurred at the site. No semivolatiles were detected during Round Two sampling and analysis.

As shown on Figure 4-14, pesticides were detected in the shallow groundwater at very low levels (<0.10 µg/L). The highest pesticide concentrations were detected in wells 41-GW09 and 41-GW11. Trace levels of the pesticide beta-BHC were detected in deep monitoring wells 41-GW04DW (0.06J µg/L) and 41-GW09DW (0.04J µg/L). Beta-BHC was also detected at low levels (i.e., below MCLs and/or NCWQS) in the shallow aquifer. Concentrations were less in the deep aquifer for beta-BHC. This pesticide was not detected in the surface and subsurface soil. No pesticides were detected in any of the wells during Round 2 sampling activities.

Eleven TAL Total Metals were detected in the surficial aquifer above Federal primary or secondary MCLs and/or NCWQS during Round One (refer to Figure 4-15). Iron concentrations, based on total metals analysis, exceeded background levels as well as levels observed in shallow groundwater throughout MCB Camp Lejeune. Lead was detected in well 41-GW11 at a concentration of 9340 µg/L. Lead concentrations in surface soils were elevated at sample location 41-OS-SB12 near well location 41-GW11DW. The subsurface soil sample from monitoring well boring 41-GW11 (shallow monitoring well boring) exhibited elevated levels of lead from 1 to 3 foot depth (110 µg/kg) but not from the 5 to 7 foot depth (8.76 µg/kg). Soil samples collected from the deep monitoring well boring (41-GW11DW) had detected lead concentrations of 47.1 µg/kg at the 1 to 3 foot depth and 15.2 µg/kg at the 9 to 11 foot depth. A specific source can not be identified for the elevated total lead concentrations in the shallow and deep aquifers. Although lead is present in the surface and subsurface soils, the concentrations do not correlate with the concentrations observed in the shallow groundwater. It is possible that the existence of ferrous construction debris in the fill material may be contributing to the lead concentrations in shallow groundwater. This high concentration of total lead in groundwater indicates a potential source in the central portion of the site. Concentrations for other total metals were similar to those detected at other areas of Camp Lejeune.

Nine TAL Total Metals were detected in the shallow groundwater above Federal primary or secondary MCLs and/or NCWQS during Round Two analysis (refer to Figure 4-16). As with Round One analytical results, iron concentrations were above background levels; however, the occurrence and concentrations were not consistent with Round One results. The inconsistency between Round One and Round Two results for iron may be do to seasonal fluctuations in the groundwater between sampling rounds, variations in groundwater flow rates through the aquifer, which may increase or decrease the amount of contaminant reaching the well, and/or differences in suspended solids which may be biasing total metal concentrations. Lead was detected in ten wells during Round Two above Federal and State drinking water standards. The occurrences and concentrations for lead were not consistent with Round One results. Inconsistencies observed for lead may be do to the same reasons stated for inconsistencies observed in iron concentrations between Round One and Round Two. Other total metal concentrations were similar to Round One concentrations. Figure 4-16 presents the detected TAL Total Metal concentrations for shallow wells above Federal primary or secondary MCLs and/or NCWQS for Round Two.

Concentrations of TAL Total Metals in the Castle Hayne Aquifer were reported at levels below those in the surficial aquifer during Round One, by an order of magnitude or less. No apparent source area has been identified, based on the levels detected in surface or subsurface soils (metal concentrations in surface and subsurface soil were similar to background levels). The occurrence and concentration of metals exhibits no discernable pattern. Concentrations of these metals are similar to those detected in other areas of Camp Lejeune. Figure 4-17 presents the TAL Total Metals concentrations in the Castle Hayne Aquifer above the Federal primary or secondary MCLs and/or NCWQS for the deep aquifer during Round One.

Five TAL Total Metals (cadmium, chromium, iron, lead, and manganese) were detected during the Round Two analysis of the deep wells. Cadmium, chromium, and lead were not detected above Federal and State standards for analysis of deep wells during Round One. Silver was detected above the NCWQS in well 41-GW12DW during Round One but not during Round Two. Concentrations for total metals detected during Rounds One and Two were higher in Round Two. The detected concentrations of Total TAL Metals in deep wells above Federal and State standards during Round Two are presented on Figure 4-18.

Total Suspended Solids (TSS) result for the surficial aquifer was elevated (540 mg/L). As stated for Site 69, conclusions from the evaluation of total metals in the surficial aquifer on a base-wide basis indicated that suspended solids have a direct effect on total metal concentrations in groundwater as does the geologic conditions associated with the site area. The TSS for the deep aquifer was only slightly elevated, but may still be a contributing factor to detected total metal concentrations in the Castle Hayne Aquifer.

TAL Dissolved Metal concentrations for the surficial aquifer in Rounds One and Two at Site 41 were lower than detected total metal concentrations. Dissolved metal concentrations were similar between Round Two and Round One results. Antimony, iron, and manganese were detected above Federal MCLs and/or NCWQS in both Round One and Round Two.

Concentrations of TAL Dissolved Metals in the Castle Hayne Aquifer were lower than total metal concentrations for Round One and Round Two. Round Two concentrations were similar to Round One concentrations for dissolved metals. Antimony, and manganese were detected above MCLs and/or NCWQS for both sampling rounds. Iron was only detected above standards for Round Two.

4.4.4 Surface Water

The following section discusses the results of the surface water investigation performed at Site 41. The surface water bodies sampled at Site 41 were the unnamed tributary and Tank Creek, and two groundwater seeps which drain into the unnamed tributary.

A second surface water and sediment sampling event was conducted in August 1994. The areas sampled were the two seeps located in the northern and eastern areas of Site 41, and the unnamed tributary, upstream and downstream from the confluence of the seeps with the unnamed tributary. These areas were resampled to better define pesticide/PCB, and total and dissolved metal concentrations for the Feasibility Study.

4.4.4.1 Analytical Results

Tables 4-22 and 4-23 present the positive detection summaries for organics and total metals, respectively for both sampling events. Table 4-24 presents the positive detection summaries for dissolved metals for the second sampling event.

First Sampling Event

Organics

Chlorobenzene was the only VOC detected in surface water during the first sampling event at Site 41. This VOC was detected at low concentrations at two locations. The pesticides lindane and 4,4'-DDT were detected at low concentrations at two separate locations.

No SVOCs, PCBs, chemical surety degradation compounds, or ordnance were detected in surface water samples during the first sampling event at Site 41.

Summarized below are the organic compounds detected in surface water at Site 41. This summary includes applicable Federal and State criteria for ambient water, the range of positive detections, the location of the highest concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	AWQC	NCWQS			
VOLATILES					
Chlorobenzene	680	488	1.00J - 4.00J	41-UN-SW12	2/14
PESTICIDES					
Lindane	--	--	0.02J - 0.02J	41-UN-SW02	1/14
4,4'-DDT	0.00059	0.00059	0.03J - 0.03J	41-UN-SW02	1/14

Inorganics

Metals were detected in all surface water samples collected at Site 41 during the first sampling event. A summary of the applicable Federal and State criteria for ambient water, the range of positive detections, the location of the maximum concentration, and the frequency of detection is presented below.

Metals Detected Above CRQL	Criteria (μg/L)		Range of Positive Detections (μg/L)	Maximum Concentration Sample Location	Frequency
	Federal AWQC	NCWQS			
TOTAL METALS					
Aluminum	--	--	178 - 3,390	41-UN-SW13	13/14
Barium	1000	1000	17.9 - 113	41-UN-SW13	14/14
Calcium	--	--	9,980 - 84,200	41-UN-SW14	14/14
Chromium	50	--	8.52 - 8.52	41-TC-SW07	1/14
Iron	300	1000	469 - 14,100	41-UN-SW13	14/14
Lead	50	50	1.13J - 12.1	41-UN-SW13	9/14
Magnesium	--	--	1,550 - 12,700	41-UN-SW13	14/14
Manganese	50	50	12.3 - 209	41-UN-SW14	14/14
Mercury	0.144	--	0.101 - 0.101	41-UN-SW13	1/14
Potassium	--	--	923 - 10,200	41-UN-SW13	14/14
Sodium	--	--	4,760 - 23,600	41-UN-SW14	14/14
Zinc	--	--	16.3 - 33.2	41-NE-SW05	9/14

Detected TAL metal concentrations were within the ranges determined from Base wide surface water samples, and generally at or below established average concentrations for TAL metals in surface water.

Second Sampling Event

Organics

No organic compounds were detected in the surface water samples collected during the second sampling event.

Inorganics

Metals were detected in all surface water samples for the second sampling event. The total and dissolved metals detected above Federal and/or State standards are summarized below. This summary includes applicable standards, range of positive detections, location of the maximum concentration, and the frequency of detection.

Metals Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal AWQC	NCWQS			
TOTAL METALS					
Aluminum	--	--	76.6 - 17,800	41-UN-SW24	12/14
Arsenic	0.0022	--	2.2 - 30.2	41-UN-SW24	9/14
Barium	1000	1000	18.4 - 442	41-UN-SW24	14/14
Cadmium	10	--	6.2 - 6.2	41-UN-SW24	1/14
Calcium	--	--	21,100 - 165,000	41-UN-SW23	14/14
Cobalt	--	--	19.6 - 43.9	41-UN-SW24	3/14
Copper	300	--	13.3 - 41.2	41-UN-SW24	4/14
Iron	300	1000 --	649 - 278,000	41-UN-SW24	14/14
Lead	50	50	3.1 - 36.8	41-UN-SW25	10/14
Magnesium	--	--	1,850 - 13,500	41-UN-SW22	14/14
Manganese	50	50	17.5 - 1,700	41-UN-SW24	14/14
Mercury	0.144	--	0.21 - 0.56	41-UN-SW23	8/14
Nickel	13.4	25	20 - 20	41-UN-SW24	1/14
Potassium	--	--	1,620 - 13,400	41-UN-SW16	14/14
Sodium	--	--	573 - 67,600	41-UN-SW24	14/14
Vanadium	--	--	35.4 - 51.5	41-UN-SW24	3/14
Zinc	--	--	21.4 - 235	41-UN-SW24	14/14
DISSOLVED METALS					
Arsenic	0.0022	--	2 - 2.9	41-UN-SW28	4/14
Barium	1000	1000	18.2 - 82.4	41-UN-SW16	14/14
Calcium	--	--	23,700 - 154,000	41-UN-SW23	14/14
Cobalt	--	--	15.7 - 15.7	41-UN-SW24	1/14
Copper	300	--	11.2 - 23.8	41-UN-SW26	11/14
Iron	300	1000 --	118 - 12,800	41-UN-SW24	14/14
Lead	50	50	2.4 - 2.4	41-UN-SW28	1/14
Magnesium	--	--	2,020 - 14,200	41-UN-SW22	14/14
Manganese	50	50	18.1 - 1,360	41-UN-SW22	14/14
Potassium	--	--	1,770 - 15,600	41-UN-SW16	14/14
Sodium	--	--	6,860 - 76,800	41-UN-SW24	14/14
Zinc	--	--	5.4 - 14.1	41-UN-SW27	14/14

4.4.4.2 Background

Inorganic concentrations were within the Base upgradient study results. Table 4-25 presents a comparison of inorganic levels in surface water to base upgradient levels for the first sampling event. Table 4-26 presents a comparison of total metal levels in surface water to base upgradient levels for the second sampling event.

4.4.4.3 Extent of Contamination

No organic contaminants were detected in Tank Creek. Figures 4-19 and 4-20 present the detected concentrations of volatiles and pesticides during the first sampling event, and pesticides for the second sampling event, respectively, for Site 41. TAL metal concentrations are presented on Figures 4-21 and 4-22 for the first and second sampling events, respectively.

The only detected volatile was chlorobenzene. Chlorobenzene was detected in one surface water sample from each of the two seepage areas that drain into the unnamed tributary. Detected concentrations were low, 4.0J µg/L in the northern seep and 1.0J µg/L in the eastern seep. Chlorobenzene was not detected in the surface soils, but was detected in the subsurface soils. One detection of chlorobenzene in the subsurface soils was at sample location 41-OS-SB22 (100 µg/kg) which is approximately at the head of the eastern seep. Low levels of chlorobenzene were also detected in the shallow groundwater at Site 41, but not in the general areas of the seeps. No apparent source from soils or groundwater is evident for the detected levels of chlorobenzene in the northern seep.

Surface water samples from the unnamed tributary and Tank Creek exhibited similar contaminants and concentrations as in previous sampling events.

Pesticides were detected in one surface water sample (41-UN-SW02) at very low levels. This sample location is towards the northwest portion of the unnamed tributary upstream from the northern seep. The detected pesticides were lindane (0.020J µg/L) and 4,4'-DDT (0.030J µg/L). Lindane was not detected in the sediment sample at this location, but 4,4'-DDT was detected at a concentration of 1.36NJ µg/kg (0 to 6 inches) and 2.58J µg/kg (6 to 12 inches). Neither lindane nor 4,4'-DDT were detected in shallow groundwater at the site. The detected concentrations of lindane and 4,4-DDT in the surface water sample were equal to the minimum detected concentrations for the base-wide samples. Groundwater discharge is not likely the source of pesticides in the unnamed tributary.

Metals concentrations in surface water samples exhibited little variation between samples collected from the unnamed tributary and samples collected from Tank Creek. Metal concentrations were higher in the second round of samples collected from the seeps. In the northern seep, metal concentrations were higher at the upgradient end than near the unnamed tributary. The eastern seep exhibited higher concentrations in the central portion and at the confluence with the unnamed tributary. Metal levels in the unnamed tributary remained consistent between locations upstream and downstream of the confluence with the northern seep. The detected metal concentrations in the unnamed tributary were lower than levels in the northern seep. In the unnamed tributary at the eastern seep, metal concentrations increased near the confluence with the seep as compared to upstream locations. Farther downstream these levels continue to decrease. As discussed previously, the observed and reported ferrous construction debris could be a source for the high metal concentrations observed in the seeps.

4.4.5 Sediments

Sediment samples were collected at the surface water sample locations during the first and second sampling events.

4.4.5.1 Analytical Results

Results from sediment samples collected from Site 41 indicated positive detections of organics and inorganics (Tables 4-27 and 4-28, respectively) for both sampling events. The following is a summary of the results:

First Sampling Event

Organics

SVOCs and pesticides were the most frequently detected organic compounds in the first sampling event sediment samples at Site 41. Both SVOCs and pesticides were detected over the sampled lengths of the unnamed tributary and Tank Creek. Concentrations for both SVOCs and pesticides were low. Bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and di-n-octylphthalate, known contaminants associated with laboratory and field procedures, were detected. Pesticides were most frequently detected of the organic compounds. VOCs were detected in sediment samples but less frequently than other organic compounds. The detected VOCs are attributable to the disposal wastes reported for Site 41. Other VOC contaminants included methylene chloride and acetone which are associated with laboratory and field procedures.

The PCBs aroclor 1248 and aroclor 1254 were detected in the unnamed tributary at low levels and infrequently.

The ordnance compound 1,3,5-trinitrobenzene was detected in one sediment sample from the unnamed tributary.

Presented below is a summary table of the detected organic compounds. This summary includes the applicable National Oceanic and Atmospheric Administrations (NOAA) criteria for sediments, the range of positive detections, location of the highest concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
VOLATILES					
Methylene chloride	--	--	2.00J - 7.00J	41-TC-SD07-06	8/28
Acetone	--	--	4.00J - 190.0	41-TC-SD09-06	11/28
Trichloroethene	--	--	2.00J - 2.00J	41-UN-SD14-612	1/28
Toluene	--	--	2.00J - 2.00J	41-TC-SD07-06	2/28

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
SEMIVOLATILES					
Benzo(a)pyrene	400	2500	57.0J - 57.0J	41-TC-SD06-06	1/28
Benzo(b)fluoranthene	--	--	69.0J - 69.0J	41-TC-SD06-06	1/28
Benzo(k)fluoranthene	--	--	58.0J - 58.0J	41-TC-SD06-06	1/28
Bis(2-ethylhexyl) phthalate	--	--	44J - 94J	41-UN-SD10-612	5/28
Di-n-butylphthalate	--	--	48.0J - 370J	41-UN-SD10-06	6/28
Di-n-octylphthalate	--	--	49.0J - 310.0J	41-UN-SD03-612	3/28
Fluoranthene	600	3600	100.0J - 100.0J	41-TC-SD06-06	1/28
Pyrene	350	2200	100.0J - 100.0J	41-TC-SD06-06	1/28
PESTICIDES/PCBs					
Dieldrin	0.02	8	0.46 - 6.39NJ	41-UN-SD13-06	10/28
Endosulfan II	--	--	0.64NJ - 8.22J	41-UN-SD14-06	19/28
4,4'-DDE	2	15	0.53J - 31.3J	41-UN-SD10-612	8/28
4,4'-DDD	2	20	0.38NJ - 73.9J	41-UN-SD10-612	18/28
4,4'-DDT	1	7	0.36NJ - 34.8J	41-TC-SD06-06	15/28
Methoxychlor	--	--	0.91J - 21.7J	41-TC-SD09-06	6/28
Endrin Ketone	--	--	0.66NJ - 0.66NJ	41-UN-SD11-612	1/28
Alpha-Chlordane	--	--	0.34J - 3.72J	41-UN-SD10-06	13/28
Gamma-Chlordane	--	--	0.4J - 6.35J	41-UN-SD10-06	11/28
Aroclor 1248	50	400	63.0J - 140.0J	41-UN-SD13-612	2/28
Aroclor 1254	50	400	68.0J - 68.0J	41-UN-SD13-06	1/28
ORDNANCE					
1,3,5-Trinitrobenzene	--	--	1,390.0 - 1,390.0	41-UN-SD14-06	1/28

Inorganics

Metals were detected in all sediment samples collected from the unnamed tributary and Tank Creek at Site 41 during the first sampling event. The metals detected in the sediment samples are summarized below. This summary includes the applicable NOAA criteria, the range of positive detections, the location of the maximum concentration, and the frequency of detection.

Metals Detected Above CRQL	Criteria (mg/kg) NOAA ER-L	Criteria (mg/kg) NOAA ER-M	Range of Positive Detections (mg/kg)	Maximum Concentration Sample Location	Frequency
TOTAL METALS					
Aluminum	--	--	351 - 18,800	41-TC-SD09-06	28/28
Arsenic	33	85	0.617 - 3.67	41-TC-SD09-06	9/28
Barium	--	--	3.06 - 79.9	41-TC-SD09-06	22/28
Beryllium	--	--	0.235 - 0.413	41-UN-SD10-06	5/28
Calcium	--	--	96.3J - 4,790	41-TC-SD09-06	28/28
Chromium	80	145	2.42 - 16.5J	41-TC-SD09-06	13/28
Copper	70	390	7.34 - 8.34	41-UN-SD13-612	2/28
Iron	--	--	262J - 15,100	41-TC-SD09-06	28/28
Lead	35	110	1.10 - 59.4	41-UN-SD13-06	28/28
Magnesium	--	--	15.3 - 1,590	41-UN-SD10-06	28/28
Manganese	--	--	1.38 - 46.4	41-TC-SD09-06	23/28
Nickel	30	50	3.79 - 5.97	41-UN-SD01-06	6/28
Potassium	--	--	332 - 1,060	41-TC-SD09-06	5/28
Selenium	--	--	0.629J - 0.862J	41-TC-SD06-612	4/28
Silver	1	2.2	1.14 - 29.7	41-UN-SD13-06	3/28
Sodium	--	--	73.6 - 1,480	41-TC-SD09-06	9/28
Thallium	--	--	1.19J - 1.19J	41-UN-SD04-612	1/28
Vanadium	--	--	9.72 - 11.8	41-UN-SD13-612	8/28
Zinc	120	270	13.6 - 85.3	41-TC-SD09-06	11/28

Second Sampling Event

Organics

The pesticides 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT were detected at low concentrations within the seeps and the unnamed tributary during the second sampling event at Site 41. The following table summarizes the applicable NOAA criteria, range of positive detections, location of the highest detection, and the frequency of detection.

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
PESTICIDES/PCBs					
4,4'-DDE	2	15	7.8 - 19	41-UN-SD25-06	3/14
4,4'-DDD	2	20	4.2 - 42	41-UN-SD27-06	4/14
4,4'-DDT	1	7	5.8 - 210	41-UN-SD20-06	2/14

Inorganics

Metals were detected in all sediment samples during the second sampling event at Site 41. The following table summarizes the applicable NOAA criteria, range of positive detections, location of the maximum concentration, and frequency of detection.

Organic Compounds Detected Above CRQL	Criteria(mg/kg)		Range of Positive Detections (mg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
TOTAL METALS					
Aluminum	--	--	276 - 10,200	41-UN-SD25-06	14/14
Arsenic	33	85	0.6 - 9.3	41-UN-SD25-06	4/14
Barium	--	--	1.4 - 161	41-UN-2D25-06	14/14
Calcium	--	--	48.6 - 8,420	41-UN-SD25-06	14/14
Chromium	80	145	2.3 - 2.8	41-UN-SD24-06	3/14
Cobalt	--	--	2.8 - 2.8	41-UN-SD24-06	1/14
Copper	70	390	6.3 - 19.9	41-UN-SD25-06	2/14
Iron	--	--	300 - 104,000	41-UN-SD25-06	14/14
Lead	35	110	1.5 - 28.1	41-UN-SD25-06	14/14
Magnesium	--	--	24.2 - 321	41-UN-SD25-06	14/14
Manganese	--	--	1.3 - 306	41-UN-SD23-06	14/14
Mercury	0.15	1.3	0.46 - 0.63	41-UN-SD23-06	2/14
Sodium	--	--	29.8 - 410	41-UN-SD25-06	14/14
Vanadium	--	--	3.5 - 30	41-UN-SD25-06	4/14
Zinc	120	270	5.85 - 155	41-UN-SD25-06	14/14

4.4.5.2 Background

Volatile and semivolatile results cannot be compared to the Base wide study as the database only tabulates pesticides/PCBs. Pesticide concentrations were detected below the average determined for the Base wide study.

Inorganic concentrations for Site 41 were comparable to those tabulated for the Base wide study.

4.4.5.3 Extent of Contamination

Low levels of volatiles were reported in a limited number of sediment samples collected at Site 41. Trichloroethene was detected at a concentration of 2J µg/kg in sample 41-UN-SD14-612; however, trichloroethene was not detected in the surface water sample. Trichloroethene was not detected in the surface soils or surficial groundwater at the site. Trichloroethene was detected in one subsurface sample from 3 to 5 feet at location 41-OS-SB02 (located in the northwest area of the site). This location is on the opposite side of the site from sediment sample location 41-UN-SD14. At the observed concentrations, an apparent source of TCE cannot be determined.

Toluene was detected at a concentration of 2J µg/kg in samples 41-TC-SD06-06 and 41-TC-SD07-06. These locations are towards the upstream portion of Tank Creek, south of the site. Tank Creek flows onto the base at sample location 41-TC-SD06. Sample location 41-TC-SD07 is located downgradient from this location. Toluene was not detected in the surface or subsurface soils in this area. Shallow groundwater did not exhibit detected levels of toluene. Figure 4-23 presents the detected concentrations of volatiles in sediment. The low detected concentrations of volatiles indicate only isolated occurrences and not a major source area. No on-site source is apparent for the observed levels of toluene in the sediment samples.

Semivolatiles were detected in only one sediment sample [41-TC-SD06-06 (ground surface to 6 inches)], which was collected at an upstream location along Tank Creek. Concentrations ranged from 57J µg/kg to 100J µg/kg. Semivolatiles detected include benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene, and pyrene (refer to Figure 4-24). Semivolatiles were not detected in any of the surface water samples. Shallow and deep groundwater did not exhibit these semivolatiles. Surficial and subsurface soils detected these semivolatiles at isolated locations, primarily in the central portion of the site. As stated previously, location 41-TC-SD06 is located at the point where Tank Creek comes onto the base. An onsite source for these contaminants is not apparent. Given the location of the sampling station near Highway 17, the source of PAH contamination may be due to runoff from the roadway.

Pesticides were detected in all sediment samples collected at Site 41 (refer to Figures 4-25 and 4-26). Concentrations are either within or slightly above the general range associated with pesticide levels detected at other surface water bodies throughout MCB Camp Lejeune. Based on the distribution and concentrations of pesticide contaminants, it is not believed that the pesticides in sediment are a result of former disposal activities. Fewer pesticides were detected during the second sampling event in the seeps and unnamed tributary. Pesticide concentrations were higher for the second sampling event than the first samples collected in the seeps. The maximum concentrations of pesticides were detected in the unnamed tributary near the confluences with the seeps. All pesticides were detected above their NOAA ER-M values for the second sampling event except for 4,4'-DDD and 4,4'-DDT in sample 41-UN-SW26. However, downstream of this location, pesticide levels decrease and are similar to pesticide levels in Tank Creek.

The PCBs aroclor 1248 and 1254 were detected at sediment sample location 41-UN-SD13 (refer to Figure 4-25). This location is at the upper end of the eastern seep, located in the northeast of the site near the unnamed tributary. No PCBs were reported for the sediment sample collected downgradient in the eastern seep at the unnamed tributary.

The ordnance constituent 1,3,5-trinitrobenzene was detected at a concentration of 1390 µg/kg in sample 41-UN SD14-06 (refer to Figure 4-27). This location is at the downgradient end of the eastern seep where the seep discharges into the unnamed tributary. 1,3,5-trinitrobenzene was not detected in the surface and subsurface soil at the site. The ordnance constituent 1,3-di-nitrobenzene was detected directly north of sediment sample location 41-UN-SD14 at a concentration of 824.0 NJ µg/kg, indicating the presence of ordnance constituents in the soil at the site. No ordnance constituents were detected in the groundwater at the site. The specific source of the ordnance constituent is unknown, but the detected concentration corroborates the historical information on ordnance disposal and detonation at Site 41.

TAL metals were detected in all sediment samples (refer to Figures 4-28 and 29). Concentrations for metals in the sediment samples collected from the unnamed tributary and Tank Creek were below base-wide averages established for sediment samples at MCB Camp Lejeune (refer to Section 4.1). The sediment samples collected from the eastern seep exhibited ferrous metal (iron and lead) concentrations above the Base wide averages. Metal concentrations in the unnamed tributary and Tank Creek sediments do not appear to be significant since they are comparable to base-wide concentrations. The elevated levels of metals detected in the eastern seep may be due to the disposal of ferrous construction debris at the site, which has affected shallow groundwater, and may be contributing to the concentrations detected in the eastern seep. Half of the maximum inorganic concentrations were detected in the eastern seep during the second sampling event. Lead, mercury, silver, and zinc maximum concentrations were the only metals detected above the NOAA ER-L values.

4.4.6 Engineering Parameter Results

Engineering parameters were analyzed for selected soil and groundwater samples collected at Site 41. Soil samples were analyzed for 41-GW10 and 41-GW11. Soil engineering parameters were grain size distribution and Atterberg limits. Shallow and deep groundwater samples were collected from shallow well 41-GW04 and deep well 41-GW04DW and analyzed for alkalinity, BOD, COD, total phosphorous, TDS, TSS, total Kjeldahl nitrogen, and standard plate count. Engineering parameter results for soil and groundwater are summarized in Appendix K.

Results indicated the following average analysis data for soils for 41-GW10:

- Sand - 85.3%; silt - 6.35%; and clay - 8.35%
- Liquid limit - 12.5; and non-plastic
- U.S. Department of Agriculture soil classification is a sand/loamy sand.
- USCS soil classification is SM.

Results indicated the following average analysis data for soils for 41-GW11:

- Sand - 79.95%; silt - 6.8%; and clay - 13.25%
- Liquid limit - 15.5; non-plastic
- U.S. Department of Agriculture soil classification is a loamy sand
- USCS soil classification is SM.

Results indicated the following concentration levels in shallow (41-GW04) groundwater:

- alkalinity 136 mg/L

- BOD 3.57 mg/L
- COD 76.6 mg/L
- total phosphorous 0.01U mg/L
- TDS 151 mg/L
- total Kjeldahl N 5.59 mg/L
- TSS 540 mg/L
- standard plate count 132 CFU/mL

Results indicated the following concentration levels in deep (41-GW04DW) groundwater:

- alkalinity 169 mg/L
- BOD <2 mg/L
- COD 11 mg/L
- total phosphorous <0.10 mg/L
- TDS 162 mg/L
- total Kjeldahl N 0.184 mg/L
- TSS 179 mg/L
- standard plate count 5.74 CFU/m/L

4.4.7 Quality Assurance/Quality Control Results

Quality Assurance/Quality Control (QA/QC) samples were collected during the soil, groundwater, and surface water and sediment investigations. These samples included trip blanks, field blanks, equipment rinsates, and duplicate samples. Analytical results of the field duplicates are provided in Appendix I and other field QA/QC (e.g., rinsate blanks, trip blanks, etc.) results are provided in Appendix L.

Organics and inorganics were detected in several QA/QC samples. Organics detected in QA/QC samples included methylene chloride, acetone, and heptachlor. Methylene chloride was detected in 8 trip blanks at concentrations ranging from 2.00J µg/L to 6.00J µg/L. Acetone was detected in one trip blanks (41-RS-11) at a concentration of 2.00J µg/L. Heptachlor was detected in two rinsate blanks. As previously stated, methylene chloride and acetone are most likely the result of laboratory contamination. The presence of acetone may also be the result of decontamination procedures with isopropanol alcohol. All 24 TAL inorganics were detected in QA/QC samples but most were quantified with U, UJ, J and R qualifiers.

4.4.8 Summary

4.4.8.1 Volatile Organic Contamination

Site 41 exhibited low levels of organics in the soil and groundwater. Volatiles were detected at isolated areas in surface and subsurface soil, and in surface water and sediment. Low levels of VOCs (chlorobenzene, chloroform, dibromochloromethane and 1,1,1-trichloroethane) were detected in the shallow and/or deep aquifers at isolated locations. Chloroform was the only volatile detected above MCL and/or NCWQS within the shallow and deep aquifers. No source areas for chloroform were identified within the surface and subsurface soil which would contribute to the groundwater contamination. Chlorobenzene was detected in one surface water sample in the upper portion of the eastern seep, near where chlorobenzene was detected in the subsurface soil.

4.4.8.2 Semivolatile Organic Contamination

Semivolatiles were detected in both surface and subsurface soils, primarily within the central and eastern portions of the former disposal area. The surficial and deep aquifers exhibited only low levels of naphthalene and nitrobenzene. Semivolatiles were detected at low levels in one sediment sample at the upgradient end of Tank Creek at the base boundary. The semivolatiles in Tank Creek are likely due to runoff from Highway 17 rather than the site.

4.4.8.3 Pesticide Contamination

Pesticides were evident in surface and subsurface soil, and shallow and deep aquifers, but at low levels. The occurrence of pesticides in the soil was widespread, with the central portion of the site exhibiting the most frequent detections and highest concentrations. The surficial aquifer exhibited few pesticides above Federal MCLs and/or NCWQS, primarily in the central portion of the site. Pesticides were also detected in the surface water and sediments at Site 41. The only occurrence of pesticides in surface water was in the unnamed tributary upstream from the confluence of the northern seep. Pesticides were detected in all sediment samples collected from the unnamed tributary, Tank Creek, and the northern and eastern seeps. The occurrence and concentrations of pesticides in sediment is widespread. The highest levels are from the seep areas. The concentrations of pesticides in the surface water and sediment at Site 41 are comparable to the average concentrations determined base-wide for MCB Camp Lejeune.

4.4.8.4 PCB Contamination

Low levels of PCBs were detected in surface soil, subsurface soil, and sediment. PCBs were detected in the surface and subsurface soil only within the central portion of the former disposal area. PCBs were only detected in the sediment sample collected from the upstream end of the eastern seep. The concentrations of PCBs in sediment were slightly higher than the base-wide averages but within the ranges established for PCBs at the Base.

4.4.8.5 Ordnance and CWM Contamination

The ordnance compound 1,3-dinitrobenzene was detected in one surface soil sample (41-DS-SB03) near the eastern seep. 1,3,5-trinitrobenzene was detected in sediment sample 41-UN-SD14 in the middle section of the eastern seep. These isolated detections may be evidence of the disposal and detonation of ordnance reported for the site.

Chemical surety degradation compound acetophenone was detected in the subsurface soil at low levels at one location (41-OS-SB21) within the southern portion of the site. This may be the result of troop training exercises using tear gas.

4.4.8.6 Inorganic Contamination

Metals are the most prominent contaminant at Site 41. Metals were detected in the soil, groundwater, surface water, and sediment. A number of inorganics in soil exceeded twice the average base background concentration; however, the data do not suggest that a gross metals problem exists for soils. Elevated metals in groundwater included iron, lead, and manganese. The iron and manganese are likely associated with natural conditions whereas the lead may be elevated due to suspended solids. Inorganics in surface water showed only slight differences in concentrations between upstream and downstream samples. Iron and lead was detected at slightly higher levels in the unnamed tributary downstream of Site 41.

4.5 Site 74 - Mess Hall Grease Pit Disposal Area

The analytical results, extent of contamination, and a summary of the findings for Site 74 surface soil, subsurface soil, groundwater, and surface water and sediment investigations are presented in the following sections.

4.5.1 Surface Soil

4.5.1.1 Analytical Results

Surface soil positive detection summaries for organics and inorganics are presented in Tables 4-29 and 4-30, respectively.

Organics

Pesticides were the most frequently detected organic compounds in surface soils at Site 74. Elevated levels of pesticides were reported for Site 74. SVOCs were detected most frequently after pesticides. The SVOCs detected in surface soils are indicative of reported waste disposals at the site. SVOC concentrations were low. The phthalate contaminants detected in the surface soils are known to be associated with laboratory analysis. VOCs which are associated with solvent and fuel wastes at Site 74 are trichloroethene, toluene, styrene, and xylenes. These contaminants were reported at low concentrations. Other VOC contaminants included methylene chloride and acetone, which could result from field decontamination procedures, sampling equipment, and laboratory procedures, were also detected in the surface soils.

The chemical surety degradation compound hydroxyacetophenone was detected in one surface soil sample.

No PCBs or ordnance were detected in surface soils at Site 74.

Summarized below are the organic compounds detected in the surface soil at Site 74. This summary includes the range of positive detections, the location where the highest concentration was detected, and the frequency of detection.

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Methylene Chloride	4J - 23.0J	74-FDA-SB33-00	20/60
Acetone	4J - 210J	74-FDA-SB05-00	22/60
Trichloroethene	2J - 8J	74-FDA-SB18-00	5/60
Toluene	1J - 3J	74-FDA-SB13-00	3/60
Styrene	1J - 1J	74-FDA-SB37-00	1/60
Xylenes (total)	3J - 6J	74-FDA-SB05-00	2/60
SEMIVOLATILES			
4-Chloro-3-Methylphenol	54J - 240J	74-FDA-SB17-00	2/60
Acenaphthene	39J - 39J	74-PDA-SB01-00	1/60
Benzo(a)pyrene	130J - 130J	74-FDA-SB23-00	1/60
Benzo(g,h,i)perylene	61J - 160J	74-FDA-SB31-00	2/60
Bis(2-chloroethyl)ether	12J - 180J	74-FDA-SB02-00	5/60
Bis(2-ethylhexyl)phthalate	240J - 240J	74-FDA-SB14-00	1/60
Diethylphthalate	86J - 866	74-PDA-SB04-00	2/60
Di-n-Butylphthalate	39J - 126J	74-FDA-SB02-00	13/60
Pyrene	38J - 38J	74-PDA-SB01-00	1/60
PESTICIDES/PCBs			
alpha-BHC	0.45J - 0.45J	74-FDA-SB23-00	2/60
Heptachlor	0.2NJ - 298J	74-PDA-SB13-00	8/60
Aldrin	0.41NJ - 0.41NJ	74-FDA-SB04-00	1/60
Heptachlor Epoxide	0.21J - 1.43J	74-FPA-SB03-00	5/60
Dieldrin	0.32J - 706NJ	74-PDA-SB13-00	5/60
4,4'-DDE	0.31J - 1,730J	74-PDA-SB13-00	31/60
Endrin	0.42J - 1.06J	74-FPA-SB06-00	3/60
Endosulfan II	0.44NJ - 1.31NJ	74-FPA-SB03-00	3/60
4,4'-DDD	0.37NJ - 3,700J	74-PDA-SB06-00	17/60
4,4'-DDT	0.81J - 3,840J	74-PDA-SB13-00	22/60
Methoxychlor	166J - 166J	74-PDA-SB13-00	1/60

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Endrin Aldehyde	0.5NJ - 2.29NJ	74-PDA-SB14-00	5/60
Alpha-Chlordane	0.39J - 1,160J	74-PDA-SB13-00	8/60
Gamma-Chlordane	0.45J - 1,680J	74-PDA-SB13-00	8/60
CHEMICAL SURETY DEGRADATION COMPOUNDS			
Hydroxyacetophenone	190J -190J	74-FDA-SB25-00	1/37

Inorganics

Inorganics were detected in all surface soil samples at Site 74. The inorganics detected in surface soil are summarized below. The summary includes the range of positive detections, location of the highest concentration, and the frequency of detection. Beryllium, cobalt, and thallium were the only inorganics not detected in the surface soil at Site 41.

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	36.3 - 10,900	74-FDA-SB20-00	60/60
Antimony	1.72 - 3.43	74-PDA-SB08-00	2/60
Arsenic	0.621J - 1.16	74-FDA-SB12-00	9/60
Barium	2.89 - 54.7	74-FPA-SB02-00	54/60
Cadmium	0.543 - 0.686	75-FDA-SB05-00	4/60
Calcium	34.9 - 175,000	74-FPA-SB02-00	53/60
Chromium	1.89 - 10.6	74-FPA-SB02-00	50/60
Copper	5.07 - 22	74-FDA-SB34-00	4/60
Iron	31.2J - 34,200	74-FDA-SB08-00	60/60
Lead	0.878J - 15.4	74-FDA-SB31-00	60/60
Magnesium	16.3 - 2,790	74-FPA-SB02-00	52/60
Manganese	1.44 - 96.2	74-FDA-SB08-00	58/60
Mercury	0.015 - 0.092	74-FPA-SB04-00	8/60
Nickel	3.15 - 4.78	74-FDA-SB08-00	6/60
Potassium	80.7 - 351	74-FPA-SB02-00	16/60
Selenium	0.609 - 1.2	74-FDA-SB17-00	14/60
Silver	0.116J - 0.116J	74-FDA-SB23-00	1/60

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Sodium	105J - 860	74-FDA-SB29-00	10/60
Vanadium	4.03 - 15.1	74-FDA-SB20-00	34/60
Zinc	2.27 - 33.9	74-FPA-SB02-00	33/60
Total Cyanide	1.05 - 1.37	74-FDA-SB06-00	60/60

4.5.1.2 Background Surface Soils

Four background soil locations were sampled for surficial soils at Site 74. The background soil borings were drilled in the areas south and east of the site (refer to Figure 4-30). Tables 4-3 and 4-4 present positive detection summaries for organics and inorganics, respectively. This data has been incorporated into the Base-wide background soil database.

No volatiles or semivolatiles were detected in the surficial background soil samples.

Three samples had detections of 4,4'-DDE [74-BB-SB02-00 (2.13J µg/kg), 74-BB-SB03-00 (0.850J µg/kg), and 74-BB-SB04-00 (2.31J µg/kg)].

No PCBs, chemical surety degradation compounds, or ordnance constituents were detected in background samples.

Nineteen of 24 inorganics were detected (beryllium, cadmium, cobalt, selenium, and thallium were not detected) in background samples. Inorganic concentrations in the background soils are comparable to values reported at other sites at Camp Lejeune.

4.5.1.3 Extent of Contamination

Results indicate the presence of volatiles, semivolatiles, pesticides, chemical surety degradation compounds, and inorganics within the surface soils of Site 74. PCBs were not detected, although they were reportedly disposed of within the site.

Volatiles were detected in isolated areas of the former disposal area and the potential disposal area. Figure 4-30 presents the detected concentrations of volatiles in the surface soils. Trichloroethene (TCE) was detected the most frequently and with the highest concentrations, albeit low. TCE was detected only in samples from the former disposal area, except for one sample (74-PDA-SB11) south of the potential disposal area, and along the north-south access road located on the east side of the former disposal area (refer to Figure 4-30).

Solvents or fuels reportedly had been used to ignite grease during disposal operations; however, only low levels of volatiles (trichloroethene, toluene, styrene and xylenes) were detected (infrequently) in surface samples.

Semivolatiles were present in surface soils at relatively isolated areas of the former disposal area and at one location in the western corner of the potential disposal area south of the former disposal area. The detected concentrations for semivolatiles are presented on Figure 4-31. Concentrations were generally low except for 4-chloro-3-methylphenol, benzo(a)pyrene, benzo(g,h,i)perylene, and bis(2-ethylhexyl)ether. These higher detections of semivolatiles were located in the southern portion of the former disposal area. The semivolatile detections generally occur towards the perimeter of the former disposal area.

The polycyclic aromatic hydrocarbons (PAHs) benzo(a)pyrene, benzo(g,h,i)perylene, and pyrene, which were detected in the surface soil, may have resulted from localized surface spills during the operation of the disposal area, or may be related to past "burning " operations.

Pesticides were detected over a widespread area of Site 74 in surface soils. The extent of pesticide contamination in surface soils at Site 74 is depicted on Figure 4-32. Due to the large number, frequency, and concentration ranges of pesticides detected in the surface soil at Site 74, only those detections above 1 μg/kg are presented on Figure 4-32. Fifteen of 21 pesticides were detected at Site 74 within the former disposal area, potential disposal area and former pesticide control area. The highest concentrations of pesticides were detected at the former pesticide control area. This was the area where pesticides were reportedly stored and handled prior to use. Site-specific background samples exhibited very low levels of one pesticide, 4,4-DDE. Historical usage of pesticides at Camp Lejeune for pest control has been well documented (Water and Air Research, 1983), which may also account for some of the widespread, but low levels of pesticides detected at the site.

The chemical surety degradation compound hydroxyacetophenone was only detected in sample 74-FDA-SB25-00 at a concentration of 190J μg/kg. This compound is likely associated with training exercises involving the use of tear gas. As noted in Section 4.1.2.1, hydroxyacetophenone and acetophenone are degradation compounds of chloroacetophenone, which is the main ingredient of "riot gas" (i.e., tear gas). Figure 4-33 presents the detected concentration of hydroxyacetophenone and its location.

The concentration ranges for most of the inorganics detected in the surface soils were similar to concentrations detected in the site-specific background samples collected during the 1994 RI program and the Base background ranges for soils at MCB Camp Lejeune. Table 4-31 is a comparison of inorganics in surface soils to site and base background values. Metals with concentrations significantly above the background levels were aluminum, calcium, iron, magnesium, manganese, and sodium. Manganese, as reported in previous studies, is a common inorganic found throughout Camp Lejeune (Greenhorne & O'Mara, 1992). The concentrations for the inorganics detected in surface soils were generally within an order of magnitude of background levels. Because of the random distribution of the inorganics, it does not appear that the source is related to Site 74 activities.

4.5.2 Subsurface Soils

4.5.2.1 <u>Analytical Results</u>

Subsurface soil results for organics and inorganics are presented in Tables 4-32 and 4-33, respectively.

Organics

Within the subsurface soil at Site 74, pesticides were the most frequently detected organic compounds. The concentrations for pesticides were low. Phthalates were the only SVOCs detected in the subsurface soil. These are known contaminants which can result from laboratory procedures. Methylene chloride and acetone, associated with field decontamination procedures and laboratory procedures, were the only detected VOCs.

No PCBs, chemical surety degradation compounds, or ordnance were detected in subsurface soil at Site 74.

Summarized below are the detected organic compounds in the subsurface soil at Site 74. This summary includes the range of positive detections, the location of the maximum concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Methylene Chloride	190 - 190	74-FPA-SB04-04	1/47
Acetone	6.00J - 820.0	74-FDA-SB08-04	32/47
SEMIVOLATILES			
Bis(2-ethylhexyl)phthalate	37.0J - 240.0J	74-GW08-03	8/47
Diethylphthalate	874 - 874	74-PDA-SB06-04	1/47
Di-n-Butylphthalate	43.0J - 155.0J	74-FPA-SB02-06	10/47
PESTICIDES/PCBs			
Heptachlor	0.240J - 1.59J	74-GW03A-04	3/47
Aldrin	0.400J - 0.400J	74-PDA-SB09-06	1/47
Heptachlor Epoxide	0.330J - 0.330J	74-PDA-SB08-02	1/47
4,4'-DDE	1.05NJ - 21.3J	74-FPA-SB03-03	5/47
4,4'-DDD	0.590J - 3.61J	74-PDA-SB06-04	5/47
4,4'-DDT	0.340J - 21.37J	74-PDA-SB06-02	9/47
Methoxychlor	7.06J - 7.06J	74-FPA-SB01-03	1/57
Endrin Aldehyde	0.48NJ - 0.77NJ	74-GW03A-03	2/47

Inorganics

Inorganics were detected in all subsurface soil samples at Site 74. The inorganics detected in subsurface soil are summarized below. This summary includes the range of positive detections, where the highest concentration was detected, and the frequency of detection.

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	349 - 9,380	74-FPA-SB09-07	47/47
Antimony	1.9 - 1.97	74-PDA-SB04-05	2/47
Arsenic	0.538 - 2.76	74-PDA-SB02-03	10/47
Barium	2.77 - 17.5	74-PDA-SB07-01	29/47
Calcium	34 - 2,250	74-FPA-SB04-08	23/47
Chromium	1.92 - 9.91	74-FPA-SB02-03	41/47
Iron	123 - 4,940	74-FPA-SB06-03	47/47
Lead	0.751 - 7.42	74-FPA-SB04-08	47/47
Magnesium	15.4 - 250	74-FPA-SB09-07	45/47
Manganese	1.55 - 21.7	74-PDA-SB05-02	32/47
Mercury	0.056 - 0.056	74-GW04-05	1/47
Potassium	191 - 302	74-PDA-SB10-08	4/47
Selenium	0.818 - 0.818	74-GW07-01	1/47
Vanadium	3.93 - 14.2	74-FPA-SB06-03	16/47
Zinc	2.51 - 11.9	74-FPA-SB04-08	18/47
Total Cyanide	1.05 - 1.25	74-GW08-03	47/47

4.5.2.2 Extent of Contamination

No volatiles or semivolatiles were detected in the subsurface soils.

Pesticides were detected at low levels in the subsurface soils to depths of 11 to 13 feet in the potential disposal area (refer to Figure 4-34). Within the former pesticide control area, pesticides were detected at depths of 5 to 7 feet and 9 to 11 feet. Pesticides generally adhere to soil particles and do not migrate. The depths at which pesticides were detected may indicate that filling or regrading could have occurred in this area after the former pest control building was torn down. There does not appear to be evidence of vertical migration due to the fact that sampling locations had detected levels of pesticides at depth but not in the surface samples. Two locations within the former disposal area had detected pesticides at depths of 1 to 3 feet and 7 to 9 feet. Pesticides were detected in monitoring well soil boring 74-GW03A, north of the former disposal area, at depths of 3 to 5 feet and 5 to 7 feet.

No PCBs or chemical surety degradation compounds or ordnance constituents were detected in the subsurface soils.

The concentration ranges for most of the inorganics detected in the subsurface soils were similar to concentrations detected in the Base background ranges for soils at MCB Camp Lejeune. Table 4-34 presents a comparison of inorganics in subsurface soil to base background values. Metals with concentrations significantly above the background levels were aluminum, calcium, iron, magnesium, manganese, and sodium. Iron and manganese were also reported in shallow groundwater at levels above the Federal MCLs and/or NCWQS. Manganese, as reported in previous studies, is a common inorganic found throughout Camp Lejeune (Greenhorne & O'Mara, 1992). The concentrations for the inorganics detected in both the surface and subsurface soils were generally within an order of magnitude of background levels. Because of the random distribution of the inorganics, it does not appear that the source is related to Site 74 activities.

4.5.3 Groundwater

In addition to the Round One groundwater sampling, a special limited sampling event was conducted in August 1994. Two monitoring wells (74-GW03A and 74-GW07) were sampled using a low-flow purging technique to reduce or eliminate suspended solids which contribute to total metal concentrations.

4.5.3.1 Analytical Results

Groundwater analytical results for the surficial aquifer at Site 74 are provided in Table 4-35, Table 4-36, and Table 4-37 for organics, total metals and dissolved metals, respectively.

Organics

Pesticides were the most frequently detected organic compounds in the surficial groundwater at Site 74. Pesticides were detected at low concentrations. The known decontamination and laboratory procedure contaminants phthalates and acetone were detected in the groundwater.

No PCBs, chemical surety degradation compounds, or ordnance were detected in the surficial groundwater at Site 74.

Summarized below are the organic compounds detected in the shallow groundwater at Site 74. This summary includes the applicable Federal and State drinking water standards, the range of positive detections, the location with the highest detected concentration, and the frequency of detection.

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
Acetone	--	700	2J - 2.04J	74-GW03A	1/8
SEMIVOLATILES					
Di-n-Butylphthalate	--	700	2J - 2J	74-GW04	1/8
PESTICIDES/PCBs					
Lindane	0.2	0.2	0.04J - 0.04J	74-GW08	1/7
Heptachlor	0.4	0.008	0.01NJ - 0.01NJ	74-GW01	1/7
Endosulfan II	--	--	0.02J - 0.02J	74-GW08	1/7
Alpha-Chlordane	2	0.027	0.02NJ - 0.02NJ	74-GW08	1/7

Inorganics

Metals were detected in all groundwater samples at Site 74. The total and dissolved metals detected above Federal and/or State standards in groundwater are summarized below. This summary includes the applicable Federal and State standards, the range of positive detections, location of the highest detected concentration, and the frequency of detection.

Metals Detected Above CRQL	Standards (µg/L) Federal MCL	Standards (µg/L) NCWQS	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
TOTAL METALS					
Chromium	100	50	56.6 - 56.6	74-GW01	1/8
Iron	300	300	821 - 96,100.0	74-GW02	8/8
Lead	15	15	15.3 - 15.3	74-GW01	1/8
Manganese	50	50	115.0 - 115.0	74-GW02	1/8
DISSOLVED METALS					
Antimony	6	--	8.26 - 8.26	74-GW08	1/8
Iron	300	300	350 - 1,040	74-GW03A	4/5
Manganese	50	50	1,730 - 1,730	74-GW07	1/8

Groundwater field parameter results for pH, temperature, and specific conductance are presented in Table 4-38. These values represent all field measurements obtained during groundwater sampling activities (i.e., from each well volume purged). Reviewing the last readings obtained for each well, which are representative of groundwater conditions following purging, pH values ranged from 4.18 to 7.26 s.u., specific conductance values ranged from 38 to 193 micromhos/cm, and temperature values ranged from 14 to 18°C. Specific conductance values appear to be within the range of natural waters, which is 50 to 500 micromhos/cm (Pagenkopf, 1978), except for well 74-GW01 (only one volume of groundwater was purged due to the well going dry). All values for pH are below the range of Federal Secondary Drinking Water MCLs (6.5 to 8.5 s.u.) with the exception of the three readings at well 74-GW07.

4.5.3.2 Background

Monitoring well 74-GW03A is in an upgradient direction to Site 74, based on groundwater measurements and flow direction. Organic concentrations in well 74-GW03A were nondetect, except for acetone. Maximum inorganic concentrations above Federal and/or State standards were only detected for iron in well 74-GW03A. These concentrations were comparable with Base background levels.

4.5.3.3 Extent of Contamination

Acetone and di-n-butylphthalate were they only VOCs and SVOCs detected in the surficial groundwater. It is suspected that these compounds are present due to laboratory contamination.

PCBs, and chemical surety degradation compounds were not detected in shallow groundwater at Site 74.

Four pesticides were detected in shallow groundwater at Site 74. Lindane (gamma-BHC) (0.04J µg/kg), endosulfan II (0.02J µg/kg), and alpha-chlordane (0.02NJ µg/kg) were detected in sample 74-GW08-01. Well 74-GW08 is located in the southeast corner of the former pesticide control area. The concentrations are low but may be attributed to the former activities of pesticide staging and mixing, which is evident from the pesticides detected in the surface and subsurface soils in this area. Sample 74-GW01-01 exhibited a concentration of heptachlor at 0.01NJ µg/kg. This well is located east of the former disposal area. Well 74-GW01 is in a downgradient direction from the former disposal area where pesticides were detected in the surface and subsurface soils. Only heptachlor was detected above the Federal MCLs and/or NCWQS.

There was a total of four TAL metals (total) detected above the Federal MCLs and/or NCWQS, incorporating the low-flow sampling. Figure 4-35 presents the detected concentrations of TAL metals above the MCLs and/or NCWQS. Iron was the most frequently detected metal in the shallow groundwater, with the highest recorded concentrations. The highest total iron concentration was detected in well 74-GW02, east of the former disposal area. Iron was detected in well 74-GW03A at a concentration of 38,500 µg/L. The subsurface samples collected from depths of 5 to 7 feet and 7 to 9 feet at this location exhibited low levels (393 and 243 µg/kg, respectively) of iron. Metal concentrations do not appear to correlate to the groundwater flow direction. They are scattered over the site with no discernable migration path. Groundwater concentrations of metals also do not correlate specifically with surface and subsurface soils. Metals were detected in all areas of the site with no pattern to high concentrations and no direct correlation to concentrations detected in groundwater.

Dissolved iron and manganese were detected above MCLs and/or NCWQS. Dissolved concentrations were detected less frequently and at lower concentrations (generally an order of magnitude) than total metals. Concentrations of dissolved metals show no apparent pattern. Iron concentrations above standards are found in the north, east and south of the former disposal area, and within the central portion of the former disposal area. The TSS value (937 mg/L) was elevated for the surficial groundwater sample.

Results from the low flow purge samples showed a decrease in total metals concentrations. These concentrations were similar to dissolved metal concentrations which support the conclusion that suspended solids in the sample affect total metal concentrations. Conclusions from the evaluation of total metals in the surficial aquifer on a Base wide basis indicated that suspended solids have a direct effect on total metal concentrations in groundwater as does the geologic conditions associated with the site area.

4.5.4 Surface Water

The following section discusses the results of the surface water investigation performed at Site 74. The surface water body sampled at Site 74 was Henderson Pond, which is situated due south of the former pesticide handling area.

4.5.4.1 Analytical Results

Results from surface water samples collected from Site 74 during the RI indicated positive detections of inorganics (Table 4-39). No organic contaminants were detected in any of the surface water samples.

Organics

No organic compounds were detected in the surface water at Site 74.

Inorganics

Metals were detected in all surface water samples at Site 74. The metals detected in surface water are summarized below. This summary includes applicable Federal and State criteria, range of positive detections, the location of the highest detected concentration, and the frequency of detection.

Metals Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal AWQC	NCWQS			
Aluminum	--	--	127J - 492J	74-PDA-SW01	3/3
Calcium	--	--	10,400 - 11,700	74-PDA-SW02	3/3
Iron	300	--	138 - 274	74-PDA-SW02	3/3
Lead	50	50	1.62J - 6.04J	74-PDA-SW02	3/3
Magnesium	--	--	782 - 881	74-PDA-SW02	3/3
Potassium	--	--	448 - 719	74-PDA-SW01	2/3
Sodium	--	--	13,400 - 21,700	74-PDA-SW02	3/3

4.5.4.2 Extent of Contamination

No organics were detected in the three surface water samples collected from Henderson Pond.

Seven TAL metals were detected. Figure 4-36 presents the detected concentrations of metals. TAL metals concentrations for the surface water samples collected at Henderson Pond were below average concentrations established for Base wide total metals in surface water samples. The detected concentrations for lead (5.84 µg/L, 6.04 µg/L, and 1.62 µg/L) in the three surface water samples were slightly higher than the 3.33 µg/L average determined from Base wide samples.

No previous surface water sampling has been conducted at Site 74, so no comparisons can be made. Comparing to values from the Base upgradient results, Henderson Pond exhibited results lower than the Base upgradient study for inorganics (refer to Table 4-40).

4.5.5 Sediments

4.5.5.1 Analytical Results

Results of sediment samples collected from Henderson Pond indicated positive detections of organics and inorganics (Tables 4-41 and 4-42, respectively).

Organics

VOCs, SVOCs, and pesticides were the organic compounds detected in the sediment at Site 74. Pesticides were detected most frequently; however, at low concentrations. Trichloroethene and 3,3-dichlorobenzidine were the only detected VOCs and SVOCs, respectively, in the sediment at Site 74. These organic compounds were also detected at low concentrations.

No PCBs, chemical surety degradation compounds, or ordnance were detected in the sediment samples at Site 74.

Summarized below are the organic compounds detected in the sediment at Site 74. This summary includes the applicable NOAA criteria for sediment, range of positive detections, location where the highest concentration was detected, and the frequency of detection.

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
VOLATILES					
Trichloroethene	--	--	8.0J - 8.0J	74-PDA-SD01-06	1/3
SEMIVOLATILES					
3,3-Dichlorobenzidine	--	--	140.0J - 140.0J	74-PDA-SD03-06	1/3
PESTICIDES/PCBs					
4,4'-DDE	2	15	0.900J - 1.85J	74-PDA-SD01-06	2/3
4,4'-DDT	1	7	0.820NJ - 0.820NJ	74-PDA-SD02-06	1/3
Endosulfan II	--	--	0.63J - 0.80J	74-PDA-SD03-06	2/3
Methoxychlor	--	--	0.830J - 0.83J	74-PDA-SD02-06	1/3
Endrin Aldehyde	--	--	1.35NJ - 1.35NJ	74-PDA-SD03-06	1/3

Inorganics

Metals were detected in all sediment samples at Site 74. The metals detected in the sediment are summarized below. This summary includes the applicable NOAA criteria for sediment, range of positive detections, location of the highest detected concentration, and the frequency of detection.

Metals Detected Above CRQL	Criteria (mg/kg) NOAA ER-L	NOAA ER-M	Range of Positive Detections (mg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	--	--	584 - 3,320	74-PDA-SD02-06	3/3
Barium	--	--	5,73 - 13	74-PDA-SD02-06	2/3
Calcium	--	--	178 - 725	74-PDA-SD02-06	3/3
Chromium	80	145	1.8 - 3.13	74-PDA-SD02-06	2/3
Iron	--	--	199 - 1,530	74-PDA-SD02-06	3/3
Lead	35	110	2.67J - 6.06J	74-PDA-SD02-06	3/3
Magnesium	--	--	19.3 - 102	74-PDA-SD02-06	3/3
Manganese	--	--	2.76 - 5.27	74-PDA-SD02-06	3/3
Selenium	--	--	1.02 - 1.02	74-PDA-SD03-06	1/3
Vanadium	--	--	4.4 - 4.4	74-PDA-SD03-06	1/3
Zinc	120	270	12.6 - 12.6	74-PDA-SD02-06	1/3

4.5.5.2 Extent of Contamination

Results indicated the presence of volatiles, semivolatiles, pesticides, and inorganics in the three sediment samples collected from Henderson Pond. Refer to Figure 4-37 for the detected concentrations of volatiles and semivolatiles. Figure 4-38 presents the positive detections for pesticides in the sediment samples collected at Henderson Pond. TAL metals concentrations are presented on Figure 4-39.

Trichloroethene (TCE) was detected at a concentration of 8.00J µg/kg in sample 74-PDA-SD01-06. 3,3-dichlorobenzidine was detected at a concentration of 140.0J µg/kg in sample 74-PDA-SD03-06. The presence of TCE in sediment is not likely related to disposal activities at Site 74. There are no known historical records indicating the disposal of TCE near this pond. It is possible that the TCE is due to groundwater discharge; however, this cannot be determined due to a lack of groundwater data near this area.

3,3-dichlorobenzidine, generally classified as a solvent constituent, was detected in sample 74-PDA-SD03-06 at a concentration of 140.0J µg/kg. 3,3-dichlorobenzidine was not detected in surface and subsurface soils, or shallow groundwater. This tends to indicate that the presence of this contaminant is not from Site 74.

Five pesticides were detected in sediment samples at levels which are similar to other pesticide levels throughout MCB Camp Lejeune. The pesticides 4,4'-DDD, 4,4'-DDT, endosulfan II, and methoxychlor were detected at concentrations towards the lower end of the Base wide concentration ranges for these pesticides. Endrin aldehyde was not detected in the Base wide sediment samples, but it was detected in the southern sample location at a concentration of 1.35NJ µg/kg. The presence of pesticides in sediments is likely due to the historical usage of pesticides at the base. The presence of these pesticides is not likely due to surface runoff from the former pest control area due to the low levels and widespread extent of contamination. No documentation is available to substantiate pesticide usage in the area.

No organics were detected above NOAA ER-L values for sediments.

Eleven TAL metals were detected in sediment samples. Total metal concentrations in the sediment samples were below the Base wide averages determined for sediments.

4.5.6 Engineering Parameter Results

Engineering parameters were analyzed for selected soil and groundwater samples collected at Site 74. A soil sample was analyzed from monitoring well boring 74-GW05. A surficial aquifer groundwater sample was collected from shallow well 74-GW05. Soil engineering parameters were grain size distribution and Atterberg limits. Groundwater engineering parameters included alkalinity, BOD, COD, total phosphorous, TDS, TSS, total Kjeldahl nitrogen, and standard plate count. Engineering parameter results for soil and groundwater are summarized in Appendix K.

No analytical data is available from engineering analysis of the soil sample due to problems at the lab with reporting.

Results indicated the following concentration levels in the surficial aquifer:

- alkalinity <1.0 mg/L
- BOD 3.53 mg/L
- COD 36.7 mg/L
- total phosphorous 0.02 mg/L
- TDS 60 mg/L
- total Kjeldahl N 0.739 mg/L
- TSS 937 mg/L
- standard plate count 30700 CFU/mL

4.5.7 Quality Assurance/Quality Control Results

Quality Assurance/Quality Control (QA/QC) samples were collected during the soil, groundwater, and surface water and sediment investigations. These samples included trip blanks, field blanks, equipment rinsates, and duplicates. Analytical results of the field duplicates are provided in Appendix I and other field QA/QC (e.g., rinsate blanks, trip blanks, etc.) results are provided in Appendix L.

Various organics and inorganics were detected in QA/QC samples. The only organics detected were methylene chloride, acetone, and di-n-butylphthalate. Methylene chloride was detected in 4 trip blanks and 1 rinsate sample. Acetone were detected in one trip blank (74-TB-07). Di-n-butylphthalate was detected in one rinsate sample (74-RS-03). As stated previously, methylene chloride and acetone are most likely the result of laboratory contamination. Acetone may also be the result of decontamination procedures with isopropanol alcohol. Di-n-butylphthalate detected in the rinsate sample may be the result of the gloves used in the field. Phthalates are a common component of plastics and the isopropanol alcohol (which may degrade the gloves) used in the deconing procedures may have caused the phthalates to be detected in the rinsate sample. All TAL inorganics were detected in QA/QC samples but most were quantified with U, UJ, R, and UR qualifiers.

4.5.8 Summary

Pesticides was the contaminant class detected most frequently and at the highest concentrations, primarily at the former pesticide control and potential disposal areas. The wide range of pesticides and concentrations detected in the surface soils and at depth (up to 13 feet) indicates contamination from the former site operations of staging and mixing pesticides. Pesticides have not significantly affected the shallow groundwater at the site, or the surface water and sediments at Henderson Pond.

Low levels of volatiles and semivolatiles were detected in surface soil at isolated areas of the site, but have not impacted subsurface soils or groundwater. The low level of the chemical surety degradation compound hydroxyacetophenone detected in the southwest corner of the former disposal area can be attributed to the use of tear gas during training exercises. No PCBs were detected in the soils, groundwater, surface water, or sediments at the site.

TAL metals were detected in the soils, groundwater, and surface water and sediments. No discernable pattern is apparent for the metals extent. Concentrations in soils were generally similar to those reported for site-specific background samples and detected in other areas of the base. In groundwater, no migration pathway could be identified to determine a source. Well 74-GW03A, located to the north of the former disposal area in a general upgradient direction, had the second highest concentration of iron.

The presence of TCE in two sediment samples may be due to other unknown disposal operations near the pond.

SECTION 4.0 TABLES

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-DS-SB01-00	41-DS-SB02-00	41-DS-SB03-00	41-DS-SB04-00	41-DS-SB05-00	41-DS-SB06-00	41-DS-SB07-00
Laboratory Sample ID:		9402042-10A	9402043-09	9402043-10	9402042-11A	9402042-12A	9402042-13A	9402042-14A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		87.1	85.5	77.2	89.9	88.3	86.9	83
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenz[a,h]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-DS-SB01-00	41-DS-SB02-00	41-DS-SB03-00	41-DS-SB04-00	41-DS-SB05-00	41-DS-SB06-00	41-DS-SB07-00
Laboratory Sample ID:		9402042-10A	9402043-09	9402043-10	9402042-11A	9402042-12A	9402042-13A	9402042-14A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		87.1	85.5	77.2	89.9	88.3	86.9	83
	UNITS							
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	3 J	ND	ND	ND
Acetone	UG/KG	ND	ND	ND	ND	ND	3 J	3 J
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	4.72 NJ	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	0.96 J	ND	ND	0.72 J	1.4 J	0.45 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	0.56 J	ND	ND	ND	ND	ND
Endosulfan sulfate	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	1.26 J	ND	ND	1.4 J	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	1.69 J	ND	ND	ND	ND
Aroclor 1242	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
ORDNANCE								
1,3-Dinitrobenzene	UG/KG	ND	ND	824 NJ	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]e identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-DS-SB08-00	41-DS-SB09-00	41-DS-SB10-00	41-DS-SB11-00	41-DS-SB12-00	41-OS-SB02-00	41-OS-SB03-00
Laboratory Sample ID:		9402043-07	9402042-15A	9402042-16A	9402042-17A	9402042-18A	9402021-06	9402021-10
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		83.5	87.5	75.7	87.5	86.8	86.8	82.6
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	71 J
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenz[a,h]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	230 J	150 J
di-n-Octylphthalate	UG/KG	ND	55 J	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-DS-SB08-00	41-DS-SB09-00	41-DS-SB10-00	41-DS-SB11-00	41-DS-SB12-00	41-OS-SB02-00	41-OS-SB03-00
Laboratory Sample ID:		9402043-07	9402042-15A	9402042-16A	9402042-17A	9402042-18A	9402021-06	9402021-10
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		83.5	87.5	75.7	87.5	86.8	86.8	82.6
	UNITS							
VOLATILES								
Methylene chloride	UG/KG	ND	ND	5 J	ND	ND	ND	ND
Acetone	UG/KG	ND	ND	ND	ND	ND	ND	5 J
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	1.51 J	ND	ND	7.16 J
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	9.6 NJ
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	1.81 J	1.75 NJ	ND	0.44 NJ	0.43 J	61 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	2.93 J
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	3.59 J
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	0.37 J	2.28 J	ND	ND	0.58 NJ	44 J
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	3.28 NJ
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	0.5 J	92.7 J
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	0.4 J	93.5 J
Aroclor 1242	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
ORDNANCE								
1,3-Dinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]ected
NJ - estimated/t[illegible] identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB04-00	41-0S-SB05-00	41-0S-SB06-00	41-0S-SB07-00	41-OS-SB08-00	41-0S-SB09-00	41-0S-SB10-00
Laboratory Sample ID:		9402086-04	9402042-01A	9402086-01	9402042-05A	9402086-09	9402042-03A	9402064-04
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		90.3	91.6	88.1	86.2	86.3	89	84.3
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	380 J
Anthracene	UG/KG	ND	ND	ND	ND	ND	ND	510
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	2400
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	40 J	2000
Benzo[b]fluoranthene	UG/KG	ND	ND	39 J	ND	ND	38 J	2500
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	1600
Benzo[k]fluoranthene	UG/KG	ND	ND	54 J	ND	ND	50 J	1700
bis(2-Chloroethyl) ether	UG/KG	ND	65 J	ND	ND	ND	ND	57 J
bis(2-Ethylhexyl)phthalate	UG/KG	43 J	ND	42 J	ND	240 J	ND	170 J
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	330 J
Chrysene	UG/KG	ND	ND	50 J	ND	ND	49 J	2300
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	130 J
Dibenz[a,h]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	69 J	ND	110 J	ND	55 J	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	108 J	ND	53 J	79 J	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	280 J
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	72 J	ND	ND	ND	2600
Pyrene	UG/KG	ND	ND	73 J	ND	50 J	71 J	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB04-00	41-0S-SB05-00	41-0S-SB06-00	41-0S-SB07-00	41-OS-SB08-00	41-0S-SB09-00	41-0S-SB10-00
Laboratory Sample ID:		9402086-04	9402042-01A	9402086-01	9402042-05A	9402086-09	9402042-03A	9402064-04
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		90.3	91.6	88.1	86.2	86.3	89	84.3
	UNITS							
VOLATILES								
Methylene chloride	UG/KG	3 J	4 J	4 J	3 J	ND	5 J	ND
Acetone	UG/KG	ND	ND	ND	6 J	ND	18 J	20
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	0.83 J	ND	13.03 NJ	ND	6.12 NJ
4,4'-DDE	UG/KG	1.07 J	ND	0.84 J	0.4 J	87.6 J	4.02 J	38.9 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	ND	ND	2.61 J	ND	ND	0.45 NJ	ND
4,4'-DDD	UG/KG	0.8 J	ND	2.88 J	ND	ND	4.18 J	43.2 J
Endosulfan sulfate	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	1.03 NJ	0.57 J	10.4 NJ	1.27 J	41.3 J
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	0.68 NJ	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	0.25 J	1.66 J
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	1.33 J
Aroclor 1242	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
ORDNANCE								
1,3-Dinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]cted
NJ - estimated/te[illegible]e identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB11-00	41-0S-SB12-00	41-0S-SB13-00	41-0S-SB14-00	41-0S-SB15-00	41-0S-SB16-00	41-0S-SB17-00
Laboratory Sample ID:		9402086-07	9402042-08A	9402052-08	9402064-01	9402070-01	9402043-05	9402052-03
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		84.8	76.8	87.1	81.9	83.8	83.6	83.9
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	180 J	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	55 J	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	91 J	ND	ND	ND	ND	ND
Anthracene	UG/KG	ND	110 J	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	360 J	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	300 J	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	270 J	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	240 J	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	320 J	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	46 J	580 J	ND	ND	240 J	51 J	ND
Carbazole	UG/KG	ND	44 J	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	420 J	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenz[a,h]anthracene	UG/KG	ND	57 J	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	42 J	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	110 J
Fluoranthene	UG/KG	ND	820	ND	2500 J	40 J	ND	ND
Fluorene	UG/KG	ND	79 J	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	70 J	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	540	ND	1800 J	ND	ND	ND
Pyrene	UG/KG	ND	600 J	ND	2300 J	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB11-00	41-0S-SB12-00	41-0S-SB13-00	41-0S-SB14-00	41-0S-SB15-00	41-0S-SB16-00	41-0S-SB17-00
Laboratory Sample ID:		9402086-07	9402042-08A	9402052-08	9402064-01	9402070-01	9402043-05	9402052-03
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		84.8	76.8	87.1	81.9	83.8	83.6	83.9
	UNITS							
VOLATILES								
Methylene chloride	UG/KG	4 J	3 J	3 J	ND	ND	ND	2 J
Acetone	UG/KG	ND	ND	11.5 J	33 J	14 J	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	0.92 J	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	5.13 NJ	ND	0.47 J	ND	2.05 J	1.12 J	1.07 NJ
4,4'-DDE	UG/KG	25.1 J	60.8 J	0.46 NJ	32.4 J	1.14 J	4.07 J	4.24 J
Endrin	UG/KG	1.47 NJ	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	4.15 NJ	ND	4.62 NJ	ND	1.88 J	1 NJ	ND
4,4'-DDD	UG/KG	48.2 J	92 J	0.77 NJ	79.1 J	2.35 NJ	3.07 NJ	1.52 J
Endosulfan sulfate	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	14.8 J	8.06 J	1.86 J	277 J	1.73 J	1.01 NJ	2.14 J
Methoxychlor	UG/KG	ND	1.41 J	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	1.37 J	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	1.7 J	2.17 J	ND	0.44 J	0.85 J	ND	0.48 J
gamma-Chlordane	UG/KG	1.17 J	2.01 J	ND	ND	0.74 J	ND	0.28 J
Aroclor 1242	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
ORDNANCE								
1,3-Dinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB18-00	41-0S-SB19-00	41-0S-SB20-00	41-0S-SB21-00	41-0S-SB22-00	41-0S-SB23-00	41-0S-SB24-00
Laboratory Sample ID:		9402061-01	9402043-03	9402052-04	9402052-05	9402061-04	9402043-01	9402061-07
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		88.2	84.2	82.7	89	84.5	85.8	83.8
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Anthracene	UG/KG	ND	ND	41 J	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	130 J	ND	140 J	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	120 J	ND	120 J	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	120 J	ND	140 J	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	71 J	ND	46 J	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	120 J	ND	86 J	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	160 J	ND	ND	ND	70 J	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	160 J	ND	150 J	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenz[a,h]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	62 J	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	200 J	ND	86 J	ND	52 J	ND	40 J
Fluoranthene	UG/KG	240 J	ND	240 J	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	71 J	ND	76 J	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	140 J	ND	200 J	ND	ND	ND	ND
Pyrene	UG/KG	240 J	ND	230 J	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB18-00	41-0S-SB19-00	41-0S-SB20-00	41-0S-SB21-00	41-0S-SB22-00	41-0S-SB23-00	41-0S-SB24-00
Laboratory Sample ID:		9402061-01	9402043-03	9402052-04	9402052-05	9402061-04	9402043-01	9402061-07
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		88.2	84.2	82.7	89	84.5	85.8	83.8
	UNITS							
VOLATILES								
Methylene chloride	UG/KG	ND	ND	4 J	3 J	ND	ND	ND
Acetone	UG/KG	ND	2800	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	2 J	ND	1 J
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	2.39 J	ND	ND	ND	0.56 NJ	ND	0.81 NJ
Dieldrin	UG/KG	2.81 J	5.65 J	0.83 NJ	ND	2.16 NJ	3.07 NJ	1.04 NJ
4,4'-DDE	UG/KG	1.48 J	6.36 J	2.29 J	ND	1.58 NJ	69.3 J	3.22 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	3.79 J	4.44 J	3.62 J	ND	5.01 J	ND	2.5 J
4,4'-DDD	UG/KG	2.76 J	6.92 J	ND	ND	8.46 J	45 J	4.68 J
Endosulfan sulfate	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	2.7 J	25 J	ND	7.41 J	66.3 J	1.66 J
Methoxychlor	UG/KG	1.51 J	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	0.44 NJ	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	0.61 J	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	0.87 J	2.25 J	0.27 NJ	ND	3.88 J	1.47 J	0.84 J
gamma-Chlordane	UG/KG	0.57 J	0.8 J	0.3 J	ND	3.68 J	1.25 J	0.82 J
Aroclor 1242	UG/KG	ND	82.9 J	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	58.4 J	ND
ORDNANCE								
1,3-Dinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]cted
NJ - estimated/t[illegible] identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB25-00	41-OS-SB26-00	41-OS-SB27-00	41-OS-SB28-00	41-OS-SB29-00	41-OS-SB30-00	41-OS-SB31-00
Laboratory Sample ID:		9402088-01A	9402088-03A	9402088-05A	9402088-08A	9402071-03	9402071-05	9402088-10A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:						02/05/94	02/05/94	
Percent Solids:		84.6	80.6	73	82.2	88.8	83.2	69.5
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	94 J	ND	ND	59 J
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	64 J	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenz[a,h]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	86 J	99 J	86 J	58 J	ND	92.0 J	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB25-00	41-OS-SB26-00	41-OS-SB27-00	41-OS-SB28-00	41-OS-SB29-00	41-OS-SB30-00	41-OS-SB31-00
Laboratory Sample ID:		9402088-01A	9402088-03A	9402088-05A	9402088-08A	9402071-03	9402071-05	9402088-10A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:						02/05/94	02/05/94	
Percent Solids:		84.6	80.6	73	82.2	88.8	83.2	69.5
	UNITS							
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	4 J	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	0.03 NJ	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	0.3 NJ	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	0.12 J	0.51 NJ	ND	0.790 J	43.6 J	ND
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	0.37 J	ND	ND	ND	ND	ND
Endosulfan sulfate	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	1.7 J	2 J	0.410 NJ	20.1 J	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	0.08 J	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	0.06 NJ	ND	ND	ND	ND	ND
Aroclor 1242	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
ORDNANCE								
1,3-Dinitrobenzene	UG/KG	N/A	N/A	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB32-00	41-OS-SB33-00	41-OS-SB34-00
Laboratory Sample ID:		9402088-12A	9402071-08	9402088-15A
Depth:		0-12"	0-12"	0-12"
Date Sampled:			02/05/94	
Percent Solids:		85.5	78.1	77.7
	UNITS			
SEMIVOLATILES				
1,4-Dichlorobenzene	UG/KG	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND
Anthracene	UG/KG	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	220 J
bis(2-Ethylhexyl)phthalate	UG/KG	47 J	ND	ND
Carbazole	UG/KG	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND
Dibenz[a,h]anthracene	UG/KG	ND	ND	ND
di-n-Butylphthalate	UG/KG	43 J	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-1
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB32-00	41-OS-SB33-00	41-OS-SB34-00
Laboratory Sample ID:		9402088-12A	9402071-08	9402088-15A
Depth:		0-12"	0-12"	0-12"
Date Sampled:			02/05/94	
Percent Solids:		85.5	78.1	77.7
	UNITS			
VOLATILES				
Methylene chloride	UG/KG	ND	ND	ND
Acetone	UG/KG	7 J	ND	ND
Toluene	UG/KG	ND	ND	ND
PESTICIDE/PCBS				
beta-BHC	UG/KG	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	0.22 NJ	ND	ND
Heptachlor	UG/KG	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND
Dieldrin	UG/KG	0.2 NJ	ND	ND
4,4'-DDE	UG/KG	0.56 J	ND	4.11 J
Endrin	UG/KG	ND	ND	ND
Endosulfan II	UG/KG	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND
Endosulfan sulfate	UG/KG	0.32 J	ND	ND
4,4'-DDT	UG/KG	ND	0.910 NJ	3.67 J
Methoxychlor	UG/KG	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND
Aroclor 1242	UG/KG	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND
ORDNANCE				
1,3-Dinitrobenzene	UG/KG	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-2
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION
TAL INORGANICS

Client Sample ID:		41-DS-SB01-00	41-DS-SB02-00	41-DS-SB03-00	41-DS-SB04-00	41-DS-SB05-00	41-DS-SB06-00	41-DS-SB07-00	41-DS-SB08-00
Laboratory Sample ID:		9402042-10A	9402043-09	9402043-10	9402042-11A	9402042-12A	9402042-13A	9402042-14A	9402043-07
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:									
Percent Solids:		87.1	85.5	77.2	89.9	88.3	86.9	83	83.5
	UNITS								
Aluminum	MG/KG	4080 J	2650	3140	1430 J	3390 J	4190 J	5850 J	5690
Antimony	MG/KG	ND	ND	2.18 J	ND	ND	ND	ND	ND
Arsenic	MG/KG	0.998	ND	ND	ND	ND	ND	ND	ND
Barium	MG/KG	4.32	6.53	7.47	3.78	13.6	11.9	14.2	13.2
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND	0.215	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	165	135	162	37.2	ND	ND	66	104
Chromium	MG/KG	5.44	ND	2.85	ND	2.25	2.68	6.26	5.09
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	3540 J	1600	722	849 J	2080 J	1720 J	4060 J	2790
Lead	MG/KG	3.67 J	4.67 J	9.66 J	2.57 J	6.61 J	6.79 J	6.42 J	9.09 J
Magnesium	MG/KG	93	96.3	75.6	32.5	64.2	85	155	181
Manganese	MG/KG	1.67 J	6.27	3.63	ND	4.89 J	10.5 J	7.46 J	11.3
Mercury	MG/KG	ND	0.077	0.108	ND	ND	ND	ND	0.074
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	201	ND	ND	ND	ND	ND	206
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	10.8	ND	ND	ND	4.62	6.32	9.38	6.2
Zinc	MG/KG	6.16	6.21	5.19	4.21	6.81	6.65	8.65	9.11
Total Cyanide	MG/KG	1.15	1.17	1.3	1.11	1.13	1.15	1.57	1.2

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-2
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION
TAL INORGANICS

Client Sample ID:		41-DS-SB09-00	41-DS-SB10-00	41-DS-SB11-00	41-DS-SB12-00	41-OS-SB01-00	41-OS-SB02-00	41-OS-SB03-00	41-0S-SB04-00
Laboratory Sample ID:		9402042-15A	9402042-16A	9402042-17A	9402042-18A	9402021-01	9402021-06	9402021-10	9402086-04
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:									
Percent Solids:		87.5	75.7	87.5	86.8	84.7	86.8	82.6	90.3
	UNITS								
Aluminum	MG/KG	2580 J	2670 J	4640	4430 J	14200	7890	6770	981
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	1.26	2.22	1.79	1.73	ND
Barium	MG/KG	7.28	17.9	8.12	15.9	19.1	12.1	21.7	3.14
Beryllium	MG/KG	ND	ND	ND	ND	0.2	ND	ND	0.221
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	42.2	830	806	ND	1700	547	16600	297
Chromium	MG/KG	ND	2.63	3.76	3.86	17.3	9.72	9.21	2.39 J
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	1330 J	1820 J	2040	1840 J	12200	4900	5040	451
Lead	MG/KG	5.43 J	10 J	6.19	10.7 J	7.31	6.57	37.1	3.37
Magnesium	MG/KG	45.4	79.7	75	102	358	236	468	39.3
Manganese	MG/KG	6.06 J	6.4	10.1	9.32	8.84	4.68	18.9	2.17
Mercury	MG/KG	ND	ND	0.106	0.115	ND	ND	0.084	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	391	298	227	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	18.3 J	ND	ND	0.096	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND	84.7
Vanadium	MG/KG	ND	5.9	6.67	5.78	26.3	14.1	11.7	ND
Zinc	MG/KG	5.41	8.35	5.26	6.76	9.02	7.92	50	ND
Total Cyanide	MG/KG	1.14	1.32	1.49	1.15	1.18	1.15	1.21	1.11

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-2
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION
TAL INORGANICS

Client Sample ID:		41-0S-SB05-00	41-0S-SB06-00	41-0S-SB07-00	41-OS-SB08-00	41-0S-SB09-00	41-0S-SB10-00	41-OS-SB11-00	41-0S-SB12-00
Laboratory Sample ID:		9402042-01A	9402086-01	9402042-05A	9402086-09	9402042-03A	9402064-04	9402086-07	9402042-08A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:									
Percent Solids:		91.6	88.1	86.2	86.3	89	84.3	84.8	76.8
	UNITS								
Aluminum	MG/KG	1440 J	2710	4710 J	4070	3970 J	3320	3260	17400 J
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	2.57	ND
Arsenic	MG/KG	ND	ND	0.721	ND	ND	1.02	ND	3.54
Barium	MG/KG	5.42	8.49	12.9	24.8	13.3	29.3	27.2	82.2
Beryllium	MG/KG	ND	ND	0.208	0.188	ND	0.295	ND	0.238
Cadmium	MG/KG	ND	ND	ND	1.23	ND	ND	1.84	7.44
Calcium	MG/KG	251	4700	1170	1590	2060	4750	1190	8970
Chromium	MG/KG	2.19	4.05 J	8.77	7.32 J	5.42	7.47 J	8.34 J	41.4
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND	6.46
Copper	MG/KG	ND	6.4	4.17	12.9	7.42	44.5	30.7	132
Iron	MG/KG	1060 J	2050	5970 J	6590	3040 J	4660	4800	91600 J
Lead	MG/KG	4.43 J	12.7	9.56 J	52.3	66.7 J	212	101	341 J
Magnesium	MG/KG	43.6	130	157	144	156	221	104	426
Manganese	MG/KG	1.85 J	6.65	7.11 J	37.3	12.5 J	30.6	55.8	6000 J
Mercury	MG/KG	ND	ND	ND	0.205	ND	0.073	0.316	0.768
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND	35.3
Potassium	MG/KG	ND	ND	ND	ND	ND	ND	ND	196
Selenium	MG/KG	ND	0.357	ND	ND	ND	0.467	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND	0.903 J
Sodium	MG/KG	ND	86.8	ND	88.6	ND	142	192	230
Vanadium	MG/KG	ND	5.91	17.9	7.69	8.01	9.16	9.4	27
Zinc	MG/KG	4.89	11.4	8.58	163	34.8	158	196	14600
Total Cyanide	MG/KG	1.09	1.14	1.16	1.16	1.12	1.19	1.18	1.32

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-2
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION
TAL INORGANICS

Client Sample ID:		41-0S-SB13-00	41-0S-SB14-00	41-0S-SB15-00	41-0S-SB16-00	41-0S-SB17-00	41-0S-SB18-00	41-0S-SB19-00	41-0S-SB20-00
Laboratory Sample ID:		9402052-08	9402064-01	9402070-01	9402043-05	9402052-03	9402061-01	9402043-03	9402052-04
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:									
Percent Solids:		87.1	81.9	83.8	83.6	83.9	88.2	84.2	82.7
	UNITS								
Aluminum	MG/KG	1510	2830	2860	4250	12800	3060	4980	5140
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	1.14 J	1.16	ND	4.42	0.819	1.92	1.51
Barium	MG/KG	5.71	17.3	14.1	9.84	25.5	13.3	16.4	14.1
Beryllium	MG/KG	ND	0.344	0.322	ND	0.191	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	0.854	ND	ND	1.48
Calcium	MG/KG	117	612	1240	685	40300	306	5020	1250
Chromium	MG/KG	2.68	9.95 J	7.08 J	5.22	20.3	4.67	18.2	8.51
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	10.2	7.42	ND	13.6 J	14 J	20.6	9.08 J
Iron	MG/KG	397	4520	3980	2580	12100	2700	12400	4080
Lead	MG/KG	6.38	59.7	52.8	14.3 J	116	17.3	23.1 J	30.1
Magnesium	MG/KG	53.1	502	99.2	158	1100	106	202	211
Manganese	MG/KG	1.69	43.4	12.4	5.19	41.9	7.67	53.8	22.8
Mercury	MG/KG	0.086	0.129	ND	0.081	0.187	ND	0.105	ND
Nickel	MG/KG	ND	7.48	ND	ND	7.36	ND	7.41	ND
Potassium	MG/KG	ND	ND	ND	ND	547	ND	259	245
Selenium	MG/KG	ND	ND	0.596	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	174	ND	ND	ND	ND
Vanadium	MG/KG	ND	39.8	7.93	9.68	24.8	7.35	8.26	10.7
Zinc	MG/KG	13.1 J	62.6	31.6	15.2	94.6 J	33.3 J	121	47.6 J
Total Cyanide	MG/KG	1.15	1.22	1.19	1.2	1.19	1.13	1.19	1.21

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible] ected

TABLE 4-2
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION
TAL INORGANICS

Client Sample ID:		41-0S-SB21-00	41-0S-SB22-00	41-0S-SB23-00	41-0S-SB24-00	41-OS-SB25-00	41-OS-SB26-00	41-OS-SB27-00	41-OS-SB28-00
Laboratory Sample ID:		9402052-05	9402061-04	9402043-01	9402061-07	9402088-01A	9402088-03A	9402088-05A	9402088-08A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:									
Percent Solids:		89	84.5	85.8	83.8	84.6	80.6	73	82.2
	UNITS								
Aluminum	MG/KG	2990	5640	4500	4160	6280	878	6300	1190
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	0.909	0.68	2.52	0.797	ND	0.671	ND
Barium	MG/KG	9.9	16.3	13.8	13.9	10.5	3.22	21.7	19.8
Beryllium	MG/KG	ND	0.187	ND	ND	ND	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	32.9	715	8380	2930	56.7	174	2990	894
Chromium	MG/KG	3.68	6.67	7.71	7.24	8.93 J	2.79 J	7.96 J	3.21 J
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	4.63 J	ND	ND	ND	ND
Iron	MG/KG	584	3030	4570	4510	4950 J	676 J	3190 J	481 J
Lead	MG/KG	2.71	157	22.9 J	23.1	9.26 J	7.06 J	27.5 J	9.31 J
Magnesium	MG/KG	94.4	215	276	268	162	28.1	277	88.3
Manganese	MG/KG	ND	11.4	13.7	15.3	2.46	1.97	30.6	8.52
Mercury	MG/KG	0.098	ND	0.1	ND	ND	ND	0.105	0.074
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	184	254	186	299	ND	317	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	120	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	6.8	8.62	9.95	13.9	ND	9.96	ND
Zinc	MG/KG	3.77 J	28.5 J	26.4	21.7 J	ND	ND	39.5	ND
Total Cyanide	MG/KG	1.12	1.18	1.16	1.19	1.18	1.24	1.37	1.22

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-2
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
DOWNSLOPE AND ONSITE SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION
TAL INORGANICS

Client Sample ID:		41-OS-SB29-00	41-OS-SB30-00	41-OS-SB31-00	41-OS-SB32-00	41-OS-SB33-00	41-OS-SB34-00
Laboratory Sample ID:		9402071-03	9402071-05	9402088-10A	9402088-12A	9402071-08	9402088-15A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/05/94	02/05/94			02/05/94	
Percent Solids:		88.8	83.2	69.5	85.5	78.1	77.7
	UNITS						
Aluminum	MG/KG	2760.0 J	6090.0 J	3620	930	3150.0 J	2900
Antimony	MG/KG	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	ND
Barium	MG/KG	7.52	9.04	27.8	5.69	11.2	9.12
Beryllium	MG/KG	ND	0.206	ND	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	ND	158.0	3190	329	179.0	745
Chromium	MG/KG	ND	7.84	4.09 J	ND	3.80	3.53 J
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	5.38	ND	ND	ND
Iron	MG/KG	1350.0 J	4810.0 J	1230 J	874 J	1980.0 J	1150 J
Lead	MG/KG	3.05	3.48	12.7 J	15.3 J	7.73	15.8 J
Magnesium	MG/KG	51.0	167.0	203	51.4	133.0	55.7
Manganese	MG/KG	4.08 J	3.50 J	56.4	4.76	4.54 J	9.46
Mercury	MG/KG	ND	ND	0.097	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	13.6	ND	ND	ND	ND
Zinc	MG/KG	3.98	7.62	28.5	13.1	26.4	49.5
Total Cyanide	MG/KG	1.13	1.20	1.44	1.17	1.28	1.29

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

TABLE 4-3
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITES 41, 69, AND 74)
SITE - BACKGROUND SURFACE SOILS
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-BB-SB01-00	41-BB-SB02-00	41-BB-SB03-00	41-BB-SB04-00	69-BB-SB02-00	69-BB-SB03-00	74-BB-SB02-00
Laboratory Sample ID:		9402043-12	9402043-13	9402043-14	9402043-15	9401055-04A	9401055-05A	9401138-15
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/02/94	02/02/94	02/02/94	02/02/94	01/08/94	34342	01/23/94
Percent Solids:		81.4	91.4	90.5	84.0	84.5	83.0	85.5
	UNITS							
SEMIVOLATILES								
2-Chloronaphthalene	UG/KG	ND	280.0 J	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	39.0 J	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	210.0 J	ND	ND	ND	ND
PESTICIDES								
4,4'-DDE	UG/KG	49.0 J	ND	ND	2.62 J	1.20 J	68.4 J	2.13 J
Endosulfan II	UG/KG	2.76 NJ	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	34.2 J	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	6.33 J	ND	ND	1.81 J	ND	40.4 J	ND
Endrin ketone	UG/KG	1.70 NJ	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-3
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITES 41, 69, AND 74)
SITE - BACKGROUND SURFACE SOILS
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-BB-SB03-00	74-BB-SB04-00
Laboratory Sample ID:		9401138-16	9401138-17
Depth:		0-12"	0-12"
Date Sampled:		01/23/94	01/23/94
Percent Solids:		92.3	82.4
	UNITS		
SEMIVOLATILES			
2-Chloronaphthalene	UG/KG	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND
Diethylphthalate	UG/KG	ND	ND
PESTICIDES			
4,4'-DDE	UG/KG	0.850 J	2.31 J
Endosulfan II	UG/KG	ND	ND
4,4'-DDD	UG/KG	ND	ND
4,4'-DDT	UG/KG	ND	ND
Endrin ketone	UG/KG	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/t[illegible]e identification

TABLE 4-4
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITES 41, 69, AND 74)
SITE - BACKGROUND SURFACE SOILS
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-BB-SB01-00	41-BB-SB02-00	41-BB-SB03-00	41-BB-SB04-00	69-BB-SB01-00	69-BB-SB02-00	69-BB-SB03-00
Laboratory Sample ID:		9402043-12	9402043-13	9402043-14	9402043-15	9401055-03A	9401055-04A	9401055-05A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/02/94	02/02/94	02/02/94	02/02/94	01/08/94	34342	34342
Percent Solids:		81.4	91.4	90.5	84.0	93.0	84.5	83.0
	UNITS							
Aluminum	MG/KG	528.0	1430.0	2100.0	5370.0	1310.0	4150.0	9570.0
Antimony	MG/KG	2.07 J	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	ND	0.790
Barium	MG/KG	ND	4.06	4.53	13.4	5.60	15.4	19.6
Calcium	MG/KG	ND	54.6	79.2	46.3	28.2	43.6	282.0
Chromium	MG/KG	ND	ND	2.64	3.24	ND	4.00 J	12.5 J
Copper	MG/KG	ND	87.2	ND	ND	ND	ND	ND
Iron	MG/KG	83.0	970.0	1120.0	2160.0	425.0	1430.0	9640.0
Lead	MG/KG	2.59 J	10.9 J	9.98 J	6.61 J	2.80	6.00	5.30
Magnesium	MG/KG	ND	39.1	74.0	144.0	37.3	91.8	610.0
Manganese	MG/KG	ND	10.2	11.6	11.8	15.1	12.7	12.3
Mercury	MG/KG	ND	0.078	0.057	0.080	ND	0.060	ND
Nickel	MG/KG	ND	ND	ND	ND	2.90	ND	ND
Potassium	MG/KG	ND	ND	190.0	177.0	ND	ND	361.0 J
Silver	MG/KG	ND	ND	ND	ND	ND	ND	4.30 J
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	ND	ND	ND	13.5
Zinc	MG/KG	2.66	6.11	5.97	7.15	3.10	5.20	10.8
Total Cyanide	MG/KG	1.23	1.09	1.10	1.19	2.20	2.40	2.40

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-4
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITES 41, 69, AND 74)
SITE - BACKGROUND SURFACE SOILS
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		69-BB-SB04-00	74-BB-SB01-00	74-BB-SB02-00	74-BB-SB03-00	74-BB-SB04-00
Laboratory Sample ID:		9401055-06A	9401138-14	9401138-15	9401138-16	9401138-17
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/08/94	01/23/94	01/23/94	01/23/94	01/23/94
Percent Solids:		83.4	87.2	85.5	92.3	82.4
	UNITS					
Aluminum	MG/KG	5360.0	3110.0	1730.0	1000.0	2100.0
Antimony	MG/KG	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND
Barium	MG/KG	20.8	11.1	ND	3.12	16.0
Calcium	MG/KG	53.0	181.0	46.9	43.9	377.0
Chromium	MG/KG	5.80 J	ND	2.70	ND	1.98
Copper	MG/KG	ND	4.56	3.92	ND	ND
Iron	MG/KG	3890.0	1740.0	401.0	787.0	1640.0
Lead	MG/KG	5.60	5.19 J	3.79 J	1.14 J	142.0 J
Magnesium	MG/KG	247.0	70.0	37.5	16.1	52.5
Manganese	MG/KG	8.30	9.44	3.13	7.37	4.61
Mercury	MG/KG	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND
Potassium	MG/KG	106.0 J	ND	ND	ND	ND
Silver	MG/KG	0.390 J	ND	ND	ND	ND
Sodium	MG/KG	ND	70.4	71.8	87.6	122.0
Vanadium	MG/KG	5.60	5.21	ND	ND	4.69
Zinc	MG/KG	7.90	ND	ND	ND	ND
Total Cyanide	MG/KG	2.40	1.15	1.17	1.08	1.21

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

TABLE 4-5

COMPARISON OF INORGANIC LEVELS IN SURFACE SOILS AT SITE 41 TO BACKGROUND LEVELS REMEDIAL INVESTIGATION - CTO - 0212 MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 41 (mg/kg)	Site Background (mg/kg)	Base Background (µg/kg)
Aluminum	878 - 17,400	528 - 5,370	17.7 - 9,570
Antimony	2.18 - 2.57	2.07 - 2.07	0.33 - 8
Arsenic	0.671 - 4.42	ND	0.065 - 3.9
Barium	3.14 - 82.2	4.06 - 13.4	0.65 - 20.8
Beryllium	0.187 - 0.344	ND	0.02 - 0.26
Cadmium	0.854 - 7.44	ND	0.04 - 0.6
Calcium	32.9 - 40,300	46.3 - 54.6	4.25 - 10,700
Chromium	2.19 - 41.4	2.64 - 3.24	0.33 - 12.5
Cobalt	6.46 - 6.46	ND	0.185 - 2.355
Copper	4.17 - 132	87.2 - 87.2	0.5 - 87.2
Iron	397 - 91,600	83 - 2,160	69.7 - 9,640
Lead	2.57 - 341	2.59 - 10.9	0.47 - 142
Magnesium	28.1 - 1,100	39.1 - 144	2.55 - 610
Manganese	1.67 - 6,000	10.2 - 11.8	0.87 - 66
Mercury	0.056 - 0.768	0.057 - 0.080	0.01 - 0.08
Nickel	7.36 - 35.3	ND	0.6 - 3.55
Potassium	184 - 547	177 - 190	1 - 416
Selenium	0.357 - 0.596	ND	0.075 - 1.3
Silver	0.096 - 18.3	ND	0.0435 - 4.3
Sodium	84.7 - 230	ND	4.7 - 126
Vanadium	4.62 - 39.8	ND	0.305 - 18.2
Zinc	3.77 - 14,600	2.66 - 7.15	0.3 - 28.3
Total Cyanide	1.09 - 1.57	1.09 - 1.23	0.265 - 2.4

ND = Nondetect

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB01-02	41-OS-SB01-05	41-OS-SB02-02	41-OS-SB02-03	41-OS-SB03-01	41-0S-SB04-02	41-0S-SB04-03
Laboratory Sample ID:		9402021-02	9402021-03	9402021-08	9402021-09	9402021-11	9402086-05	9402086-06
Depth:		3-5'	9-11'	3-5'	5-7'	1-3'	3-5'	5-7'
Date Sampled:								
Percent Solids:		83.4	88.8	88	93.5	82.8	87.6	78.1
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	800	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	230 J	ND	40 J	39 J	ND	ND	61 J
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	200 J	180 J	230 J	87 J	110 J	43 J	69 J
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB01-02	41-OS-SB01-05	41-OS-SB02-02	41-OS-SB02-03	41-OS-SB03-01	41-0S-SB04-02	41-0S-SB04-03
Laboratory Sample ID:		9402021-02	9402021-03	9402021-08	9402021-09	9402021-11	9402086-05	9402086-06
Depth:		3-5'	9-11'	3-5'	5-7'	1-3'	3-5'	5-7'
Date Sampled:								
Percent Solids:		83.4	88.8	88	93.5	82.8	87.6	78.1
	UNITS							
VOLATILES								
Chloromethane	UG/KG	3 J	2 J	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	5 J	7 J
Acetone	UG/KG	ND	ND	9 J	11 J	ND	54 J	62 J
2-Butanone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	1 J	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	18	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	11.5 J	ND	ND
Endosulfan I	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	7.57 J
4,4'-DDE	UG/KG	ND	ND	ND	ND	38 J	ND	4.78 NJ
Endrin	UG/KG	ND	ND	ND	ND	4.25 NJ	ND	ND
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	10 J
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	ND	11.5 J
4,4'-DDT	UG/KG	ND	ND	ND	ND	46 J	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]cted
NJ - estimated/te[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB01-02	41-OS-SB01-05	41-OS-SB02-02	41-OS-SB02-03	41-OS-SB03-01	41-0S-SB04-02	41-0S-SB04-03
Laboratory Sample ID:		9402021-02	9402021-03	9402021-08	9402021-09	9402021-11	9402086-05	9402086-06
Depth:		3-5'	9-11'	3-5'	5-7'	1-3'	3-5'	5-7'
Date Sampled:								
Percent Solids:		83.4	88.8	88	93.5	82.8	87.6	78.1
	UNITS							
PESTICIDE/PCBS Cont.								
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	160 J	ND	2.94 NJ
gamma-Chlordane	UG/KG	ND	ND	ND	ND	170 J	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Acetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB05-01	41-0S-SB06-01	41-0S-SB06-03	41-0S-SB07-01	41-0S-SB07-02	41-OS-SB08-01	41-0S-SB09-01
Laboratory Sample ID:		9402042-02A	9402086-02	9402086-03	9402042-06A	9402042-07A	9402086-10	9402042-04A
Depth:		1-3'	1-3'	5-7'	1-3'	3-5'	1-3'	1-3'
Date Sampled:								
Percent Solids:		87.4	89.3	87.1	89.9	81	88.7	88.5
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	240 J	1060	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	55 J	49 J	ND	ND	150 J	ND
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	52 J	46 J	ND	ND	73 J	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	40 J	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]ve identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB05-01	41-0S-SB06-01	41-0S-SB06-03	41-0S-SB07-01	41-0S-SB07-02	41-OS-SB08-01	41-0S-SB09-01
Laboratory Sample ID:		9402042-02A	9402086-02	9402086-03	9402042-06A	9402042-07A	9402086-10	9402042-04A
Depth:		1-3'	1-3'	5-7'	1-3'	3-5'	1-3'	1-3'
Date Sampled:								
Percent Solids:		87.4	89.3	87.1	89.9	81	88.7	88.5
	UNITS							
VOLATILES								
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	3 J	3 J	ND	ND	4 J
Acetone	UG/KG	ND	74 J	1500 J	51 J	54 J	44	67 J
2-Butanone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	1 J	ND	ND
Chlorobenzene	UG/KG	ND	ND	7 J	ND	39 J	ND	4 J
Ethylbenzene	UG/KG	ND	ND	7 J	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	11.9 J	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	13.1 J	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	12.8 J	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	0.32 J	27.6 J	ND	ND	3.27 NJ	0.42 NJ
4,4'-DDE	UG/KG	ND	0.39 J	ND	ND	ND	10.3 J	0.32 NJ
Endrin	UG/KG	ND	ND	28.3 J	ND	ND	1.14 NJ	ND
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	4.22 J	0.87 J
4,4'-DDD	UG/KG	ND	1.52 J	0.82 J	ND	ND	5.58 NJ	1.23 J
4,4'-DDT	UG/KG	ND	ND	29.7 J	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	0.86 J	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB05-01	41-0S-SB06-01	41-0S-SB06-03	41-0S-SB07-01	41-0S-SB07-02	41-OS-SB08-01	41-0S-SB09-01
Laboratory Sample ID:		9402042-02A	9402086-02	9402086-03	9402042-06A	9402042-07A	9402086-10	9402042-04A
Depth:		1-3'	1-3'	5-7'	1-3'	3-5'	1-3'	1-3'
Date Sampled:								
Percent Solids:		87.4	89.3	87.1	89.9	81	88.7	88.5
	UNITS							
PESTICIDE/PCBS Cont.								
Endrin aldehyde	UG/KG	ND	ND	0.86 J	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	0.29 J	ND	ND	ND	0.74 J	0.53 J
gamma-Chlordane	UG/KG	ND	0.31 J	ND	ND	ND	0.54 J	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Acetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/t[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB10-01	41-OS-SB11-01	41-0S-SB12-02	41-0S-SB14-01	41-0S-SB14-02	41-0S-SB15-01	41-0S-SB15-02
Laboratory Sample ID:		9402064-06	9402086-08	9402042-09A	9402064-02	9402064-03	9402070-02	9402070-03
Depth:		1-3'	1-3'	3-5'	1-3'	3-5'	1-3'	3-5'
Date Sampled:								
Percent Solids:		87.8	82.4	82.7	88.6	92.8	86.6	87
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	41 J	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	130 J	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	4700 J	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	4600 J	ND	41 J	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	79 J	ND
bis(2-Ethylhexyl)phthalate	UG/KG	67 J	105 J	ND	7200 J	ND	490	74 J
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	66 J	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	48 J	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	51 J	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	67 J	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	120 J	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	63 J

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB10-01	41-OS-SB11-01	41-0S-SB12-02	41-0S-SB14-01	41-0S-SB14-02	41-0S-SB15-01	41-0S-SB15-02
Laboratory Sample ID:		9402064-06	9402086-08	9402042-09A	9402064-02	9402064-03	9402070-02	9402070-03
Depth:		1-3'	1-3'	3-5'	1-3'	3-5'	1-3'	3-5'
Date Sampled:								
Percent Solids:		87.8	82.4	82.7	88.6	92.8	86.6	87
	UNITS							
VOLATILES								
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	4 J	26 J	21 J	3 J	ND
Acetone	UG/KG	ND	160 J	24 J	3800 J	960	ND	72
2-Butanone	UG/KG	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	4 J
Ethylbenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	2.17 J	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	1.61 J	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	0.4 J	ND
Endosulfan I	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	27.1 J	ND	1.95 NJ	0.48 NJ	ND	ND
4,4'-DDE	UG/KG	5.95 J	17.4 J	2.96 J	39.6 J	2.48 J	ND	12.6 J
Endrin	UG/KG	ND	5.96 NJ	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	ND	25.2 NJ	ND	ND	0.92 NJ	ND	ND
4,4'-DDD	UG/KG	ND	25.4 NJ	0.85 NJ	147 J	2.12 J	ND	10.8 J
4,4'-DDT	UG/KG	ND	ND	ND	302 J	4.96 J	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	5.47 NJ	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB10-01	41-OS-SB11-01	41-0S-SB12-02	41-0S-SB14-01	41-0S-SB14-02	41-0S-SB15-01	41-0S-SB15-02
Laboratory Sample ID:		9402064-06	9402086-08	9402042-09A	9402064-02	9402064-03	9402070-02	9402070-03
Depth:		1-3'	1-3'	3-5'	1-3'	3-5'	1-3'	3-5'
Date Sampled:								
Percent Solids:		87.8	82.4	82.7	88.6	92.8	86.6	87
	UNITS							
PESTICIDE/PCBS Cont.								
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	6.81 J	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	1.03 J	ND	ND	ND	0.62 J	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Acetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB16-01	41-0S-SB17-01	41-0S-SB17-02	41-0S-SB18-01	41-0S-SB19-01	41-0S-SB21-01	41-0S-SB21-02
Laboratory Sample ID:		9402043-06	9402052-01	9402052-02	9402061-03	9402043-04	9402052-06	9402052-07
Depth:		1-3'	1-3'	3-5'	1-3'	1-3'	1-3'	3-5'
Date Sampled:								
Percent Solids:		84.9	88.9	87.1	87.7	87.9	69.7	82
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	61 J
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	71 J	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	74 J	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	75 J	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	60 J	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	80 J	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	63 J	ND	ND	88 J	57 J	ND	ND
Butyl benzyl phthalate	UG/KG	ND	ND	ND	88 J	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	89 J	ND	ND	43 J	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	110 J	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	ND	44 J	1600	180 J	ND	ND	ND
Fluoranthene	UG/KG	130 J	ND	ND	69 J	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	71 J	260 J	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	39 J	ND	ND	ND
Pyrene	UG/KG	120 J	ND	ND	63 J	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/t[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB16-01	41-0S-SB17-01	41-0S-SB17-02	41-0S-SB18-01	41-0S-SB19-01	41-0S-SB21-01	41-0S-SB21-02
Laboratory Sample ID:		9402043-06	9402052-01	9402052-02	9402061-03	9402043-04	9402052-06	9402052-07
Depth:		1-3'	1-3'	3-5'	1-3'	1-3'	1-3'	3-5'
Date Sampled:								
Percent Solids:		84.9	88.9	87.1	87.7	87.9	69.7	82
	UNITS							
VOLATILES								
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	2 J	3 J	ND	ND	2 J	9 J
Acetone	UG/KG	ND	210	210 J	ND	ND	160 J	ND
2-Butanone	UG/KG	ND	ND	15 J	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	0.91 J	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	UG/KG	ND	ND	ND	2.92 NJ	ND	ND	ND
Dieldrin	UG/KG	5.6 J	1.51 NJ	ND	60 NJ	ND	ND	ND
4,4'-DDE	UG/KG	ND	5.31 J	13.8 J	8.77 NJ	ND	ND	ND
Endrin	UG/KG	4.61 J	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	13.74 J	1.5 NJ	ND	19.4 J	ND	ND	ND
4,4'-DDD	UG/KG	16.14 J	8.56 J	30.6 J	12.4 J	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	ND	5.95 J	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB16-01	41-0S-SB17-01	41-0S-SB17-02	41-0S-SB18-01	41-0S-SB19-01	41-0S-SB21-01	41-0S-SB21-02
Laboratory Sample ID:		9402043-06	9402052-01	9402052-02	9402061-03	9402043-04	9402052-06	9402052-07
Depth:		1-3'	1-3'	3-5'	1-3'	1-3'	1-3'	3-5'
Date Sampled:								
Percent Solids:		84.9	88.9	87.1	87.7	87.9	69.7	82
	UNITS							
PESTICIDE/PCBS Cont.								
Endrin aldehyde	UG/KG	ND	1.6 J	ND	4.38 J	ND	ND	ND
alpha-Chlordane	UG/KG	4.77 J	0.59 J	1.21 J	3.39 NJ	ND	ND	ND
gamma-Chlordane	UG/KG	3.64 J	0.44 J	1.43 J	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	36.7 J	ND	ND
Aroclor 1260	UG/KG	317 J	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Acetophenone	UG/KG	ND	ND	ND	ND	ND	ND	120 J

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB22-01	41-0S-SB22-03	41-0S-SB23-01	41-0S-SB24-01	41-0S-SB24-02	41-OS-SB25-01	41-OS-SB26-01
Laboratory Sample ID:		9402061-05	9402061-06	9402043-02	9402061-08	9402061-09	9402088-02A	9402088-04A
Depth:		1-3'	5-7'	1-3'	1-3'	3-5'	2.5-3.5'	1.0-1.5'
Date Sampled:								
Percent Solids:		89.3	76.9	84.2	84.3	86	83.7	81.8
	UNITS							
SEMIVOLATILES								
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	550	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	53 J	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	98 J	ND	ND	ND	ND
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	130 J	88 J
di-n-Octylphthalate	UG/KG	180 J	640	ND	140 J	40 J	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	46 J	ND	ND	ND
Fluorene	UG/KG	ND	44 J	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	290 J	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	103 J	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	63 J	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB22-01	41-0S-SB22-03	41-0S-SB23-01	41-0S-SB24-01	41-0S-SB24-02	41-OS-SB25-01	41-OS-SB26-01
Laboratory Sample ID:		9402061-05	9402061-06	9402043-02	9402061-08	9402061-09	9402088-02A	9402088-04A
Depth:		1-3'	5-7'	1-3'	1-3'	3-5'	2.5-3.5'	1.0-1.5'
Date Sampled:								
Percent Solids:		89.3	76.9	84.2	84.3	86	83.7	81.8
	UNITS							
VOLATILES								
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	ND	40 J	ND	17 J	39 J	ND	22
2-Butanone	UG/KG	ND	1 J	ND	ND	4 J	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	100	ND	ND	ND	ND	ND
Ethylbenzene	UG/KG	ND	58	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	0.68 J	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	UG/KG	0.78 NJ	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	4.78 J	4.3 J	4.51 J	0.87 NJ	0.69 NJ	ND	ND
4,4'-DDE	UG/KG	1.84 J	5.3 J	5.3 J	2.31 J	1.32 J	ND	ND
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	3.67 J	ND	ND	1.11 J	0.5 NJ	ND	ND
4,4'-DDD	UG/KG	1.87 NJ	1060 J	ND	2.4 J	3.32 J	ND	ND
4,4'-DDT	UG/KG	2.85 NJ	56.8 J	ND	0.68 NJ	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]ve identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-0S-SB22-01	41-0S-SB22-03	41-0S-SB23-01	41-0S-SB24-01	41-0S-SB24-02	41-OS-SB25-01	41-OS-SB26-01
Laboratory Sample ID:		9402061-05	9402061-06	9402043-02	9402061-08	9402061-09	9402088-02A	9402088-04A
Depth:		1-3'	5-7'	1-3'	1-3'	3-5'	2.5-3.5'	1.0-1.5'
Date Sampled:								
Percent Solids:		89.3	76.9	84.2	84.3	86	83.7	81.8
	UNITS							
PESTICIDE/PCBS Cont.								
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	1.69 J	ND	1.4 J	0.28 NJ	0.85 J	ND	ND
gamma-Chlordane	UG/KG	0.9 J	ND	0.85 J	ND	0.85 J	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	34.6 J	ND	ND	ND	ND
CHEMICAL SURETY								
Acetophenone	UG/KG	ND	ND	ND	ND	ND	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB31-01	41-OS-SB32-01	41-OS-SB34-01	41-GW07-01	41-GW07-04	41-GW08-01	41-GW08-02	41-GW10-01
Laboratory Sample ID:		9402088-11A	9402088-13A	9402088-16A	9402087-03	9402087-05	9402078-05	9402078-06	9402071-01
Depth:		2-3'	2-5-3.5'	2-3'	0-2'	6-8'	0-2'	2-4'	0-2'
Date Sampled:									
Percent Solids:		77.5	72.8	82.3	78.6	71.5	91.9	90.9	89.5
	UNITS								
SEMIVOLATILES									
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	51 J	83 J	180 J	ND	ND
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	55 J	ND	89 J	47 J	ND	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]tected
NJ - estimated[illegible]/e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB31-01	41-OS-SB32-01	41-OS-SB34-01	41-GW07-01	41-GW07-04	41-GW08-01	41-GW08-02	41-GW10-01
Laboratory Sample ID:		9402088-11A	9402088-13A	9402088-16A	9402087-03	9402087-05	9402078-05	9402078-06	9402071-01
Depth:		2-3'	2-5-3.5'	2-3'	0-2'	6-8'	0-2'	2-4'	0-2'
Date Sampled:									
Percent Solids:		77.5	72.8	82.3	78.6	71.5	91.9	90.9	89.5
	UNITS								
VOLATILES									
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	3 J	3 J	ND
Acetone	UG/KG	ND	4 J	30	6000 J	41 J	940 J	ND	ND
2-Butanone	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS									
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	0.93 J	1.01 J	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	0.7 J	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	0.73 J	ND	ND	1.1 J	ND	ND	ND	0.8
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	0.82 J	0.34 NJ	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-OS-SB31-01	41-OS-SB32-01	41-OS-SB34-01	41-GW07-01	41-GW07-04	41-GW08-01	41-GW08-02	41-GW10-01
Laboratory Sample ID:		9402088-11A	9402088-13A	9402088-16A	9402087-03	9402087-05	9402078-05	9402078-06	9402071-01
Depth:		2-3'	2-5-3.5'	2-3'	0-2'	6-8'	0-2'	2-4'	0-2'
Date Sampled:									
Percent Solids:		77.5	72.8	82.3	78.6	71.5	91.9	90.9	89.5
	UNITS								
PESTICIDE/PCBS Cont.									
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY									
Acetophenone	UG/KG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW11-01	41-GW11-03	41-GW12-01	41-GW12-02	41-GW13-01	41-GW13-03	41-GW04DW-01	41-GW06DW-02
Laboratory Sample ID:		9402087-01	9402087-02	9402092-03	9402092-04	9402092-01	9402092-02	9402078-01	9402131-01A
Depth:		0-2'	4-6'	0-2'	2-4'	0-2'	4-6'	0-2'	2-4'
Date Sampled:									
Percent Solids:		87.4	94.7	85	83.1	85.5	87.8	87.1	89.6
	UNITS								
SEMIVOLATILES									
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	130 J	95 J	55 J	69 J	49 J	75 J	ND	45
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	43 J	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	48 J	49 J	51 J	100 J	51 J	84 J	ND	40
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	64 J	ND	ND	ND	ND	ND	ND	ND
Fluorene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	52 J	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW11-01	41-GW11-03	41-GW12-01	41-GW12-02	41-GW13-01	41-GW13-03	41-GW04DW-01	41-GW06DW-02
Laboratory Sample ID:		9402087-01	9402087-02	9402092-03	9402092-04	9402092-01	9402092-02	9402078-01	9402131-01A
Depth:		0-2'	4-6'	0-2'	2-4'	0-2'	4-6'	0-2'	2-4'
Date Sampled:									
Percent Solids:		87.4	94.7	85	83.1	85.5	87.8	87.1	89.6
	UNITS								
VOLATILES									
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	8 J	ND	ND
Acetone	UG/KG	ND	28 J	ND	89 J	ND	210 J	95 J	ND
2-Butanone	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS									
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG NJ	5.85 J	ND	ND	ND	ND	ND	ND	ND
Endrin	UG/KG	0.35 J	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	1.18 NJ	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	5.42 J	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]cted
NJ - estimated/t[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW11-01	41-GW11-03	41-GW12-01	41-GW12-02	41-GW13-01	41-GW13-03	41-GW04DW-01	41-GW06DW-02
Laboratory Sample ID:		9402087-01	9402087-02	9402092-03	9402092-04	9402092-01	9402092-02	9402078-01	9402131-01A
Depth:		0-2'	4-6'	0-2'	2-4'	0-2'	4-6'	0-2'	2-4'
Date Sampled:									
Percent Solids:		87.4	94.7	85	83.1	85.5	87.8	87.1	89.6
	UNITS								
PESTICIDE/PCBS Cont.									
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	0.29 J	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	214 J	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY									
Acetophenone	UG/KG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW06DW-03	41-GW07DW-02	41-GW07DW-06	41-GW11DW-01	41-GW11DW-06	41-GW12DW-02
Laboratory Sample ID:		9402131-02A	9402087-07	9402087-09	9402078-03	9402078-04	9402120-01A
Depth:		4-6'	2-4'	10-12'	0-2'	10-12'	2-4'
Date Sampled:							
Percent Solids:		83.5	83.3	63.5	89.5	81.8	80.1
	UNITS						
SEMIVOLATILES							
1,4-Dichlorobenzene	UG/KG	ND	ND	ND	49 J	ND	ND
2-Methylnaphthalene	UG/KG	ND	ND	ND	ND	120 J	ND
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND
4-Methylphenol	UG/KG	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	62 J	52 J	ND
Benzo[a]anthracene	UG/KG	ND	ND	ND	160 J	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	130 J	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	150 J	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	110 J	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	109 J	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG J	46 J	89 J	140 J	220 J	180 J	46 J
Butyl benzyl phthalate	UG/KG	ND	ND	ND	ND	ND	ND
Carbazole	UG/KG	ND	ND	ND	ND	ND	ND
Chrysene	UG/KG	ND	ND	ND	170 J	ND	ND
Dibenzofuran	UG/KG	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG J	ND	79 J	62 J	ND	ND	47 J
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	260 J	ND	ND
Fluorene	UG/KG	ND	ND	ND	49 J	56 J	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND	ND	ND	105 J	ND	ND
Naphthalene	UG/KG	ND	ND	ND	45 J	130 J	ND
N-nitrosodiphenylamine	UG/KG	ND	ND	ND	ND	240 J	ND
Phenanthrene	UG/KG	ND	ND	ND	260 J	83 J	ND
Pyrene	UG/KG	ND	ND	ND	290 J	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]cted
NJ - estimated/t[illegible] identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW06DW-03	41-GW07DW-02	41-GW07DW-06	41-GW11DW-01	41-GW11DW-06	41-GW12DW-02
Laboratory Sample ID:		9402131-02A	9402087-07	9402087-09	9402078-03	9402078-04	9402120-01A
Depth:		4-6'	2-4'	10-12'	0-2'	10-12'	2-4'
Date Sampled:							
Percent Solids:		83.5	83.3	63.5	89.5	81.8	80.1
	UNITS						
VOLATILES							
Chloromethane	UG/KG	ND	ND	ND	ND	ND	ND
Methylene chloride	UG/KG	ND	ND	ND	6 J	7 J	ND
Acetone	UG/KG	ND	71 J	27 J	ND	230 J	ND
2-Butanone	UG/KG	ND	ND	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND
Benzene	UG/KG	ND	ND	ND	ND	ND	ND
Chlorobenzene	UG/KG	ND	ND	ND	ND	ND	ND
Ethylbenzene	UG/KG	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS							
beta-BHC	UG/KG	ND	ND	ND	ND	ND	ND
delta-BHC	UG/KG	ND	ND	ND	ND	ND	ND
Lindane (gamma-BHC)	UG/KG	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND
Endosulfan I	UG/KG	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	ND	10.2 J	10.8 J	ND
Endrin	UG/KG	ND	ND	ND	ND	ND	ND
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	25.6 J	2.15 J	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW06DW-03	41-GW07DW-02	41-GW07DW-06	41-GW11DW-01	41-GW11DW-06	41-GW12DW-02
Laboratory Sample ID:		9402131-02A	9402087-07	9402087-09	9402078-03	9402078-04	9402120-01A
Depth:		4-6'	2-4'	10-12'	0-2'	10-12'	2-4'
Date Sampled:							
Percent Solids:		83.5	83.3	63.5	89.5	81.8	80.1
	UNITS						
PESTICIDE/PCBS Cont.							
Endrin aldehyde	UG/KG	ND	ND	ND	0.85 NJ	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND
Aroclor 1260	UG/KG	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY							
Acetophenone	UG/KG	N/A	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/t[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW12WD-03
Laboratory Sample ID:		9402120-02A
Depth:		4-6'
Date Sampled:		
Percent Solids:		82.2
	UNITS	
SEMIVOLATILES		
1,4-Dichlorobenzene	UG/KG	ND
2-Methylnaphthalene	UG/KG	ND
4-Chloro-3-methylphenol	UG/KG	ND
4-Methylphenol	UG/KG	ND
Acenaphthene	UG/KG	ND
Benzo[a]anthracene	UG/KG	ND
Benzo[a]pyrene	UG/KG	ND
Benzo[b]fluoranthene	UG/KG	ND
Benzo[g,h,i]perylene	UG/KG	ND
Benzo[k]fluoranthene	UG/KG	ND
bis(2-Chloroethyl) ether	UG/KG	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND
Butyl benzyl phthalate	UG/KG	ND
Carbazole	UG/KG	ND
Chrysene	UG/KG	ND
Dibenzofuran	UG/KG	ND
Diethylphthalate	UG/KG	ND
di-n-Butylphthalate	UG/KG	ND
di-n-Octylphthalate	UG/KG	ND
Fluoranthene	UG/KG	ND
Fluorene	UG/KG	ND
Indeno[1,2,3-cd]pyrene	UG/KG	ND
Naphthalene	UG/KG	ND
N-nitrosodiphenylamine	UG/KG	ND
Phenanthrene	UG/KG	ND
Pyrene	UG/KG	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW12WD-03
Laboratory Sample ID:		9402120-02A
Depth:		4-6'
Date Sampled:		
Percent Solids:		82.2
	UNITS	
VOLATILES		
Chloromethane	UG/KG	ND
Methylene chloride	UG/KG	ND
Acetone	UG/KG	ND
2-Butanone	UG/KG	ND
Trichloroethene	UG/KG	ND
Benzene	UG/KG	ND
Chlorobenzene	UG/KG	ND
Ethylbenzene	UG/KG	ND
PESTICIDE/PCBS		
beta-BHC	UG/KG	ND
delta-BHC	UG/KG	ND
Lindane (gamma-BHC)	UG/KG	ND
Heptachlor	UG/KG	ND
Aldrin	UG/KG	ND
Heptachlor epoxide	UG/KG	ND
Endosulfan I	UG/KG	ND
Dieldrin	UG/KG	ND
4,4'-DDE	UG/KG	ND
Endrin	UG/KG	ND
Endosulfan II	UG/KG	ND
4,4'-DDD	UG/KG	ND
4,4'-DDT	UG/KG	ND
Methoxychlor	UG/KG	ND
Endrin ketone	UG/KG	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/t[illegible]e identification

TABLE 4-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW12WD-03
Laboratory Sample ID:		9402120-02A
Depth:		4-6'
Date Sampled:		
Percent Solids:		82.2
	UNITS	
PESTICIDE/PCBS Cont.		
Endrin aldehyde	UG/KG	ND
alpha-Chlordane	UG/KG	ND
gamma-Chlordane	UG/KG	ND
Aroclor 1254	UG/KG	ND
Aroclor 1260	UG/KG	ND
CHEMICAL SURETY		
Acetophenone	UG/KG	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-OS-SB01-02	41-OS-SB01-05	41-OS-SB02-02	41-OS-SB02-03	41-OS-SB03-01	41-0S-SB04-02	41-0S-SB04-03
Laboratory Sample ID:		9402021-02	9402021-03	9402021-08	9402021-09	9402021-11	9402086-05	9402086-06
Depth:		3-5'	9-11'	3-5'	5-7'	1-3'	3-5'	5-7'
Date Sampled:								
Percent Solids:		83.4	88.8	88	93.5	82.8	87.6	78.1
	UNITS							
Aluminum	MG/KG	6890	1470	3580	1290	8100	8900	2760
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	1.17	2.65	1.53	3.02	0.518	ND
Barium	MG/KG	11.9	ND	6.79	3.68	21.5	14.7	8.29
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND	0.23
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	208	ND	106	86.2	8750	322	1190
Chromium	MG/KG	8.38	4.1	5.82	3.83	10.8	9.29 J	3.94 J
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	2670	3920	2390	2260	6470	13600	1720
Lead	MG/KG	4.83	2	3.89	1.87	829	5	16.6
Magnesium	MG/KG	169	32.2	110	49.8	323	145	78.2
Manganese	MG/KG	3.06	ND	2.5	ND	12.7	2.44	5.36
Mercury	MG/KG	ND	0.057	ND	ND	0.082	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	224	ND	ND	ND	269	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	0.202	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	59.3	112	181
Vanadium	MG/KG	11.6	ND	10.3	4.79	16.4	13.2	ND
Zinc	MG/KG	5.48	3.75	3.97	3.08	57.5	ND	ND
Total Cyanide	MG/KG	1.2	1.13	1.14	1.07	1.21	1.14	1.28

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible] 'ected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-0S-SB05-01	41-0S-SB06-01	41-0S-SB06-03	41-0S-SB07-01	41-0S-SB07-02	41-OS-SB08-01	41-0S-SB09-01
Laboratory Sample ID:		9402042-02A	9402086-02	9402086-03	9402042-06A	9402042-07A	9402086-10	9402042-04A
Depth:		1-3'	1-3'	5-7'	1-3'	3-5'	1-3'	1-3'
Date Sampled:								
Percent Solids:		87.4	89.3	87.1	89.9	81	88.7	88.5
	UNITS							
Aluminum	MG/KG	1280 J	6330	4440	3110 J	6650 J	5610	1080 J
Antimony	MG/KG	ND	2.94	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	0.798	ND	ND	ND	1.16	ND
Barium	MG/KG	3.97	22.8	12.6	9.46	18.8	105	3.22
Beryllium	MG/KG	ND	ND	ND	ND	0.284	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	2.75	ND
Calcium	MG/KG	126	1220	689	516	1430	18900	209
Chromium	MG/KG	2.27	9.89 J	4.87 J	4	9.22	27.5 J	3.58
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	6.97	ND	ND	ND	32.3	ND
Iron	MG/KG	672 J	8930	3940	1310 J	3920 J	7550	3410 J
Lead	MG/KG	2.64 J	40.3	11.3	2.39 J	6.93 J	108	8.6 J
Magnesium	MG/KG	47.2	160	96	100	338	416	34.9
Manganese	MG/KG	1.86 J	33	14.8	3.19 J	18.1 J	84.1	16.2 J
Mercury	MG/KG	ND	ND	ND	ND	ND	0.086	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	167	535	221	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	110	113	ND	ND	208	ND
Vanadium	MG/KG	ND	9.73	6.25	6.82	13.6	10.1	ND
Zinc	MG/KG	4.87	48.3	ND	6.5	19	229	6.03
Total Cyanide	MG/KG	1.14	1.12	1.15	1.11	1.23	1.13	1.13

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-0S-SB10-01	41-OS-SB11-01	41-0S-SB12-02	41-0S-SB14-01	41-0S-SB14-02	41-0S-SB15-01	41-0S-SB15-02
Laboratory Sample ID:		9402064-06	9402086-08	9402042-09A	9402064-02	9402064-03	9402070-02	9402070-03
Depth:		1-3'	1-3'	3-5'	1-3'	3-5'	1-3'	3-5'
Date Sampled:								
Percent Solids:		87.8	82.4	82.7	88.6	92.8	86.6	87
	UNITS							
Aluminum	MG/KG	2280	8670	2660 J	2400	1250	2670	3220
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	0.797	ND	1.16	ND	ND	ND
Barium	MG/KG	18.3	186	17.6	16.6	5.27	10.6	12
Beryllium	MG/KG	ND	ND	0.187	ND	ND	0.197	ND
Cadmium	MG/KG	ND	4.73	ND	ND	ND	ND	ND
Calcium	MG/KG	2290	4650	612	8100	238	637	636
Chromium	MG/KG	5.01 J	40.5 J	4.13	9 J	2.37 J	6.5 J	4.91 J
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	15.3	39.8	ND	8.82	ND	3.77	7.7
Iron	MG/KG	1610	8000	1660 J	3080	814	1930	1950
Lead	MG/KG	45.7	104	10.4 J	157	10.2	124	54
Magnesium	MG/KG	148	340	65	431	43.2	69.6	109
Manganese	MG/KG	17.2	62.4	6.12	29.5	3.52	9.11	10
Mercury	MG/KG	ND	0.279	ND	0.164	ND	ND	ND
Nickel	MG/KG	ND	7.56	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	265	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	0.474	0.539	ND	0.422
Silver	MG/KG	ND	0.403 J	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	486	136	ND	ND	ND	ND
Vanadium	MG/KG	ND	16.2	5.34	22.1	ND	ND	5.91
Zinc	MG/KG	110	407	11.5	55.5	12.4	40.5	43.2
Total Cyanide	MG/KG	1.14	1.21	1.21	1.13	1.08	1.15	1.15

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-GW12DW-02	41-GW12WD-03
Laboratory Sample ID:		9402120-01A	9402120-02A
Depth:		2-4'	4-6'
Date Sampled:			
Percent Solids:		80.1	82.2
	UNITS		
Aluminum	MG/KG	5630	5700
Antimony	MG/KG	ND	ND
Arsenic	MG/KG	0.733	ND
Barium	MG/KG	12.7	12.3
Beryllium	MG/KG	ND	ND
Cadmium	MG/KG	ND	ND
Calcium	MG/KG	43.5	ND
Chromium	MG/KG	7.08	7.24
Cobalt	MG/KG	ND	ND
Copper	MG/KG	ND	ND
Iron	MG/KG	4180	1980
Lead	MG/KG	3.5 J	5.54 J
Magnesium	MG/KG	161	162
Manganese	MG/KG	3.39	3.62
Mercury	MG/KG	ND	ND
Nickel	MG/KG	ND	ND
Potassium	MG/KG	ND	ND
Selenium	MG/KG	ND	ND
Silver	MG/KG	ND	ND
Sodium	MG/KG	ND	ND
Vanadium	MG/KG	8.93	7.08
Zinc	MG/KG	5.1	5.53
Total Cyanide	MG/KG	1.25	1.22

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-0S-SB16-01	41-0S-SB17-01	41-0S-SB17-02	41-0S-SB18-01	41-0S-SB19-01	41-0S-SB21-01	41-0S-SB21-02
Laboratory Sample ID:		9402043-06	9402052-01	9402052-02	9402061-03	9402043-04	9402052-06	9402052-07
Depth:		1-3'	1-3'	3-5'	1-3'	1-3'	1-3'	3-5'
Date Sampled:								
Percent Solids:		84.9	88.9	87.1	87.7	87.9	69.7	82
	UNITS							
Aluminum	MG/KG	5910	2870	3690	2450	8480	4480	3350
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	1.63	0.71 J	0.934	1.24	0.989	1.66	ND
Barium	MG/KG	25	12	16	11.8	15.9	25.3	24.2
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	893	764	5460	689	870	101	735
Chromium	MG/KG	7.81	4.35	8.88	22.6	11	6.67	3.25
Cobalt	MG/KG	ND	ND	ND	4.53	ND	ND	ND
Copper	MG/KG	ND	ND	4.12 J	37 J	ND	ND	ND
Iron	MG/KG	5100	4210	3160	41100	8560	3820	1910
Lead	MG/KG	21 J	16.1	28.6	35.1	12.1 J	6.74	11.4
Magnesium	MG/KG	217	137	208	42.9	309	98.8	205
Manganese	MG/KG	10.7	16.7	13.7	244	24.7	3.06	7.12
Mercury	MG/KG	0.09	0.123	0.11	0.152	0.078	ND	ND
Nickel	MG/KG	ND	ND	ND	12.9	ND	ND	ND
Potassium	MG/KG	256	123	152	ND	430	257	247
Selenium	MG/KG	ND	0.948	0.663	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	16.6	ND	5.74	5.83	12.7	12.1	ND
Zinc	MG/KG	33.2	22.7 J	48.2 J	40.8 J	30.7	6.25 J	5.17 J
Total Cyanide	MG/KG	1.18	1.12	1.15	1.14	1.29	1.43	1.22

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-0S-SB22-01	41-0S-SB22-03	41-0S-SB23-01	41-0S-SB24-01	41-0S-SB24-02	41-OS-SB25-01	41-OS-SB26-01
Laboratory Sample ID:		9402061-05	9402061-06	9402043-02	9402061-08	9402061-09	9402088-02A	9402088-04A
Depth:		1-3'	5-7'	1-3'	1-3'	3-5'	2.5-3.5'	1.0-1.5'
Date Sampled:								
Percent Solids:		89.3	76.9	84.2	84.3	86	83.7	81.8
	UNITS							
Aluminum	MG/KG	3790	3400	7980	3960	4390	2990	3590
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	0.783	ND	ND	0.721	1.4	ND	ND
Barium	MG/KG	11.5	11.6	18.8	9.95	10.4	8.61	10.6
Beryllium	MG/KG	ND	ND	0.267	ND	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	354	1270	1520	3440	2290	ND	318
Chromium	MG/KG	4.9	4.57	8.69	5.78	4.23	3.68 J	3.47 J
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	8.38 J	ND	5.06 J	ND	ND	ND
Iron	MG/KG	5050	8780	5990	2730	3100	1050 J	983 J
Lead	MG/KG	61.2	36.3	13.4 J	49.3	19.3	4.34 J	3.54 J
Magnesium	MG/KG	128	146	265	203	122	22.8	80.3
Manganese	MG/KG	ND	52.1	14.1	9.03	5.93	ND	5.73
Mercury	MG/KG	0.119	ND	0.127	0.11	ND	0.066	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	313	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	0.615	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	98.7	194
Vanadium	MG/KG	5.56	ND	8.57	9.06	7.54	ND	ND
Zinc	MG/KG	21.7 J	37.7 J	18.2	26.4 J	10.2 J	ND	ND
Total Cyanide	MG/KG	1.12	1.3	1.19	1.19	1.16	1.19	1.22

MG/KG - milligram per kilogram
J - value is estimated
ND - n[illegible]ected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-OS-SB27-01	41-OS-SB28-01	41-OS-SB29-01	41-OS-SB30-01	41-OS-SB31-01	41-OS-SB32-01	41-OS-SB33-01
Laboratory Sample ID:		9402088-07A	9402088-09A	9402071-04	9402071-06	9402088-11A	9402088-13A	9402071-09
Depth:		2.5-3.5'	2-3'	2-3'	2-3'	2-3'	2.5-3.5'	1-2'
Date Sampled:				02/05/94	02/05/94			02/05/94
Percent Solids:		85	83.2	86.0	61.5	77.5	72.8	79.8
	UNITS							
Aluminum	MG/KG	9030	2870	3990.0 J	9430.0 J	3030	2000	2060.0 J
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	0.597	ND	0.546
Barium	MG/KG	16.8	18.2	6.25	31.6	17	8.02	5.60
Beryllium	~~MG/KG~~	ND	ND	ND	0.310	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	965	213	46.5	1300.0	1560	322	74.5
Chromium	MG/KG	10.3 J	4.05 J	3.66	6.62	3.51 J	ND	2.65
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	3630 J	1060 J	1750.0 J	3200.0 J	1570 J	4650 J	935.0 J
Lead	MG/KG	6.26 J	7.47 J	3.78	7.78	7.02 J	2.13	3.12
Magnesium	MG/KG	233	66.1	133.0	203.0	91.5	67.3 J	86.5
Manganese	MG/KG	3.72	ND	2.90 J	4.98 J	9.75	4.63	2.82 J
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	322	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	14.1	ND	5.17	11.5	ND	ND	ND
Zinc	MG/KG	ND	ND	5.18	7.46	14.2	16.2	10.4
Total Cyanide	MG/KG	1.18	1.2	1.16	1.63	1.29	1.37	1.25

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-OS-SB34-01	41-GW07-01	41-GW07-04	41-GW08-01	41-GW08-02	41-GW10-01	41-GW11-01	41-GW11-03
Laboratory Sample ID:		9402088-16A	9402087-03	9402087-05	9402078-05	9402078-06	9402071-01	9402087-01	9402087-02
Depth:		2-3'	0-2'	6-8'	0-2'	2-4'	0-2'	0-2'	4-6'
Date Sampled:									
Percent Solids:		82.3	78.6	71.5	91.9	90.9	89.5	87.4	94.7
	UNITS								
Aluminum	MG/KG	486	5160	12200	2630	1420	1920 J	4320	2350
Antimony	MG/KG	ND	ND	2.12 J	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	1.08 J	1.19 J	ND	ND	1.1 J	1.58 J	ND
Barium	MG/KG	ND	17.5	20.1	6.56	4.94	3.15	22.6	10.2
Beryllium	MG/KG	ND	ND	0.237	ND	ND	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	ND	1300	121	205	109	73.2	1810	295
Chromium	MG/KG	2.49 J	5.96	15.7	3.6	3.01	2.1	11.2	3.41
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	22.5	4.53
Iron	MG/KG	115 J	3850 J	18900 J	1010 J	518 J	1330 J	12300 J	1550 J
Lead	MG/KG	1.19 J	7.89	8.48	4.01	2.23	6.5	110	8.76
Magnesium	MG/KG	18.4	189	279	84.4	50.8	49.1	189	152
Manganese	MG/KG	ND	11	2.37	2.7	1.73	2.39 J	75.9	5.04
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	0.312	0.122
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	201	259	ND	ND	ND	ND	167
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND	0.595 J
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	9.16	25.7	ND	ND	ND	9.3	8.31
Zinc	MG/KG	ND	8.72 J	7.25 J	2.81 J	ND	3.73	130 J	48.4 J
Total Cyanide	MG/KG	1.22	1.27	1.4	1.09	1.1	1.12	1.14	1.06

MG/KG - milligram per kilogram
J - value is estimated
ND - n[illegible]cted

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-GW12-01	41-GW12-02	41-GW13-01	41-GW13-03	41-GW04DW-01	41-GW04DW-02	41-GW06DW-02
Laboratory Sample ID:		9402092-03	9402092-04	9402092-01	9402092-02	9402078-01	9402078-02	9402131-01A
Depth:		0-2'	2-4'	0-2'	4-6'	0-2'	2-4'	2-4'
Date Sampled:								
Percent Solids:		85	83.1	85.5	87.8	87.1	85.1	89.6
	UNITS							
Aluminum	MG/KG	5880	7740	10300	2900	3820	7640	3900
Antimony	MG/KG	ND	ND	1.92 J	ND	ND	ND	ND
Arsenic	MG/KG	0.792 J	1.19 J	1.32 J	ND	ND	0.915 J	ND
Barium	MG/KG	15.3	18.1	19.3	9.64	9.38	14.4	6.67
Beryllium	MG/KG	0.205	ND	ND	ND	ND	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	95.3	ND	88.6	ND	81.5	93	66
Chromium	MG/KG	7.12	9.9	11.3	3.33	3.59	7.16	4.76
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	3950 J	4900 J	7680 J	1000 J	2030 J	4280 J	1650
Lead	MG/KG	5.98	3.98	7.11	3.77	4.76	6.22	2.92 J
Magnesium	MG/KG	203	297	330	75.3	91.6	264	104
Manganese	MG/KG	4.25	6.25	6.62	1.63	3.72	7.8	4.03
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	186	321	249	180	ND	ND	ND
Selenium	MG/KG	ND	0.373 J	0.781 J	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	10	14.2	17.2	5.31	6.76	14.2	5.71
Zinc	MG/KG	6.41 J	5.61 J	5.6 J	3.43 J	7.74 J	6.13 J	3.11
Total Cyanide	MG/KG	1.18	1.2	1.17	1.14	1.15	1.18	1.12

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-7
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
ONSITE SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		41-GW06DW-03	41-GW07DW-02	41-GW07DW-06	41-GW09DW-02	41-GW09DW-05	41-GW11DW-01	41-GW11DW-06
Laboratory Sample ID:		9402131-02A	9402087-07	9402087-09	9402065-01	9402065-02	9402078-03	9402078-04
Depth:		4-6'	2-4'	10-12'	2-4'	9-11'	0-2'	10-12'
Date Sampled:								
Percent Solids:		83.5	83.3	63.5	80.6	78.5	89.5	81.8
	UNITS							
Aluminum	MG/KG	601	7910	7440	10900 J	13500 J	3610	2750
Antimony	MG/KG	ND	ND	ND	ND	ND	2.91 J	ND
Arsenic	MG/KG	ND	0.829 J	0.866 J	0.738	ND	0.929 J	ND
Barium	MG/KG	ND	20.3	16.9	19.7	23	21.4	18.5
Beryllium	MG/KG	ND	ND	0.288	ND	0.253	ND	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	1.32	ND
Calcium	MG/KG	37.3	356	86.7	178	2570	2740	548
Chromium	MG/KG	ND	13	8.51	10.8	18.1	7.7	4.02
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	27.8	4.94
Iron	MG/KG	274	6530 J	2810 J	4350 J	4050 J	6040 J	1620 J
Lead	MG/KG	0.894 J	6.69	8.62	7.53	10.3	47.1	15.2
Magnesium	MG/KG	ND	212	188	317	567	208	109
Manganese	MG/KG	2.91	5.26	9.48	4.4 J	6.77 J	42.9	5.98
Mercury	MG/KG	ND	ND	ND	ND	ND	0.109	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	386	292	218	562	268	ND
Selenium	MG/KG	ND	0.618 J	0.891 J	ND	ND	ND	0.41 J
Silver	MG/KG	ND	ND	9.71 J	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	16.1	12	15.5	23.3	7.43	ND
Zinc	MG/KG	4.01	4.84 J	18.3 J	5.46	7.98	102 J	30.3 J
Total Cyanide	MG/KG	1.2	1.2	1.57	1.24	1.27	1.12	1.22

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

TABLE 4-8

COMPARISON OF INORGANIC LEVELS IN SUBSURFACE SOILS AT SITE 41 TO BASE BACKGROUND LEVELS REMEDIAL INVESTIGATION - CTO - 0212 MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 41 (mg/kg)	Base Background (μg/kg)
Aluminum	4.86 - 13,500	16.9 - 11,000
Antimony	1.92 - 2.94	0.355 - 6.9
Arsenic	0.518 - 3.02	0.033 - 15.4
Barium	3.15 - 186	0.65 - 22.6
Beryllium	0.187 - 0.31	0.01 - 0.31
Cadmium	1.32 - 4.73	0.155 - 1.2
Calcium	37.3 - 18,900	4.75 - 4,410
Chromium	2.1 - 40.5	0.65 - 66.4
Cobalt	4.53 - 4.53	0.175 - 7
Copper	3.77 - 39.8	0.47 - 9.5
Iron	115 - 41,100	63.3 - 90,500
Lead	0.894 - 829	0.465 - 21.4
Magnesium	18.4 - 567	2.85 - 852
Manganese	1.63 - 244	0.395 - 19.9
Mercury	0.056R - 0.312	0.01 - 0.68
Nickel	7.56 - 12.9	0.45 - 4.7
Potassium	123 - 562	1.05 - 1,250
Selenium	0.373 - 0.948	0.085 - 2.4
Silver	0.202 - 9.71	0.175 - 1
Sodium	59.3 - 486	5.4 - 141
Vanadium	4.79 - 25.7	0.34 - 69.4
Zinc	2.81 - 407	0.32 - 26.6
Total Cyanide	1.06 - 1.63	NA

ND = Nondetect

TABLE 4-9
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW02-01	41-GW03-01	41-GW04-01	41-GW04DW-01	41-GW09-01	41-GW09DW-01	41-GW10-01	41-GW11-01
Laboratory Sample ID:		9402119-01	9402121-01	9402121-03	9402159-01A	9402161-01A	9402162-01	9402161-03A	9402165-01
Date Sampled:		02/14/94	02/14/94	02/15/94					
	UNITS								
SEMIVOLATILES									
bis(2-Ethylhexyl)phthalate	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/L	ND	2.00 J	2.00 J	ND	ND	ND	ND	ND
Naphthalene	UG/L	ND	ND	ND	ND	ND	ND	ND	3 J
Nitrobenzene	UG/L	ND	ND	ND	ND	ND	4 J	ND	ND
VOLATILES									
1,2-Dichloroethene(total)	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	UG/L	ND	ND	ND	ND	1.36 J	ND	3.17 J	ND
Bromodichloromethane	UG/L	ND	ND	ND	ND	1.05 J	ND	ND	ND
Dibromochloromethane	UG/L	ND	ND	ND	ND	1.95 J	ND	ND	ND
Benzene	UG/L	ND	ND	ND	ND	ND	ND	ND	2.67 J
Bromoform	UG/L	ND	ND	ND	ND	1.33 J	ND	ND	ND
Chlorobenzene	UG/L	ND	ND	ND	ND	ND	ND	ND	1.49 J
Xylenes (total)	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS									
alpha-BHC	UG/L	ND	ND	ND	ND	0.01 J	ND	ND	ND
beta-BHC	UG/L	0.040 J	ND	ND	0.06 NJ	0.08 J	0.04 J	ND	ND
4,4'-DDD	UG/L	ND	ND	ND	ND	ND	ND	ND	0.01 NJ

UG/L - microgram per liter
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-9
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW11-01D	41-GW11DW-01	41-GW12DW-01	41-GW13-01
Laboratory Sample ID:		9402165-03	9402163-01	9402159-03A	9402157-03A
Date Sampled:					
	UNITS				
SEMIVOLATILES					
bis(2-Ethylhexyl)phthalate	UG/L	ND	ND	ND	1 J
di-n-Butylphthalate	UG/L	ND	ND	ND	1 J
Naphthalene	UG/L	3 J	ND	ND	ND
Nitrobenzene	UG/L	ND	ND	ND	ND
VOLATILES					
1,2-Dichloroethene(total)	UG/L	ND	1.22 J	ND	ND
Chloroform	UG/L	ND	ND	1.02 J	ND
Bromodichloromethane	UG/L	ND	ND	ND	ND
Dibromochloromethane	UG/L	ND	ND	1.27 J	ND
Benzene	UG/L	2.82 J	ND	ND	ND
Bromoform	UG/L	ND	ND	ND	ND
Chlorobenzene	UG/L	1.57 J	ND	ND	ND
Xylenes (total)	UG/L	1.03 J	ND	ND	ND
PESTICIDE/PCBS					
alpha-BHC	UG/L	ND	ND	ND	ND
beta-BHC	UG/L	0.03 NJ	ND	ND	ND
4,4'-DDD	UG/L	ND	ND	ND	ND

UG/L - microgram per liter
J - value is estimated
ND - not detected
NJ - estimated/t[illegible]e identification

TABLE 4-10
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		41-GW01-01	41-GW02-01	41-GW03-01	41-GW04-01	41-GW04DW-01	41-GW05-01	41-GW06DW-01	41-GW07-01
Laboratory Sample ID:		9402122-01	9402119-01	9402121-01	9402121-03	9402159-01A	9402122-03	9402163-03	9402152-01A
Date Sampled:		02/14/94	02/14/94	02/14/94	02/15/94		02/14/94		
	UNITS								
Aluminum	UG/L	42300.0 J	125000.0 J	58800.0 J	6390.0 J	269	20300.0 J	12600 J	145000
Antimony	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	UG/L	11.5 J	7.44 J	2.75 J	6.69 J	3.71 J	13.0 J	9.58	13.3
Barium	UG/L	189.0	465.0	310.0	55.2	22.6	55.7	186	717
Beryllium	UG/L	5.40	6.80	2.38	ND	ND	1.57	ND	5.59
Cadmium	UG/L	ND	6.26	ND	ND	ND	9.96	4.7	9.08
Calcium	UG/L	42500.0	136000.0	20300.0	29300.0	107000	66200.0	434000	11100
Chromium	UG/L	64.2 J	244.0 J	99.1 J	10.5 J	ND	54.4 J	40.5	166
Cobalt	UG/L	31.0	16.5	ND	ND	ND	ND	ND	ND
Copper	UG/L	31.8	83.6	25.9	ND	ND	27.0	ND	28.5
Iron	UG/L	66200.0 J	80800.0 J	35300.0 J	54900.0 J	691 J	55300.0 J	15300	71100 J
Lead	UG/L	24.6 J	19.8 J	6.12 J	4.82 J	ND	23.7 J	11.1 J	94.6
Magnesium	UG/L	4010.0	31000.0	2500.0	2150.0	1630	2970.0	6710	5960
Manganese	UG/L	951.0	572.0	72.4	226.0	16.9	203.0	101	167
Mercury	UG/L	ND	0.922	ND	ND	ND	ND	0.152	ND
Nickel	UG/L	ND	41.4 J	36.1 J	ND	ND	38.0 J	ND	88.7
Potassium	UG/L	3080	21300	3080	3080	1550	3080	2900	4780
Selenium	UG/L	ND	3.66	ND	ND	ND	1.66	ND	7.74 J
Silver	UG/L	ND	ND	ND	24.8	ND	ND	ND	ND
Sodium	UG/L	5830	28600	2080	5510	11800	5940	17800	11700
Vanadium	UG/L	77.1 J	204.0 J	83.6 J	ND	ND	38.1 J	49.8	150
Zinc	UG/L	124.0 J	146.0 J	130.0 J	25.7 J	17.8	173.0 J	83.8	276

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-10
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		41-GW07DW-01	41-GW08-01	41-GW09-01	41-GW09DW-01	41-GW10-01	41-GW11-01	41-GW11DW-01
Laboratory Sample ID:		9402162-03	9402157-05A	9402161-01A	9402162-01	9402161-03A	9402165-01	9402163-01
Date Sampled:								
	UNITS							
Aluminum	UG/L	1770 J	13800	26800	2490 J	81900	75700 J	247 J
Antimony	UG/L	ND	ND	ND	ND	ND	17.9 J	ND
Arsenic	UG/L	4.79	2.4 J	7.66	ND	36.3	24.2	ND
Barium	UG/L	42.7	139	200	39.8	248	999	92.1
Beryllium	UG/L	ND	ND	ND	ND	7.41	ND	ND
Cadmium	UG/L	ND	ND	ND	ND	16.3	110	ND
Calcium	UG/L	172000	31400	8750	74300	250000	130000	224000
Chromium	UG/L	ND	17.3	36.6	ND	176	149	ND
Cobalt	UG/L	ND	ND	ND	ND	37.8	ND	ND
Copper	UG/L	ND	ND	ND	ND	26.3	1030	ND
Iron	UG/L	3140	13600 J	31200 J	2260	124000 J	155000	1360
Lead	UG/L	5.96 J	32.6	33.8	4.33 J	73.6	9340	1.88 J
Magnesium	UG/L	2800	2280	3570	2070	15300	22700	5860
Manganese	UG/L	41.8	56.6	212	36.8	455	2110	87.5
Mercury	UG/L	ND	ND	ND	ND	ND	ND	ND
Nickel	UG/L	ND	ND	ND	ND	68.1	137	ND
Potassium	UG/L	1180	1340	2900	1030	2750	26800	2740
Selenium	UG/L	8.36 J	ND	2.12 J	1.87 J	ND	ND	2.74 J
Silver	UG/L	ND	ND	ND	ND	ND	8.52 J	ND
Sodium	UG/L	8880	3190	18000	22700	40200	27900	95100
Vanadium	UG/L	ND	25.9	46.7	ND	199	244	ND
Zinc	UG/L	32.9	56.5	27.8	26.4	173	5180	50.3

UG/L - microgram per liter
J - value is estimated
ND - [illegible]cted

TABLE 4-10
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		41-GW12-01	41-GW12DW-01	41-GW13-01
Laboratory Sample ID:		9402157-01A	9402159-03A	9402157-03A
Date Sampled:				
	UNITS			
Aluminum	UG/L	65900	1880	38100
Antimony	UG/L	ND	ND	ND
Arsenic	UG/L	8.98	ND	9.7
Barium	UG/L	356	53	382
Beryllium	UG/L	42.8	ND	4.53
Cadmium	UG/L	25.1	ND	4.6
Calcium	UG/L	828000	93300	14200
Chromium	UG/L	151	12.6	54.5
Cobalt	UG/L	117	ND	40.1
Copper	UG/L	ND	ND	ND
Iron	UG/L	160000 J	2430 J	40700 J
Lead	UG/L	22.1	3.16 J	29.1
Magnesium	UG/L	11900	6410	4660
Manganese	UG/L	1070	35	80.3
Mercury	UG/L	ND	ND	ND
Nickel	UG/L	111	ND	32.1
Potassium	UG/L	1960	13800	18100
Selenium	UG/L	ND	4.24 J	3.49 J
Silver	UG/L	ND	62.8 J	63.4 J
Sodium	UG/L	8480	200000	7260
Vanadium	UG/L	212	ND	72.2
Zinc	UG/L	450	25.3	178

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-11
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-GW01D-01	41-GW02D-01	41-GW03D-01	41-GW04D-01	41-GW04DWD-01	41-GW05D-01	41-GW06DWD-01	41-GW07D-01
Laboratory Sample ID:		9402122-02	9402119-02	9402121-02	9402121-04	9402159-02A	9402122-04	9402163-04	9402152-02A
Date Sampled:		02/14/94	02/14/94	02/14/94	02/15/94		02/14/94		
	UNITS								
Antimony	UG/L	ND	ND	ND	ND	12.1	ND	15.6	19.1
Arsenic	UG/L	ND	2.22	ND	4.68	ND	ND	ND	ND
Barium	UG/L	12.6	103.0	ND	44.4	17.8	ND	45.1	49.2
Calcium	UG/L	28300.0	137000.0	12200.0	32600.0	50100	54000.0	80100	4710
Iron	UG/L	ND	23700.0	ND	42400.0	ND	ND	ND	1630 J
Magnesium	UG/L	1910.0	29200.0	366.0	2540.0	1570	1370.0	2610	1750
Manganese	UG/L	129.0	469.0	ND	266.0	ND	21.2	22.7	43.2
Potassium	UG/L	964	19300	ND	3970	1210	1630	1470	1340
Selenium	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	UG/L	6260	34300	2500	6160	13500	6260	18600	11900
Zinc	UG/L	ND	ND	ND	ND	ND	ND	ND	ND

UG/L - microgram per liter
J - value is estimated
ND - [illegible]ected

TABLE 4-11
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-GW07DWD-01	41-GW08D-01	41-GW09D-01	41-GW09DWD-01	41-GW10D-01	41-GW11D-01	41-GW11DWD-01	41-GW12D-01
Laboratory Sample ID:		9402162-04	9402157-06A	9402161-02A	9402162-02	9402161-04A	9402165-02	9402163-02	9402157-02A
Date Sampled:									
	UNITS								
Antimony	UG/L	11.4	17	ND	12.1	11.4	14.9	14.9	12.8
Arsenic	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Barium	UG/L	ND	23.7	44.5	ND	40.3	451	97.3	22.5
Calcium	UG/L	64500	21200	7150	43300	99600	111000	188000	91100
Iron	UG/L	ND	ND	ND	ND	ND	40700	243	ND
Magnesium	UG/L	2020	1940	2730	1840	8410	22100	6380	3530
Manganese	UG/L	23.2	29.3	138	20.1	45.3	521	94	342
Potassium	UG/L	1070	ND	2010	938	ND	29400	3480	ND
Selenium	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	UG/L	9130	4650	19400	25100	33600	30400	108000	7800
Zinc	UG/L	ND	ND	ND	ND	ND	125	ND	ND

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-11
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND ONE
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-GW12DWD-01	41-GW13D-01
Laboratory Sample ID:		9402159-04A	9402157-04A
Date Sampled:			
	UNITS		
Antimony	UG/L	ND	ND
Arsenic	UG/L	ND	ND
Barium	UG/L	32.3	40.8
Calcium	UG/L	63100	8620
Iron	UG/L	ND	313 J
Magnesium	UG/L	6740	3460
Manganese	UG/L	24.2	39.3
Potassium	UG/L	16700	1070
Selenium	UG/L	7.23 J	ND
Sodium	UG/L	244000	7070
Zinc	UG/L	ND	47

UG/L - microgram per liter
J - value is estimated
ND - [illegible]ected

TABLE 4-12

SUMMARY OF ROUND ONE GROUNDWATER FIELD PARAMETERS
SITE 41
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No. / Date of Measurement	Depth of Well (feet)[1]	Purge Volume (gallons)	Field Parameters: Well Volume	Specific Conductance at 25 deg. C (micromhos/cm)	Temperature (deg. C)	pH (S.U.)
41GW01	20.30	10	3	185	15	5.67
			4	185	15	5.59
02/14/94			5	190	14	5.55
41GW02	21.0	9	1	950	14	6.32
02/14/94			2	989	15	6.38
			3	1001	14.5	6.42
41GW03	20.46	7	1	44	14.5	5.46
02/14/94			2	49	15	5.67
			3	56	15	5.42
41GW04	21.83	7.5	1	328	11	6.04
02/15/94			2	339	13.5	6.22
			3	340	13.9	6.44
41GW05	27.54	14	3	271	17	6.41
02/14/94			4	289	18	6.50
			5	283	17	6.36
41GW07	23.3	6	1	116	17	4.98
02/18/94			2	109	16	5.02
			3	107	16.5	5.08
41GW08	17.54	4.5	1	148	15	6.65
02/18/94			2	136	15	6.50
			3	129	15	6.48
41GW09	22.78	6	1	187	17.5	4.70
02/19/94			2	185	16.5	4.78
			3	193	16	4.76
41GW10	15.66	10	1	785	16	5.97
			2	716	16.5	6.31
02/19/94			4	519	16	6.77
			5	532	16	7.10
			6	494	15	7.20

TABLE 4-12 (Continued)

SUMMARY OF ROUND ONE GROUNDWATER FIELD PARAMETERS
SITE 41
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No. / Date of Measurement	Depth of Well (feet)[1]	Purge Volume (gallons)	Field Parameters: Well Volume	Specific Conductance at 25 deg. C (micromhos/cm)	Temperature (deg. C)	pH (S.U.)
41GW11	19.03	7	1	1003	17	6.60
02/19/94			2	1008	15.5	6.62
			3	985	16.5	6.66
41GW12	18.2	11.5	1	496	17	6.90
02/18/94			2	489	15.5	6.72
			3	399	16	6.83
			4	409	15.5	6.89
			5	379	15.5	6.91
41GW13	19.82	6	1	111	17.5	5.15
02/18/94			2	115	18	5.00
			3	121	16	5.02
41GW04DW	42.34	17	1	318	15.5	7.88
02/14/94			2	299	16.5	8.01
			3	295	17	8.15
41GW06DW	42.92	20	1	382	22	8.56
02/14/94			2	424	20.2	7.41
			3	417	21	7.37
			4	416	20.5	7.30
41GW07DW	45.76	18	1	306	16.8	7.69
02/14/94			2	329	17	7.80
			3	328	17	7.75
41GW09DW	47.10	18	1	356	15	7.52
02/14/94			2	341	16	7.83
			3	316	16.5	7.93
41GW11DW	52.44	20	1	1465	20	7.10
02/14/94			2	1449	20	7.26
			3	1383	20	7.49
41GW12DW	38.35	17	1	733	18	7.52
02/14/94			2	725	18	7.66
			3	706	18	7.63

Notes: (1) Well depth taken from top of PVC riser.

TABLE 4-13
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND TWO
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-GW04-02	41-GW07-02	41-GW07DW-02	41-GW11-02	41-GW11DW-02
Laboratory Sample ID:		9405006-03	9405016-01	9405016-02	9405016-03	9405016-05
Date Sampled:						
	UNITS					
SEMIVOLATILES						
Pentachlorophenol	UG/L	ND	32.5 R	31.6 R	ND	30.5 R
VOLATILES						
Acetone	UG/L	4.00 J	5.00 J	ND	12.0 J	ND
1,1,1-Trichloroethane	UG/L	ND	ND	ND	ND	19.0
Benzene	UG/L	ND	ND	ND	2.00 J	ND
Chlorobenzene	UG/L	ND	ND	ND	2.00 J	ND

UG/L - micrograms per liter
J - value is estimated
ND - not detected
R - rejected

TABLE 4-14
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND 2
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		41-GW01-02	41-GW02-03	41-GW03-02	41-GW04-02	41-GW04DW-02	41-GW05-02	41-GW06DW-02
Laboratory Sample ID:		9405010-05	AB7985	9404226-01	9405006-03	9405006-01	9404226-07	9404226-05
Date Sampled:			08/26/94	4/27/94			4/27/94	4/27/94
	UNITS							
Aluminum	UG/L	7560	230	94900.0	56900	1570	75900.0	12700.0
Arsenic	UG/L	4.51 J	ND	8.02 J	27.9 J	2.5 J	53.5 J	10.4 J
Barium	UG/L	88.9	67.5	836.0	170	45.3	178.0	244.0
Beryllium	UG/L	1.61	ND	6.26	1.24	ND	8.52	0.954
Cadmium	UG/L	ND	ND	4.84	6.49	2.58	37.5	7.46
Calcium	UG/L	26700	116000	33800.0	71500	289000	125000.0	715000.0
Chromium	UG/L	12.1	ND	166.0	81.5	ND	159.0	40.1
Cobalt	UG/L	ND	ND	22.2	15.6	ND	25.8	ND
Copper	UG/L	ND	ND	34.1	19.4 J	ND	53.4	18.5
Iron	UG/L	17500	20600	83200.0	102000	3900	199000.0	17900.0
Lead	UG/L	12.5	2.3	ND	22.5	ND	100.0	15.2
Magnesium	UG/L	2780	20300	2970.0	4140	3380	6720.0	8540.0
Manganese	UG/L	307	334	139.0	274	35.2	766.0	154.0
Mercury	UG/L	ND	ND	ND	0.264 J	ND	ND	ND
Nickel	UG/L	ND	ND	45.3	40.5	ND	177.0	22.8
Potassium	UG/L	1130	17200	2490.0	4910	2940	8330.0	2790.0
Selenium	UG/L	ND	ND	ND	ND	ND	ND	ND
Sodium	UG/L	6320	29400	3910.0	6080	11600	5910.0	11200.0
Thallium	UG/L	ND	ND	ND	ND	ND	3.77 J	ND
Vanadium	UG/L	13	ND	131.0	136	15.1	138.0	74.0
Zinc	UG/L	ND	114	224.0	146	ND	675.0	104.0

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-14
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND 2
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		41-GW07-03	41-GW07DW-02	41-GW08-02	41-GW09-02	41-GW09DW-02	41-GW10-03	41-GW11-03
Laboratory Sample ID:		AB8054	9405016-02	9405006-05	9405010-07	9405010-09	AB8048	AB8057
Date Sampled:		08/26/94					08/26/94	08/26/94
	UNITS							
Aluminum	UG/L	3410	1280	99200	54900	30600	40.2	83
Arsenic	UG/L	2.1	ND	14.8 J	4.51 J	13 J	ND	ND
Barium	UG/L	57.3	18.2	586	451	505	21.5	358
Beryllium	UG/L	1.1	ND	21.2	1.07	1.92	ND	ND
Cadmium	UG/L	ND	2.76	7.39	ND	8.68	ND	ND
Calcium	UG/L	2050	148000	68800	12400	945000	46300	82900
Chromium	UG/L	ND	ND	112	67.1	81	ND	ND
Cobalt	UG/L	ND	ND	89.3	ND	ND	ND	ND
Copper	UG/L	ND	ND	44.2 J	21.7 J	28.5 J	ND	ND
Iron	UG/L	2890	4390	74800	54800	34100	890	26200
Lead	UG/L	3.2	ND	145	52.5	34.8	ND	26.3
Magnesium	UG/L	1750	2280	8740	6590	11400	1570	14200
Manganese	UG/L	24.5	46.2	216	181	367	64.3	186
Mercury	UG/L	ND	ND	ND	ND	ND	ND	0.33
Nickel	UG/L	ND	ND	90.4	ND	44.5	ND	ND
Potassium	UG/L	1870	977	5210	2490	3700	ND	22400
Selenium	UG/L	ND	10.3 J	ND	ND	ND	ND	ND
Sodium	UG/L	9930	6320	6200	22000	10900	4770	27300
Thallium	UG/L	ND	ND	ND	ND	ND	ND	ND
Vanadium	UG/L	ND	10.6	144	88.8	95	ND	ND
Zinc	UG/L	237	ND	283	ND	186	41.6	118

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-14
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND 2
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		41-GW11DW-02	41-GW12-02	41-GW12DW-02	41-GW13-02
Laboratory Sample ID:		9405016-05	9405006-09	9405006-07	9404226-03
Date Sampled:					4/27/94
	UNITS				
Aluminum	UG/L	4570	42300	6080	60200.0
Arsenic	UG/L	8.64 J	11.4 J	4.32 J	ND
Barium	UG/L	93.4	276	84.4	533.0
Beryllium	UG/L	ND	37.4	ND	5.25
Cadmium	UG/L	5.38	12.1	ND	4.05
Calcium	UG/L	368000	716000	180000	12500.0
Chromium	UG/L	19.8	126	26.4	82.8
Cobalt	UG/L	ND	106	ND	32.4
Copper	UG/L	16.6 J	23.4 J	ND	28.5
Iron	UG/L	12800	117000	7250	59200.0
Lead	UG/L	26.5	22.8	ND	16.1
Magnesium	UG/L	7870	9400	9420	3740.0
Manganese	UG/L	136	747	69.9	66.8
Mercury	UG/L	ND	ND	ND	ND
Nickel	UG/L	38.7	99.7	ND	28.9
Potassium	UG/L	2940	2040	17600	3520.0
Selenium	UG/L	ND	ND	ND	ND
Sodium	UG/L	140000	7500	208000	6850.0
Thallium	UG/L	ND	ND	ND	ND
Vanadium	UG/L	45.2	179	18.6	104.0
Zinc	UG/L	205	398	ND	159.0

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-15
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND TWO
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-GW01D-02	41-GW02D-03	41-GW03D-02	41-GW04D-02	41-GW04DWD-02	41-GW05D-02
Laboratory Sample ID:		9405010-06	AB7997	9404226-02	9405006-04	9405006-02	9404226-08
Date Sampled:			08/26/94				4/27/94
	UNITS						
Aluminum	UG/L	ND	ND	ND	ND	ND	ND
Antimony	UG/L	ND	ND	ND	7.3	ND	ND
Arsenic	UG/L	ND	ND	ND	10.2	ND	2.36
Barium	UG/L	21.7	70.4	11.9	41	25.6	ND
Calcium	UG/L	28700	125000	16000.0	43400	51300	54400.0
Copper	UG/L	ND	10.1	ND	ND	ND	ND
Iron	UG/L	ND	21200	ND	29500	ND	ND
Magnesium	UG/L	2460	21200	829.0	2100	1980	1130.0
Manganese	UG/L	112	352	ND	217	ND	ND
Mercury	UG/L	ND	0.23	ND	ND	ND	ND
Potassium	UG/L	675	17800	ND	2790	3670	2060.0
Selenium	UG/L	ND	ND	1.91 J	ND	ND	ND
Sodium	UG/L	6670	30700	4260.0	6200	14300	6030.0
Zinc	UG/L	ND	52.5	ND	ND	ND	ND

UG/L - micrograms per liter
J - value is estimated
MD - not detected

TABLE 4-15
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND TWO
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-GW06DWD-02	41-GW07D-03	41-GW07DWD-02	41-GW08D-02	41-GW09D-02	41-GW09DWD-02
Laboratory Sample ID:		9404226-06	AB8060	9405016-08	9405006-06	9405010-08	9405010-10
Date Sampled:		4/27/94	08/26/94				
	UNITS						
Aluminum	UG/L	ND	77.8	ND	ND	245	ND
Antimony	UG/L	19.3	ND	ND	ND	ND	ND
Arsenic	UG/L	ND	ND	ND	ND	ND	ND
Barium	UG/L	44.4	44.4	ND	17.6	138	33.1
Calcium	UG/L	90000.0	1970	63200	16400	10900	43900
Copper	UG/L	ND	25.3	ND	ND	ND	ND
Iron	UG/L	ND	298	ND	ND	ND	ND
Magnesium	UG/L	2270.0	1800	1540	1630	5600	1430
Manganese	UG/L	31.9	25.3	ND	ND	83.1	ND
Mercury	UG/L	ND	ND	ND	ND	ND	ND
Potassium	UG/L	1620.0	1510	524	826	1130	826
Selenium	UG/L	ND	ND	ND	ND	ND	ND
Sodium	UG/L	11300.0	11000	6320	6670	24100	9870
Zinc	UG/L	ND	86.8	ND	ND	ND	ND

UG/L - micrograms per liter
J - value is estimated
MD - [illegible] tected

TABLE 4-15
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER - ROUND TWO
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-GW10D-03	41-GW11D-03	41-GW11DWD-02	41-GW12D-02	41-GW12DWD-02	41-GW13D-02
Laboratory Sample ID:		AB8058	AB8061	9405016-11	9405006-10	9405006-08	9404226-04
Date Sampled:		08/26/94	08/26/94				4/27/94
	UNITS						
Aluminum	UG/L	ND	ND	ND	ND	ND	ND
Antimony	UG/L	ND	ND	ND	ND	ND	ND
Arsenic	UG/L	ND	ND	2.6	ND	ND	ND
Barium	UG/L	20.7	427	68.7	16.3	20.2	27.1
Calcium	UG/L	52100	105000	234000	79300	85700	3940.0
Copper	UG/L	16.4	16.6	ND	ND	ND	ND
Iron	UG/L	789	24900	1620	ND	ND	ND
Magnesium	UG/L	1770	18200	6540	2530	8270	1330.0
Manganese	UG/L	73.8	235	119	123	30.1	ND
Mercury	UG/L	0.23	ND	ND	ND	ND	ND
Potassium	UG/L	ND	29100	2190	1130	14700	742.0
Selenium	UG/L	ND	ND	ND	ND	ND	ND
Sodium	UG/L	5310	35700	144000	6910	133000	7200.0
Zinc	UG/L	11.3	35.7	ND	ND	ND	12.6

UG/L - micrograms per liter
J - value is estimated
MD - not detected

TABLE 4-16

SUMMARY OF ROUND TWO GROUNDWATER FIELD PARAMETERS
SITE 41
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No. / Date of Measurement	Depth of Well (feet)[1]	Purge Volume (gallons)	Field Parameters			
			Well Volume	Specific Conductance at 25 deg. C (micromhos/cm)	Temperature (deg. C)	pH (S.U.)
41GW01	20.14	2	1	156	17	6.19
04/28/94			2	168	17	6.12
			3	166	16.8	5.96
41GW02	21.52	2	1	223	18	8.21
04/27/94			2	220	17.5	8.24
			3	224	17	8.27
41GW03	21.16	2	1	60	16	7.74
04/27/94			2	72	16	7.73
			3	85	16	7.75
41GW04	21.74	2	1	263	17.5	6.41
04/26/94			2	287	18.3	6.04
			3	277	19	6.10
41GW05	27.5	3	1	277	19.5	8.43
04/27/94			2	279	19.5	8.37
			3	277	19.5	8.44
41GW07	22.82	2	1	105	17	5.04
04/28/94			2	104	17.5	4.88
			3	103	17.5	4.85
41GW08	17.38	2	1	119	19	6.15
04/26/94			2	126	18.5	6.12
			3	129	20.5	6.12
41GW09	22.70	2	1	232	16.2	4.92
04/28/94			2	220	16.7	4.83
			3	224	16.3	4.83
41GW10	15.52	1	1	610	17.7	8.02
04/27/94			2	639	17.7	7.80
			3	564	17.2	8.07
			4	406	16.9	8.24

TABLE 4-16 (Continued)

SUMMARY OF ROUND TWO GROUNDWATER FIELD PARAMETERS
SITE 41
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No. / Date of Measurement	Depth of Well (feet)[1]	Purge Volume (gallons)	Field Parameters: Well Volume	Specific Conductance at 25 deg. C (micromhos/cm)	Temperature (deg. C)	pH (S.U.)
41GW11	18.28	1.5	1	1106	20	6.56
04/28/94			2	1106	19.5	6.59
			3	1088	19.8	6.58
41GW12	18.12	2	1	338	17.5	6.86
04/26/94			2	344	17.5	7.02
			3	329	17.2	7.00
41GW13	19.70	2	1	73	17	7.56
04/27/94			2	75	16.2	7.54
			3	75	16.2	7.51
41GW04DW	42.2	6	1	322	19	7.61
04/26/94			2	327	21.5	7.63
			3	311	19.5	7.64
41GW06DW	42.5	5	1	405	20.5	8.59
04/27/94			2	444	21	8.61
			3	382	20.5	8.65
			3.5	390	21	8.69
41GW07DW	45.58	6	1	283	18	5.82
04/28/94			2	295	18.8	7.30
			3	293	18.6	7.41
			3.5	295	18.5	7.34
41GW09DW	47.09	6	1	231	18	7.47
04/28/94			2	213	18	7.55
			3	242	18	7.58
41GW11DW	51.6	6	1	1769	21.5	6.72
04/28/94			2	1677	22.6	6.73
			3	1704	21.5	6.76
41GW12DW	38.30	5	1	1085	18.5	7.23
04/26/94			2	1313	18.5	7.30
			3	1342	18.5	7.34

Notes: [1] Well depth taken from top of PVC riser.

TABLE 4-17
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

	41-GW01-01	41-GW01-02		41-GW02-01	41-GW02-02		41-GW03-01	41-GW03-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
SEMIVOLATILES									
Naphthalene	5	5	0.00	5	5	0.00	5	5	0.00
VOLATILES									
1,2-Dichlorethene	5	5	0.00	5	5	0.00	5	5	0.00
Benzene	5	5	0.00	5	5	0.00	5	5	0.00
Chlorobenzene	5	5	0.00	5	5	0.00	5	5	0.00
1,1,1-Trichlorethane	5	5	0.00	5	5	0.00	5	5	0.00
PESTICIDES/PCBs									
4,4'-DDD	0.05	0.05	200.00	0.05	0.05	0.00	0.05	0.05	0.00

TABLE 4-17
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

	41-GW04-01	41-GW04-02		41-GW04DW-01	41-GW04DW-02		41-GW05-01	41-GW05-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
SEMIVOLATILES									
Naphthalene	5	5	0.00	5	5	0.00	5	5	0.00
VOLATILES									
1,2-Dichlorethene	5	5	0.00	5	5	0.00	5	5	0.00
Benzene	5	5	0.00	5	5	0.00	5	5	0.00
Chlorobenzene	5	5	0.00	5	5	0.00	5	5	0.00
1,1,1-Trichlorethane	5	5	0.00	5	5	0.00	5	5	0.00
PESTICIDES/PCBs									
4,4'-DDD	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.05	0.00

TABLE 4-17
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

	41-GW06DW-01	41-GW06DW-02		41-GW07-01	41-GW07-02		41-GW07DW-01	41-GW07DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
SEMIVOLATILES									
Naphthalene	5	5	0.00	5	5	0.00	5	5	0.00
VOLATILES									
1,2-Dichlorethene	5	5	0.00	5	5	0.00	5	5	0.00
Benzene	5	5	0.00	5	5	0.00	5	5	0.00
Chlorobenzene	5	5	0.00	5	5	0.00	5	5	0.00
1,1,1-Trichlorethane	5	5	0.00	5	5	0.00	5	5	0.00
PESTICIDES/PCBs									
4,4'-DDD	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.05	0.00

TABLE 4-17
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

	41-GW08-01	41-GW08-02		41-GW09-01	41-GW09-02		41-GW09DW-01	41-GW09DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
SEMIVOLATILES									
Naphthalene	5	5	0.00	5	5	0.00	5	5	0.00
VOLATILES									
1,2-Dichlorethene	5	5	0.00	5	5	0.00	5	5	0.00
Benzene	5	5	0.00	5	5	0.00	5	5	0.00
Chlorobenzene	5	5	0.00	5	5	0.00	5	5	0.00
1,1,1-Trichlorethane	5	5	0.00	5	5	0.00	5	5	0.00
PESTICIDES/PCBs									
4,4'-DDD	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.05	0.00

TABLE 4-17
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

	41-GW10-01	41-GW10-02		41-GW11-01	41-GW11-02		41-GW11DW-01	41-GW11DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
SEMIVOLATILES									
Naphthalene	5	5	0.00	3	5	50.00	5	5	0.00
VOLATILES									
1,2-Dichlorethene	5	5	0.00	5	5	0.00	1.22	5	121.54
Benzene	5	5	0.00	2.67	2	28.69	5	5	0.00
Chlorobenzene	5	5	0.00	1.49	2	29.23	5	5	0.00
1,1,1-Trichlorethane	5	5	0.00	5	5	0.00	5	19	116.67
PESTICIDES/PCBs									
4,4'-DDD	0.05	0.05	0.00	0.01	0.05	133.33	0.05	0.05	0.00

TABLE 4-17
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

	41-GW12-01	41-GW12-02		41-GW12DW-01	41-GW12DW-02		41-GW13-01	41-GW13-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
SEMIVOLATILES									
Naphthalene	5	5	0.00	5	5	0.00	5	5	0.00
VOLATILES									
1,2-Dichlorethene	5	5	0.00	5	5	0.00	5	5	0.00
Benzene	5	5	0.00	5	5	0.00	5	5	0.00
Chlorobenzene	5	5	0.00	5	5	0.00	5	5	0.00
1,1,1-Trichlorethane	5	5	0.00	5	5	0.00	5	5	0.00
PESTICIDES/PCBs									
4,4'-DDD	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.05	0.00

TABLE 4-18
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD) BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL TOTAL METALS

	41-GW01-01	41-GW01-02		41-GW02-01	41-GW02-02		41-GW03-01	41-GW03-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	42300	7560	139.35		69400	200.00	58800	94900	46.97
Antimony	30	30	0.00	30	30	0.00	30	30	0.00
Arsenic	11.5	4.41	89.13	7.44	5.76	25.45	2.75	8.02	97.86
Barium	189	88.9	72.04	465	322	36.34	310	836	91.80
Beryllium	5.4	1.61	108.13	6.8	6.5	4.51	2.38	6.26	89.81
Cadmium	2.5	2.5	0.00	6.26	2.5	85.84	2.5	4.84	63.76
Calcium	42500	26700	45.66	136000	151000	10.45	20300	33800	49.91
Chromium	64.2	12.1	136.57	244	151	47.09	99.1	166	50.47
Cobalt	31	25	21.43	16.5	25	40.96	25	22.2	11.86
Copper	31.8	12.5	87.13	83.6	81.5	2.54	25.9	34.1	27.33
Iron	66200	17500	116.37	80800	65900	20.31	35300	83200	80.84
Lead	24.6	12.5	65.23	19.8	15.4	25.00	6.12	1.5	121.26
Magnesium	4010	2780	36.23	31000	26800	14.53	2500	2970	17.18
Manganese	951	307	102.38	572	484	16.67	72.4	139	63.01
Mercury	0.1	0.1	0.00	0.922	0.1	160.86	0.1	0.1	0.00
Nickel	20	20	0.00	41.4	22.9	57.54	36.1	45.3	22.60
Potassium	3080	1130	92.64	21300	19100	10.89	3080	2490	21.18
Selenium	2.5	2.5	0.00	3.66	2.5	37.66	2.5	2.5	0.00
Silver	5	5	0.00	5	5	0.00	5	5	0.00
Sodium	5830	6320	8.07	28600	32000	11.22	2080	3910	61.10
Thallium	5	5	0.00	5	5	0.00	5	5	0.00
Vanadium	77.1	13	142.29	204	181	11.95	83.6	131	44.18
Zinc	124	10	170.15	146	76.5	62.47	130	224	53.11

TABLE 4-18
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL TOTAL METALS

	41-GW04-01	41-GW04-02		41-GW04DW-01	41-GW04DW-02		41-GW05-01	41-GW05-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	6390	56900	159.61	269	1570	141.49	20300	75900	115.59
Antimony	30	30	0.00	30	30	0.00	30	30	0.00
Arsenic	6.69	27.9	122.64	3.71	2.5	38.97	13	53.5	121.80
Barium	55.2	170	101.95	22.6	45.3	66.86	55.7	178	104.66
Beryllium	2.5	1.24	67.38	2.5	2.5	0.00	1.57	8.52	137.76
Cadmium	2.5	6.49	88.77	2.5	2.58	3.15	9.96	37.5	116.06
Calcium	29300	71500	83.73	107000	289000	91.92	66200	125000	61.51
Chromium	10.5	81.5	154.35	5	5	0.00	54.4	159	98.03
Cobalt	25	15.6	46.31	25	25	0.00	25	25.8	3.15
Copper	12.5	19.4	43.26	12.5	12.5	0.00	27	53.4	65.67
Iron	54900	102000	60.04	691	3900	139.80	55300	199000	113.02
Lead	4.82	22.5	129.43	1.5	1.5	0.00	23.7	100	123.36
Magnesium	2150	4140	63.28	1630	3380	69.86	2970	6720	77.40
Manganese	226	274	19.20	16.9	35.2	70.25	203	766	116.20
Mercury	0.1	0.264	90.11	0.1	0.1	0.00	0.1	0.1	0.00
Nickel	20	40.5	67.77	20	20	0.00	38	177	129.30
Potassium	3080	4910	45.81	1550	2940	61.92	3080	8330	92.02
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	1.66	2.5	40.38
Silver	24.8	5	132.89	5	5	0.00	5	5	0.00
Sodium	5510	6080	9.84	11800	11600	1.71	5940	5910	0.51
Thallium	5	5	0.00	5	5	0.00	5	3.77	28.05
Vanadium	25	136	137.89	25	15.1	49.38	38.1	138	113.46
Zinc	25.7	146	140.13	17.8	10	56.12	173	675	118.40

TABLE 4-18
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL TOTAL METALS

	41-GW06DW-01	41-GW06DW-02		41-GW07-01	41-GW07-02		41-GW07DW-01	41-GW07DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	12600	12700	0.79	145000	20400	200.00	1770	1280	32.13
Antimony	30	30	0.00	30	30	0.00	30	30	0.00
Arsenic	9.58	1.4	149.00	13.3	5.76	79.12	4.79	5	4.29
Barium	186	244	26.98	717	224	104.78	42.7	18.2	80.46
Beryllium	2.5	0.954	89.52	5.59	0.662	157.65	2.5	2.5	0.00
Cadmium	4.7	7.46	45.39	9.08	2.5	113.64	2.76	2.5	9.89
Calcium	434000	715000	48.91	11100	3540	103.28	172000	148000	15.00
Chromium	40.5	40.1	0.99	166	28	142.27	5	5	0.00
Cobalt	25	25	0.00	25	25	0.00	25	25	0.00
Copper	12.5	18.5	38.71	28.5	12.5	78.05	12.5	12.5	0.00
Iron	15300	17900	15.66	71100	15200	129.55	3140	4390	33.20
Lead	11.1	15.2	31.18	94.6	26.4	112.73	5.96	1.5	119.57
Magnesium	6710	8540	24.00	5960	3010	65.77	2800	2280	20.47
Manganese	101	154	41.57	167	48.4	110.12	41.8	46.2	10.00
Mercury	0.152	0.1	41.27	0.1	0.1	0.00	0.1	0.1	0.00
Nickel	20	22.8	13.08	88.7	20	126.40	20	20	0.00
Potassium	2900	2790	3.87	4780	1430	107.89	1180	977	18.82
Selenium	2.5	2.5	0.00	7.74	9.44	19.79	8.36	10.3	20.79
Silver	5	5	0.00	5	5	0.00	5	5	0.00
Sodium	17800	11200	45.52	11700	10900	7.08	8880	6320	33.68
Thallium	5	5	0.00	5	5	0.00	5	5	0.00
Vanadium	49.8	74	39.10	150	24.8	143.25	25	10.6	80.90
Zinc	83.8	104	21.51	276	66.1	122.71	32.9	10	106.76

TABLE 4-18
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL TOTAL METALS

	41-GW08-01	41-GW08-02		41-GW09-01	41-GW09-02		41-GW09DW-01	41-GW09DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	13800	99200	151.15	26800	54900	68.79	2490	30600	169.90
Antimony	30	30	0.00	30	30	0.00	30	30	0.00
Arsenic	2.4	14.8	144.19	7.66	4.51	51.77	5	13	88.89
Barium	139	586	123.31	200	451	77.11	39.8	505	170.78
Beryllium	2.5	21.2	157.81	2.5	1.07	80.11	2.5	1.92	26.24
Cadmium	2.5	7.39	98.89	2.5	2.5	0.00	2.5	8.68	110.55
Calcium	31400	68800	74.65	8750	12400	34.52	74300	945000	170.84
Chromium	17.3	112	146.48	36.6	67.1	58.82	5	81	176.74
Cobalt	25	89.3	112.51	25	25	0.00	25	25	0.00
Copper	12.5	44.2	111.82	12.5	21.7	53.80	12.5	28.5	78.05
Iron	13600	74800	138.46	31200	54800	54.88	2260	34100	175.14
Lead	32.6	145	126.58	33.8	52.5	43.34	4.33	34.8	155.74
Magnesium	2280	8740	117.24	3570	6590	59.45	2070	11400	138.53
Manganese	56.6	216	116.95	212	181	15.78	36.8	367	163.55
Mercury	0.1	0.1	0.00	0.1	0.1	0.00	0.1	0.1	0.00
Nickel	20	90.4	127.54	20	20	0.00	20	44.5	75.97
Potassium	1340	5210	118.17	2900	2490	15.21	1030	3700	112.90
Selenium	2.5	2.5	0.00	2.12	2.5	16.45	1.87	2.5	28.83
Silver	5	5	0.00	5	5	0.00	5	5	0.00
Sodium	3190	6200	64.11	18000	22000	20.00	22700	10900	70.24
Thallium	5	5	0.00	5	5	0.00	5	5	0.00
Vanadium	25.9	144	139.02	46.7	88.8	62.14	25	95	116.67
Zinc	56.5	283	133.43	27.8	10	94.18	26.4	186	150.28

TABLE 4-18
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL TOTAL METALS

	41-GW10-01	41-GW10-02		41-GW11-01	41-GW11-02		41-GW11DW-01	41-GW11DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	81900	113000	31.91	75700	49400	42.05	247	4570	179.49
Antimony	30	30	0.00	17.9	73.2	121.41	30	30	0.00
Arsenic	36.3	31.1	15.43	24.2	26.9	10.57	5	8.64	53.37
Barium	248	182	30.70	999	969	3.05	92.1	93.4	1.40
Beryllium	7.41	10.9	38.12	2.5	1.58	45.10	2.5	2.5	0.00
Cadmium	16.3	9.62	51.54	110	73.1	40.31	2.5	5.38	73.10
Calcium	250000	122000	68.82	130000	123000	5.53	224000	368000	48.65
Chromium	176	158	10.78	149	102	37.45	5	19.8	119.35
Cobalt	37.8	62.7	49.55	25	16.4	41.55	25	25	0.00
Copper	26.3	38	36.39	1030	698	38.43	12.5	16.6	28.18
Iron	124000	123000	0.81	155000	144000	7.36	1360	12800	161.58
Lead	73.6	92.1	22.33	9340	12600	29.72	1.88	26.5	173.50
Magnesium	15300	8830	53.63	22700	21800	4.04	5860	7870	29.28
Manganese	455	390	15.38	2110	1740	19.22	87.5	136	43.40
Mercury	0.1	0.1	0.00	0.1	0.1	0.00	0.1	0.1	0.00
Nickel	68.1	72.5	6.26	137	108	23.67	20	38.7	63.71
Potassium	2750	1580	54.04	26800	24000	11.02	2740	2940	7.04
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	2.74	2.5	9.16
Silver	5	5	0.00	8.52	4.31	65.63	5	5	0.00
Sodium	40200	27600	37.17	27900	31800	13.07	95100	140000	38.20
Thallium	5	5	0.00	5	5	0.00	5	5	0.00
Vanadium	199	156	24.23	244	201	19.33	25	45.2	57.55
Zinc	173	231	28.71	5180	4700	9.72	50.3	205	121.19

TABLE 4-18
CALCULATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL TOTAL METALS

	41-GW12-01	41-GW12-02		41-GW12DW-01	41-GW12DW-02		41-GW13-01	41-GW13-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	65900	42300	43.62	1880	6080	105.53	38100	60200	44.96
Antimony	30	30	0.00	30	30	0.00	30	30	0.00
Arsenic	8.98	11.4	23.75	5	4.32	14.59	9.7	5	63.95
Barium	356	276	25.32	53	84.4	45.71	382	533	33.01
Beryllium	42.8	37.4	13.47	2.5	2.5	0.00	4.53	5.25	14.72
Cadmium	25.1	12.1	69.89	2.5	2.5	0.00	4.6	4.05	12.72
Calcium	828000	716000	14.51	93300	180000	63.45	14200	12500	12.73
Chromium	151	126	18.05	12.6	26.4	70.77	54.5	82.8	41.22
Cobalt	117	106	9.87	25	25	0.00	40.1	32.4	21.24
Copper	12.5	23.4	60.72	12.5	12.5	0.00	12.5	28.5	78.05
Iron	160000	117000	31.05	2430	7250	99.59	40700	59200	37.04
Lead	22.1	22.8	3.12	3.16	1.5	71.24	29.1	16.1	57.52
Magnesium	11900	9400	23.47	6410	9420	38.03	4660	3740	21.90
Manganese	1070	747	35.55	35	69.9	66.54	80.3	66.8	18.35
Mercury	0.1	0.1	0.00	0.1	0.1	0.00	0.1	0.1	0.00
Nickel	111	99.7	10.73	20	20	0.00	32.1	28.9	10.49
Potassium	1960	2040	4.00	13800	17600	24.20	18100	3520	134.88
Selenium	2.5	2.5	0.00	4.24	2.5	51.63	3.49	2.5	33.06
Silver	5	5	0.00	62.8	5	170.50	63.4	5	170.76
Sodium	8480	7500	12.27	200000	208000	3.92	7260	6850	5.81
Thallium	5	5	0.00	5	5	0.00	5	5	0.00
Vanadium	212	179	16.88	25	18.6	29.36	72.2	104	36.10
Zinc	450	398	12.26	25.3	10	86.69	178	159	11.28

TABLE 4-19
CALCUATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL DISSOLVED METALS

	41-GW01-01	41-GW01-02		41-GW02-01	41-GW02-02		41-GW03-01	41-GW03-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	100	100	0.00	100	112	11.32	100	100	0.00
Antimony	30	30	0.00	30	30	0.00	30	30	0.00
Arsenic	5	5	0.00	2.22	2.1	5.56	5	5	0.00
Barium	12.6	21.7	53.06	103	103	0.00	100	11.9	157.46
Beryllium	2.5	2.5	0.00	2.5	0.648	117.66	2.5	2.5	0.00
Calcium	28300	28700	1.40	137000	147000	7.04	12200	16000	26.95
Chromium	5	5	0.00	5	7.89	44.84	5	5	0.00
Copper	12.5	12.5	0.00	12.5	15.9	23.94	12.5	12.5	0.00
Iron	50	50	0.00	23700	20500	14.48	50	50	0.00
Lead	1.5	1.5	0.00	1.5	0.6	85.71	1.5	1.5	0.00
Magnesium	1910	2460	25.17	29200	26700	8.94	366	829	77.49
Manganese	129	112	14.11	469	445	5.25	7.5	7.5	0.00
Potassium	964	675	35.27	19300	20200	4.56	2500	2500	0.00
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	1.91	26.76
Sodium	6260	6670	6.34	34300	36600	6.49	2500	4260	52.07
Vanadium	25	25	0.00	25	10.5	81.69	25	25	0.00
Zinc	10	10	0.00	10	10	0.00	10	10	0.00

TABLE 4-19
CALCUATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL DISSOLVED METALS

	41-GW04-01	41-GW04-02		41-GW04DW-01	41-GW04DW-02		41-GW05-01	41-GW05-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	100	100	0.00	100	100	0.00	100	100	0.00
Antimony	30	7.3	121.72	12.1	30	85.04	30	30	0.00
Arsenic	4.68	10.2	74.19	5	5	0.00	5	2.36	71.74
Barium	44.4	41	7.96	17.8	25.6	35.94	100	100	0.00
Beryllium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Calcium	32600	43400	28.42	50100	51300	2.37	54000	54400	0.74
Chromium	5	5	0.00	5	5	0.00	5	5	0.00
Copper	12.5	12.5	0.00	12.5	12.5	0.00	12.5	12.5	0.00
Iron	42400	29500	35.88	50	50	0.00	50	50	0.00
Lead	1.5	1.5	0.00	1.5	1.5	0.00	1.5	1.5	0.00
Magnesium	2540	2100	18.97	1570	1980	23.10	1370	1330	2.96
Manganese	266	217	20.29	7.5	7.5	0.00	21.2	7.5	95.47
Potassium	3970	2790	34.91	1210	3670	100.82	1630	2060	23.31
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Sodium	6160	6200	0.65	13500	14300	5.76	6260	6030	3.74
Vanadium	25	25	0.00	25	25	0.00	25	25	0.00
Zinc	10	10	0.00	10	10	0.00	10	10	0.00

TABLE 4-19
CALCUATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL DISSOLVED METALS

	41-GW06DW-01	41-GW06DW-02		41-GW07-01	41-GW07-02		41-GW07DW-01	41-GW07DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	100	100	0.00	100	132	27.59	100	100	0.00
Antimony	15.6	19.3	21.20	19.1	30	44.40	11.4	30	89.86
Arsenic	5	5	0.00	5	5	0.00	5	5	0.00
Barium	45.1	44.4	1.56	49.2	53.4	8.19	100	100	0.00
Beryllium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Calcium	80100	90000	11.64	4710	3840	20.35	64500	63200	2.04
Chromium	5	5	0.00	5	5	0.00	5	5	0.00
Copper	12.5	12.5	0.00	12.5	12.5	0.00	12.5	12.5	0.00
Iron	50	50	0.00	1630	50	188.10	50	50	0.00
Lead	1.5	1.5	0.00	1.5	1.5	0.00	1.5	1.5	0.00
Magnesium	2610	2270	13.93	1750	2170	21.43	2020	1540	26.97
Manganese	22.7	31.9	33.70	43.2	40.8	5.71	23.2	7.5	102.28
Potassium	1470	1620	9.71	1340	1130	17.00	1070	524	68.51
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Sodium	18600	11300	48.83	11900	12800	7.29	9130	6320	36.38
Vanadium	25	25	0.00	25	25	0.00	25	25	0.00
Zinc	10	10	0.00	10	10	0.00	10	10	0.00

TABLE 4-19
CALCUATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL DISSOLVED METALS

	41-GW08-01	41-GW08-02		41-GW09-01	41-GW09-02		41-GW09DW-01	41-GW09DW-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	100	100	0.00	100	245	84.06	100	100	0.00
Antimony	17	30	55.32	30	30	0.00	12.1	30	85.04
Arsenic	5	5	0.00	5	5	0.00	5	5	0.00
Barium	23.7	17.6	29.54	44.5	138	102.47	100	33.1	100.53
Beryllium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Calcium	21200	16400	25.53	7150	10900	41.55	43300	43900	1.38
Chromium	5	5	0.00	5	5	0.00	5	5	0.00
Copper	12.5	12.5	0.00	12.5	12.5	0.00	12.5	12.5	0.00
Iron	50	50	0.00	50	50	0.00	50	50	0.00
Lead	1.5	1.5	0.00	1.5	1.5	0.00	1.5	1.5	0.00
Magnesium	1940	1630	17.37	2730	5600	68.91	1840	1430	25.08
Manganese	29.3	7.5	118.48	138	83.1	49.66	20.1	7.5	91.30
Potassium	2500	826	100.66	2010	1130	56.05	938	826	12.70
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Sodium	4650	6670	35.69	19400	24100	21.61	25100	9870	87.10
Vanadium	25	25	0.00	25	25	0.00	25	25	0.00
Zinc	10	10	0.00	10	10	0.00	10	10	0.00

TABLE 4-19
CALCUATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL DISSOLVED METALS

Contaminant	41-GW10-01	41-GW10-02		41-GW11-01	41-GW11-02		41-GW11DW-01	41-GW11DW-02	
	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	100	100	0.00	100	100	0.00	100	100	0.00
Antimony	11.4	30	89.86	14.9	30	67.26	12.8	30	80.37
Arsenic	5	5	0.00	5	5	0.00	5	2.6	63.16
Barium	40.3	50.3	22.08	451	551	19.96	97.3	68.7	34.46
Beryllium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Calcium	99600	83300	17.82	111000	104000	6.51	188000	234000	21.80
Chromium	5	5	0.00	5	5	0.00	5	5	0.00
Copper	12.5	12.5	0.00	12.5	12.5	0.00	12.5	12.5	0.00
Iron	50	50	0.00	40700	47100	14.58	243	1620	147.83
Lead	1.5	1.5	0.00	1.5	1.5	0.00	1.5	1.5	0.00
Magnesium	8410	6440	26.53	22100	20100	9.48	6380	6540	2.48
Manganese	45.3	92.5	68.51	521	331	44.60	94	119	23.47
Potassium	2500	293	158.04	29400	28000	4.88	3480	2190	45.50
Selenium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Sodium	33600	24300	32.12	30400	33300	9.11	108000	144000	28.57
Vanadium	25	25	0.00	25	25	0.00	25	25	0.00
Zinc	10	10	0.00	125	10	170.37	10	10	0.00

TABLE 4-19
CALCUATION OF RELATIVE PERCENT DIFFERENCE (RPD)
BETWEEN ROUND 1 AND ROUND 2 GROUNDWATER DATA
REMEDIAL INVESTIGATION CTO-0212
OPERABLE UNIT NO. 4 SITE 41
MCB CAMP LEJEUNE, NORTH CAROLINA
TAL DISSOLVED METALS

	41-GW12-01	41-GW12-02		41-GW12DW-01	41-GW12DW-02		41-GW13-01	41-GW13-02	
Contaminant	Round 1	Round 2	RPD	Round 1	Round 2	RPD	Round 1	Round 2	RPD
Aluminum	100	100	0.00	100	100	0.00	100	100	0.00
Antimony	12.8	30	80.37	30	30	0.00	30	30	0.00
Arsenic	5	5	0.00	5	5	0.00	5	5	0.00
Barium	22.5	16.3	31.96	32.3	20.2	46.10	40.8	27.1	40.35
Beryllium	2.5	2.5	0.00	2.5	2.5	0.00	2.5	2.5	0.00
Calcium	91100	79300	13.85	63100	85700	30.38	8620	3940	74.52
Chromium	5	5	0.00	5	5	0.00	5	5	0.00
Copper	12.5	12.5	0.00	12.5	12.5	0.00	12.5	12.5	0.00
Iron	50	50	0.00	50	50	0.00	313	50	144.90
Lead	1.5	1.5	0.00	1.5	1.5	0.00	1.5	1.5	0.00
Magnesium	3530	2530	33.00	6740	8270	20.39	3460	1330	88.94
Manganese	342	123	94.19	24.2	30.1	21.73	39.3	7.5	135.90
Potassium	2500	1130	75.48	16700	14700	12.74	1070	742	36.20
Selenium	7.23	2.5	97.23	2.5	2.5	0.00	2.5	2.5	0.00
Sodium	7800	6910	12.10	244000	133000	58.89	7070	7200	1.82
Vanadium	25	25	0.00	25	25	0.00	25	25	0.00
Zinc	10	10	0.00	10	10	0.00	47	12.6	115.44

TABLE 4-20

COMPARISON OF TOTAL METAL, LEVELS IN SHALLOW GROUNDWATER AT SITE 41
FOR WELLS SAMPLED WITH LOW FLOW PURGING TECHNIQUES
REMEDIAL INVESTIGATION - CTO - 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Constituent (µg/L)	Site 41 41-GW02			Site 41 41-GW07			Site 41 41-GW10			Site 41 41-GW11		
	2/14/94	4/27/94	8/27/94	2/18/94	4/28/94	8/27/94	2/16/94	4/27/94	8/27/94	2/16/94	4/28/94	8/27/94
Aluminum	125,000	69,400	230	145,000	20,400	3,410	81,900	113,000	40.2	75,700	49,400	83
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	17.9	73.2	ND
Arsenic	7.44	5.76	ND	13.3	5.76	2.1	36.3	31.1	ND	24.2	26.9	ND
Barium	465	322	67.5	717	224	57.3	248	182	21.5	999	969	358
Beryllium	6.8	6.5	ND	5.59	0.662	1.1	7.41	10.9	ND	ND	1.58	ND
Cadmium	6.26	ND	ND	9.08	ND	ND	16.3	9.62	ND	110	73.1	ND
Calcium	136,000	151,000	116,000	11,100	3,540	2,050	250,000	122,000	46,300	130,000	123,000	82,900
Chromium	244	151	ND	166	28	ND	176	158	ND	149	102	ND
Cobalt	16.5	ND	ND	ND	ND	ND	37.8	62.7	ND	ND	16.4	ND
Copper	83.6	81.5	ND	28.5	ND	ND	26.3	38	ND	1,030	698	ND
Iron	80,800	65,900	20,600	71,100	15,200	2,890	124,000	123,000	890	155,000	144,000	26,200
Lead	19.8	15.4	2.3	94.6	26.4	3.2	73.6	92.1	ND	9,340	12,600	26.3
Magnesium	31,000	26,800	20,300	5,960	3,010	1,750	15,300	8,830	1,570	22,700	21,800	14,200
Manganese	572	484	334	167	48.4	24.5	455	390	64.3	2,110	1,740	186
Mercury	0.922	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.33
Nickel	41.4	22.9	ND	88.7	ND	ND	68.1	72.5	ND	137	108	ND
Potassium	21,300	19,100	17,200	4,780	1,430	1,870	2,750	1,580	ND	26,800	24,000	22,400
Selenium	3.66	ND	ND	7.74	9.44	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.52	4.31	ND
Sodium	28,600	32,000	29,400	11,700	10,900	9,930	40,200	27,600	4,770	27,900	31,800	27,300
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	204	181	ND	150	24.8	ND	199	156	ND	244	201	ND
Zinc	146	76.5	114	276	66.1	237	173	231	41.6	5,180	4,700	118
Cyanide	ND	NA	NA	ND	NA	NA	ND	NA	NA	ND	NA	NA

ND = Nondetect
NA = Not Analyzed

TABLE 4-21

COMPARISON OF DISSOLVED METAL LEVELS IN SHALLOW GROUNDWATER AT SITE 41
FOR WELLS SAMPLED WITH LOW FLOW PURGING TECHNIQUES
REMEDIAL INVESTIGATION - CTO - 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Constituent (µg/L)	Site 41 41-GW02			Site 41 41-GW07			Site 41 41-GW10			Site 41 41-GW11		
	2/14/94	4/27/94	8/27/94	2/18/94	4/28/94	8/27/94	2/16/94	4/27/94	8/27/94	2/16/94	4/28/94	8/27/94
Aluminum	ND	112	ND	ND	132	77.8	ND	ND	ND	ND	ND	ND
Antimony	ND	ND	ND	19.1	ND	ND	11.4	ND	ND	14.9	ND	ND
Arsenic	2.22	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	10	103	70.4	49.2	53.4	44.4	40.3	50.3	20.7	451	551	427
Beryllium	ND	0.648	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	137,000	147,000	125,000	4,710	3,840	1,970	99,600	83,300	52,100	111,000	104,000	105,000
Chromium	ND	7.89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	10.1	ND	ND	25.3	ND	ND	16.4	ND	ND	16.6
Iron	23,700	20,500	21,200	1,630	ND	298	ND	ND	789	40,700	47,100	24,900
Lead	ND	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium	29,200	26,700	21,200	1,750	2,170	1,800	8,410	6,440	1,770	22,100	20,100	18,200
Manganese	469	445	352	43.2	40.8	25.3	45.3	92.5	73.8	521	331	235
Mercury	ND	ND	0.23	ND	ND	ND	ND	ND	0.23	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	19,300	20,200	17,800	1,340	1,130	1,510	ND	293	ND	29,400	28,000	29,100
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	34,300	36,600	30,700	11,900	12,800	11,000	33,600	24,300	5,310	30,400	33,300	35,700
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	ND	10.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	ND	ND	52.5	ND	ND	86.8	ND	ND	11.3	125	ND	35.7
Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

ND = Nondetect
NA = Not Analyzed

TABLE 4-22
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-NE-SW05	41-UN-SW02	41-UN-SW12	41-UN-SW-13	41-UN-SW-14	41-UN-SW20
Laboratory Sample ID:		9402093-01	9402067-01	9402067-02	9402060-03	9402060-01	AB7564
Date Sampled:		2/8/94	2/3/94	2/4/94	2/3/94	2/3/94	08/23/94
	UNITS						
VOLATILES							
Chlorobenzene	UG/L	ND	ND	4.00 J	ND	1.00 J	NA
PESTICIDE/PCBS							
Lindane (gamma-BHC)	UG/L	ND	0.020 J	ND	ND	ND	ND
Heptachlor	UG/L	ND	ND	ND	ND	ND	0.055
4,4'-DDT	UG/L	ND	0.030 J	ND	ND	ND	ND

UG/L - micrograms per liter
J - value is estimated
NA - not analyzed
ND - not detected

TABLE 4-23
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO.4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-TC-SW06	41-TC-SW07	41-TC-SW08	41-TC-SW09	41-NE-SW05	41-UN-SW01	41-UN-SW02	41-UN-SW03
Laboratory Sample ID:		9402081-05	9402080-01	9402081-01	9402081-02	9402093-01	9402063-03	9402067-01	9402039-01
Date Sampled:		2/6/94	2/7/94	2/6/94	2/6/94	2/8/94	2/4/94	2/3/94	2/1/94
	UNITS								
Aluminum	UG/L	390.0	395.0	411.0	397.0	178.0	447.0 J	303.0	437.0
Arsenic	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Barium	UG/L	23.6	25.6	29.0	25.1	27.2	23.3	21.2	20.0
Cadmium	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	UG/L	18900.0	21400.0	20300.0	19400.0	40300.0	41600.0	41400.0	30000.0
Chromium	UG/L	ND	8.52	ND	ND	ND	ND	ND	ND
Cobalt	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Copper	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Iron	UG/L	1460.0	1540.0	1490.0	1510.0	469.0	1300.0 J	662.0	633.0
Lead	UG/L	1.40	1.40	1.74	ND	1.17	1.85	ND	ND
Magnesium	UG/L	1620.0	1720.0	1710.0	2360.0	2410.0	1770.0	1940.0	1860.0
Manganese	UG/L	25.7	30.6	28.3	30.7	40.0	17.5	16.6	25.2
Mercury	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	UG/L	2210	2090	2090	2320	1620	1860	2090	1700
Sodium	UG/L	15000	15200	15000	22800	12300	22100	20900	13200
Vanadium	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	UG/L	21.4	16.7	16.8	16.3	33.2	24.9	30.4	ND

UG/L - micrograms per liter
J - value is estimated
ND - n[illegible]ected

TABLE 4-23
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO.4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SW04	41-UN-SW10	41-UN-SW11	41-UN-SW12	41-UN-SW-13	41-UN-SW-14	41-UN-SW15
Laboratory Sample ID:		9402039-03	9402022-01	9402063-01	9402067-02	9402060-03	9402060-01	AB7582
Date Sampled:		2/1/94	2/1/94	2/4/94	2/4/94	2/3/94	2/3/94	08/23/94
	UNITS							
Aluminum	UG/L	442.0	460.0	3380.0 J	ND	3390.0	ND	260
Arsenic	UG/L	ND	ND	ND	ND	ND	ND	11.8
Barium	UG/L	26.6	17.9	24.4	37.5	113.0	54.5	26.3
Cadmium	UG/L	ND	ND	ND	ND	ND	ND	ND
Calcium	UG/L	31300.0	9980.0	20200.0	39800.0	75800.0	84200.0	43200
Chromium	UG/L	ND	ND	ND	ND	ND	ND	ND
Cobalt	UG/L	ND	ND	ND	ND	ND	ND	ND
Copper	UG/L	ND	ND	ND	ND	ND	ND	ND
Iron	UG/L	655.0	718.0	2690.0 J	6260.0	14100.0	2810.0	39600
Lead	UG/L	1.13 J	ND	8.10	ND	12.1	1.52 J	3.1
Magnesium	UG/L	2040.0	1550.0	2160.0	4220.0	12700.0	11000.0	2790
Manganese	UG/L	28.5	17.1	12.3	47.7	34.1	209.0	76.5
Mercury	UG/L	ND	ND	ND	ND	0.101	ND	0.28
Nickel	UG/L	ND	ND	ND	ND	ND	ND	ND
Potassium	UG/L	1600	1490	923	3370	10200	6760	2220
Sodium	UG/L	12900	11200	4760	7490	14800	23600	573
Vanadium	UG/L	ND	ND	ND	ND	ND	ND	ND
Zinc	UG/L	ND	ND	25.0	27.2	ND	ND	59.2

UG/L - micrograms per liter
J - value is estimated
ND - not detected

TABLE 4-23
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO.4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SW16	41-UN-SW17	41-UN-SW18	41-UN-SW19	41-UN-SW20	41-UN-SW21	41-UN-SW22	41-UN-SW23
Laboratory Sample ID:		AB7579	AB7575	AB7571	AB7568	AB7565	AB7562	AB7559	AB7556
Date Sampled:		08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94
	UNITS								
Aluminum	UG/L	183	988	356	245	110	ND	ND	11000
Arsenic	UG/L	2.7	2.2	ND	2.4	ND	ND	4.8	22.1
Barium	UG/L	85.4	53.8	39.4	19.2	18.4	18.6	89.9	360
Cadmium	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	UG/L	62200	20100	34600	46900	46700	50100	104000	165000
Chromium	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	UG/L	ND	ND	ND	ND	ND	ND	ND	19.6
Copper	UG/L	ND	ND	ND	ND	ND	ND	ND	34.1
Iron	UG/L	33400	17600	10600	747	683	649	15700	245000
Lead	UG/L	7.7	3.6	4.3	ND	ND	ND	ND	36.2
Magnesium	UG/L	10500	3340	2960	1910	1850	1990	13500	12800
Manganese	UG/L	106	52.4	130	19.9	17.5	17.7	1380	1590
Mercury	UG/L	ND	0.36	0.28	0.21	ND	ND	ND	0.56
Nickel	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	UG/L	13400	2920	2080	2540	2180	2650	8740	5870
Sodium	UG/L	19300	9680	11300	21200	20800	21800	38300	60700
Vanadium	UG/L	ND	ND	ND	ND	ND	ND	ND	40.4
Zinc	UG/L	68.7	80.7	43	27.2	31.9	28.1	29.8	231

UG/L - micrograms per liter
J - value is estimated
ND - [illegible]ected

TABLE 4-23
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO.4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SW24	41-UN-SW25	41-UN-SW26	41-UN-SW27	41-UN-SW28
Laboratory Sample ID:		AB7553	AB7550	AB7547	AB7544	AB7541
Date Sampled:		08/23/94	08/23/94	08/23/94	08/23/94	08/23/94
	UNITS					
Aluminum	UG/L	17800	7060	102	76.6	585
Arsenic	UG/L	30.2	11.7	ND	ND	2.6
Barium	UG/L	442	327	21.8	23.6	26.5
Cadmium	UG/L	6.2	ND	ND	ND	ND
Calcium	UG/L	158000	121000	42500	44000	45600
Chromium	UG/L	ND	ND	ND	ND	ND
Cobalt	UG/L	43.9	20.5	ND	ND	ND
Copper	UG/L	41.2	20.1	13.3	ND	ND
Iron	UG/L	278000	238000	936	1340	2940
Lead	UG/L	36	36.8	7.2	17	4.8
Magnesium	UG/L	11400	10000	1940	2140	2410
Manganese	UG/L	1700	1200	20.4	44.9	85.6
Mercury	UG/L	0.46	0.26	0.23	ND	ND
Nickel	UG/L	20	ND	ND	ND	ND
Potassium	UG/L	4920	4450	2290	1960	1620
Sodium	UG/L	67600	52600	14100	15300	16300
Vanadium	UG/L	51.5	35.4	ND	ND	ND
Zinc	UG/L	235	133	21.4	30.8	47.8

UG/L - micrograms per liter
J - value is estimated
ND - not detected

TABLE 4-24
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-UN-SW15 F	41-UN-SW16 F	41-UN-SW17 F	41-UN-SW18 F	41-UN-SW19 F	41-UN-SW20 F	41-UN-SW21 F
Laboratory Sample ID:		AB7596	AB7595	AB7594	AB7593	AB7592	AB7591	AB7590
Date Sampled:		08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94
	UNITS							
Arsenic	UG/L	2	ND	ND	ND	ND	ND	ND
Barium	UG/L	24.6	82.4	47.2	34.1	19.1	18.8	18.2
Calcium	UG/L	53000	74000	23700	39200	54400	55400	56500
Cobalt	UG/L	ND	ND	ND	ND	ND	ND	ND
Copper	UG/L	18.2	ND	15.1	21.5	20.8	19	ND
Iron	UG/L	118	6000	1060	2390	161	146	148
Lead	UG/L	ND	ND	ND	ND	ND	ND	ND
Magnesium	UG/L	3570	12700	4000	3380	2200	2230	2220
Manganese	UG/L	83.8	121	50.7	152	18.5	18.1	20.6
Potassium	UG/L	2520	15600	3120	2380	2670	2500	2780
Sodium	UG/L	6860	22700	11400	12300	24500	24700	24300
Zinc	UG/L	7.8	5.4	11.1	11.4	8.1	8.1	6

UG/L - micrograms per liter
ND - [illegible]ected

TABLE 4-24
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		41-UN-SW22 F	41-UN-SW23 F	41-UN-SW24 F	41-UN-SW25 F	41-UN-SW26 F	41-UN-SW27 F	41-UN-SW28 F
Laboratory Sample ID:		AB7589	AB7588	AB7587	AB7586	AB7585	AB7584	AB7583
Date Sampled:		08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94
	UNITS							
Arsenic	UG/L	2.6	ND	2.8	ND	ND	ND	2.9
Barium	UG/L	79.5	73	75.1	80.5	21	25.1	22.3
Calcium	UG/L	106000	154000	144000	115000	44400	49200	47000
Cobalt	UG/L	ND	ND	15.7	ND	ND	ND	ND
Copper	UG/L	ND	11.2	17.8	18.9	23.8	18.7	17.7
Iron	UG/L	6110	8170	12800	11300	498	1210	783
Lead	UG/L	ND	ND	ND	ND	ND	ND	2.4
Magnesium	UG/L	14200	13400	12200	11200	2020	2630	2290
Manganese	UG/L	1360	1170	1230	972	21.2	88.8	47.4
Potassium	UG/L	9670	6020	4820	3670	2150	1770	1840
Sodium	UG/L	38100	65900	76800	58800	14900	17700	16000
Zinc	UG/L	8.9	6.4	9.5	10.2	13	14.1	11.2

UG/L - micrograms per liter
ND - not detected

TABLE 4-25

COMPARISON OF INORGANIC LEVELS IN SURFACE WATER
AT SITE 41 DURING FIRST SAMPLING EVENT
TO BASE UPGRADIENT LEVELS
REMEDIAL INVESTIGATION - CTO - 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 41 (µg/L)	Base Upgradient (µg/L)
Aluminum	178 - 3,390	178 - 1,350
Barium	17.9 - 113	13.4 - 27.2
Calcium	9,980 - 84,200	600 - 41,600
Chromium	8.52 - 8.52	ND
Iron	4.69 - 14,100	413 - 1,460
Lead	1.13 - 12.1	1.17 - 10.4
Magnesium	1,550 - 12,700	588 - 2,410
Manganese	12.3 - 209	6.2 - 40
Mercury	0.101 - 0.101	0.52 - 0.52
Potassium	923 - 10,200	341 - 2,210
Sodium	4,760 - 23,600	3,930 - 22,100
Zinc	16.3 - 33.2	18 - 111

ND = Nondetect

TABLE 4-26

COMPARISON OF TOTAL METAL LEVELS IN SURFACE WATER AT SITE 41
DURING SECOND SAMPLING EVENT TO BASE UPGRADIENT LEVELS
REMEDIAL INVESTIGATION - CTO - 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 41 (µg/L)	Base Upgradient (µg/L)
Aluminum	76.6 - 17,800	178 - 1,350
Arsenic	2.2 - 30.2	ND
Barium	18.4 - 442	13.4 - 27.2
Cadmium	6.2 - 6.2	3 - 3
Calcium	20,100 - 165,000	600 - 41,600
Cobalt	19.6 - 43.9	8 - 8
Copper	13.3 - 41.2	4 - 129
Iron	649 - 278,000	413 - 1,460
Lead	1.52 - 36.8	1.17 - 10.4
Magnesium	1,850 - 12,700	588 - 2,410
Manganese	17.5 - 1,700	6.2 - 40
Mercury	0.101 - 0.56	0.52 - 0.52
Nickel	20 - 20	1,380 - 1,380
Potassium	1,620 - 13,400	341 - 2,210
Sodium	573 - 67,600	3,930 - 22,100
Vanadium	35.4 - 51.5	1.9 - 1.0
Zinc	21.4 - 235	18 - 111

ND = Nondetect

TABLE 4-27
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-UN-SD01-06	41-UN-SD01-612	41-UN-SD02-06	41-UN-SD02-612	41-UN-SD03-06	41-UN-SD03-612
Laboratory Sample ID:		9402062-03	9402062-04	9402066-01A	9402066-02A	9402041-01	9402041-03
Date Sampled:		2/4/94	2/4/94			2/1/94	2/1/94
Percent Solids		73.5	75.5	78.8	78.8	74.9	72.9
	UNITS						
SEMIVOLATILES							
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	95.0 J	49.0 J	ND	ND	ND	310.0 J
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND
VOLATILES							
Methylene chloride	UG/KG	ND	ND	ND	ND	2.00 J	3.00 J
Acetone	UG/KG	40.0	ND	ND	ND	51.0 J	80.0 J
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS							
Dieldrin	UG/KG	1.35 NJ	1.08 NJ	1.21 J	ND	0.830 NJ	ND
4,4'-DDE	UG/KG	4.66	4.90 J	ND	ND	3.05 J	3.98 J
Endosulfan II	UG/KG	0.800 NJ	ND	0.96 NJ	0.76 NJ	0.640 NJ	ND
4,4'-DDD	UG/KG	2.77 J	12.7 J	ND	1.59 J	3.73 J	15.3 J
4,4'-DDT	UG/KG	ND	0.810 NJ	1.36 NJ	2.58 J	1.26 J	1.25 J
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	1.38 J	1.15 J	ND	ND	0.820 J	0.340 J
gamma-Chlordane	UG/KG	1.43 J	1.35 J	ND	ND	0.920 J	0.440 J
Aroclor 1248	UG/KG	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND
ORDNANCE							
1,3,5-Trinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative value
R - rejected

TABLE 4-27
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-UN-SD04-06	41-UN-SD04-612	41-NE-SD05-06	41-NE-SD05-612	41-UN-SD10-06	41-UN-SD10-612
Laboratory Sample ID:		9402041-05	9402041-06	9402091-01A	9402091-02A	9402020-01	9402020-02
Date Sampled:		2/1/94	2/1/94				
Percent Solids		78.1	77.1	77.5	78.9	43.8	56
	UNITS						
SEMIVOLATILES							
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	65 J	44 J	89 J	94 J
di-n-Butylphthalate	UG/KG	ND	ND	59 J	65 J	370 J	240 J
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND
VOLATILES							
Methylene chloride	UG/KG	2.00 J	3.00 J	6 J	7 J	ND	ND
Acetone	UG/KG	ND	150.0 J	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS							
Dieldrin	UG/KG	0.460 NJ	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	2.07 J	1.34 J	1.27 J	ND	29 J	31.3 J
Endosulfan II	UG/KG	ND	ND	ND	ND	2.13 NJ	ND
4,4'-DDD	UG/KG	3.95 J	1.70 J	1.09 J	ND	23.1 J	73.9 J
4,4'-DDT	UG/KG	ND	ND	0.36 NJ	ND	4.51 J	5.96 J
Methoxychlor	UG/KG	ND	ND	ND	ND	3.2 J	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	0.410 J	ND	ND	ND	3.72 J	1.81 J
gamma-Chlordane	UG/KG	0.400 J	ND	ND	ND	6.35 J	1.45 J
Aroclor 1248	UG/KG	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND
ORDNANCE							
1,3,5-Trinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimat[illegible]tive value
R - rejected

TABLE 4-27
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-UN-SD11-06	41-UN-SD11-612	41-UN-SD12-612	41-UN-SD13-06	41-UN-SD13-612	41-UN-SD14-06
Laboratory Sample ID:		9402062-01	9402062-02	9402066-04A	9402053-05	9402053-06	9402053-01
Date Sampled:		2/4/94	2/4/94		2/3/94	2/3/94	2/3/94
Percent Solids		77.1	79.6	81.5	45.8	52.9	62.7
	UNITS						
SEMIVOLATILES							
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND
VOLATILES							
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	ND	ND	ND	130.0	25.0	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS							
Dieldrin	UG/KG	ND	ND	ND	6.39 NJ	5.19 NJ	2.07 NJ
4,4'-DDE	UG/KG	ND	ND	ND	14.3	14.9 J	4.04 J
Endosulfan II	UG/KG	ND	ND	ND	5.90 J	3.44 NJ	8.22 J
4,4'-DDD	UG/KG	ND	ND	ND	7.69 J	10.5 J	5.90 J
4,4'-DDT	UG/KG	0.430 NJ	ND	ND	4.78 J	9.64 J	2.29 J
Methoxychlor	UG/KG	ND	ND	1.93 J	ND	ND	ND
Endrin ketone	UG/KG	ND	0.660 NJ	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	2.56 J	3.09 J	1.39 NJ
gamma-Chlordane	UG/KG	ND	ND	ND	2.00 J	2.44 J	1.00 NJ
Aroclor 1248	UG/KG	ND	ND	ND	63.0 J	140.0 J	ND
Aroclor 1254	UG/KG	ND	ND	ND	68.0 J	ND	ND
ORDNANCE							
1,3,5-Trinitrobenzene	UG/KG	ND	ND	ND	ND	ND	1390.0

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative value
R - rejected

TABLE 4-27
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-UN-SD14-612	41-UN-SD20	41-UN-SD23	41-UN-SD25	41-UN-SD26	41-UN-SD28	41-TC-SD06-06
Laboratory Sample ID:		9402053-02	AB7522	AB7513	AB7507	AB7504	AB7498	9402082-05A
Date Sampled:		2/3/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	2/6/94
Percent Solids		63.6	82	42.4	19.7	80.6	74.8	65.0
	UNITS							
SEMIVOLATILES								
Benzo[a]pyrene	UG/KG	ND	NA	NA	NA	NA	NA	57.0 J
Benzo[b]fluoranthene	UG/KG	ND	NA	NA	NA	NA	NA	69.0 J
Benzo[k]fluoranthene	UG/KG	ND	NA	NA	NA	NA	NA	58.0 J
bis(2-Ethylhexyl)phthalate	UG/KG	ND	NA	NA	NA	NA	NA	ND
di-n-Butylphthalate	UG/KG	ND	NA	NA	NA	NA	NA	ND
di-n-Octylphthalate	UG/KG	ND	NA	NA	NA	NA	NA	ND
Fluoranthene	UG/KG	ND	NA	NA	NA	NA	NA	100.0 J
Pyrene	UG/KG	ND	NA	NA	NA	NA	NA	100.0 J
VOLATILES								
Methylene chloride	UG/KG	ND	NA	NA	NA	NA	NA	ND
Acetone	UG/KG	ND	NA	NA	NA	NA	NA	51.0
Trichloroethene	UG/KG	2.00 J	NA	NA	NA	NA	NA	ND
Toluene	UG/KG	ND	NA	NA	NA	NA	NA	2.00 J
PESTICIDE/PCBS								
Dieldrin	UG/KG	1.57 NJ	ND	ND	ND	ND	ND	2.50 J
4,4'-DDE	UG/KG	2.91 NJ	18	ND	19	ND	7.8	ND
Endosulfan II	UG/KG	3.57 J	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	6.68 J	27	17	ND	4.2	42	1.24 NJ
4,4'-DDT	UG/KG	1.58 NJ	210	ND	ND	5.8	ND	2.00 J
Methoxychlor	UG/KG	2.22 NJ	ND	ND	ND	ND	ND	ND
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	0.980 J	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND	ND
ORDNANCE								
1,3,5-Trinitrobenzene	UG/KG	ND	NA	NA	NA	NA	NA	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]ected
NJ - estimat[illegible]ative value
R - rejected

TABLE 4-27
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-TC-SD06-612	41-TC-SD07-06	41-TC-SD07-612	41-TC-SD08-06	41-TC-SD08-612	41-TC-SD09-06
Laboratory Sample ID:		9402082-06A	9402079-01A	9402079-02A	9402082-01A	9402082-02A	9402082-03A
Date Sampled:		2/6/94	2/7/94	2/7/94	2/6/94	2/6/94	2/6/94
Percent Solids		70.2	76.6	73.9	70.6	58.2	25.2
	UNITS						
SEMIVOLATILES							
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	47.0 J	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	48.0 J	56.0 J	ND	ND
di-n-Octylphthalate	UG/KG	ND	ND	ND	ND	ND	ND
Fluoranthene	UG/KG	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND
VOLATILES							
Methylene chloride	UG/KG	ND	7.00 J	6.00 J	ND	ND	ND
Acetone	UG/KG	ND	ND	ND	4.00 J	44.0	190.0
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	2.00 J	ND	ND	ND	ND
PESTICIDE/PCBS							
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	1.28 NJ	ND	ND	0.530 J	ND	11.2 NJ
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	12.6 J	ND	ND	0.380 NJ	ND	63.3 J
4,4'-DDT	UG/KG	34.8 J	ND	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	1.38 J	0.910 J	ND	21.7 J
Endrin ketone	UG/KG	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	2.01 J	ND	ND	ND	ND	3.48 J
gamma-Chlordane	UG/KG	0.990 NJ	ND	ND	ND	ND	ND
Aroclor 1248	UG/KG	ND	ND	ND	ND	ND	ND
Aroclor 1254	UG/KG	ND	ND	ND	ND	ND	ND
ORDNANCE							
1,3,5-Trinitrobenzene	UG/KG	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative value
R - rejected

TABLE 4-27
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		41-TC-SD09-612
Laboratory Sample ID:		9402082-04A
Date Sampled:		2/6/94
Percent Solids		39.4
	UNITS	
SEMIVOLATILES		
Benzo[a]pyrene	UG/KG	ND
Benzo[b]fluoranthene	UG/KG	ND
Benzo[k]fluoranthene	UG/KG	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND
di-n-Butylphthalate	UG/KG	ND
di-n-Octylphthalate	UG/KG	ND
Fluoranthene	UG/KG	ND
Pyrene	UG/KG	ND
VOLATILES		
Methylene chloride	UG/KG	ND
Acetone	UG/KG	150.0
Trichloroethene	UG/KG	ND
Toluene	UG/KG	ND
PESTICIDE/PCBS		
Dieldrin	UG/KG	8.46 R
4,4'-DDE	UG/KG	8.46 R
Endosulfan II	UG/KG	8.46 R
4,4'-DDD	UG/KG	8.46 R
4,4'-DDT	UG/KG	8.46 R
Methoxychlor	UG/KG	43.6 R
Endrin ketone	UG/KG	8.46 R
alpha-Chlordane	UG/KG	4.36 R
gamma-Chlordane	UG/KG	4.36 R
Aroclor 1248	UG/KG	84.6 R
Aroclor 1254	UG/KG	84.6 R
ORDNANCE		
1,3,5-Trinitrobenzene	UG/KG	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated tentative value
R - rejected

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SD01-06	41-UN-SD01-612	41-UN-SD02-06	41-UN-SD02-612	41-UN-SD03-06	41-UN-SD03-612
Laboratory Sample ID:		9402062-03	9402062-04	9402066-01A	9402066-02A	9402041-01	9402041-03
Date Sampled:		2/4/94	2/4/94			2/1/94	2/1/94
Percent Solids		73.5	75.5	78.8	78.8	74.9	72.9
	UNITS						
Aluminum	MG/KG	1720	2780	466 J	670 J	623	654
Arsenic	MG/KG	ND	ND	ND	ND	ND	ND
Barium	MG/KG	5.24	7.66	3.5	5.5	4.07	ND
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	1250	1660	157 J	208 J	409	308
Chromium	MG/KG	ND	ND	ND	ND	ND	ND
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND
Iron	MG/KG	924 J	1160 J	290 J	439 J	567 J	487 J
Lead	MG/KG	13.8 J	12.6 J	3.79	3.26	4.07 J	4.70 J
Magnesium	MG/KG	62.5	59.4	20.5	ND	28.2	32.1
Manganese	MG/KG	2.94	2.67	10.1 J	1.93 J	2.27	1.99
Mercury	MG/KG	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	5.97	3.79	ND	ND	ND	4.57
Potassium	MG/KG	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	0.651 J	ND	ND	0.809 J
Silver	MG/KG	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	73.6 J	ND	117	ND	ND	ND
Thallium	MG/KG	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	ND	ND	ND
Zinc	MG/KG	ND	ND	ND	ND	ND	ND

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R - rejected

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SD04-06	41-UN-SD04-612	41-NE-SD05-06	41-NE-SD05-612	41-UN-SD10-06	41-UN-SD10-612
Laboratory Sample ID:		9402041-05	9402041-06	9402091-01A	9402091-02A	9402020-01	9402020-02
Date Sampled:		2/1/94	2/1/94				
Percent Solids		78.1	77.1	77.5	78.9	43.8	56
	UNITS						
Aluminum	MG/KG	613	371	437 J	351 J	6400 J	3380 J
Arsenic	MG/KG	ND	ND	ND	ND	ND	0.981
Barium	MG/KG	ND	ND	ND	ND	21.9	17.3
Beryllium	MG/KG	ND	ND	ND	ND	0.413	ND
Calcium	MG/KG	177	96.4	314 J	216 J	2000	1170
Chromium	MG/KG	ND	ND	2.42 J	ND	6.85	3.72
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND
Iron	MG/KG	343 J	267 J	354 J	262 J	4760 J	4410 J
Lead	MG/KG	5.49 J	4.20 J	1.94	2.19	33.1	19.9
Magnesium	MG/KG	25.2	15.3	21.5	ND	844	439
Manganese	MG/KG	1.38	ND	1.96 J	ND	17.3 J	14.5 J
Mercury	MG/KG	ND	ND	ND	ND	0.114 R	0.089 R
Nickel	MG/KG	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	1.14	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	117	632	421
Thallium	MG/KG	ND	1.19 J	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	ND	9.72	ND
Zinc	MG/KG	ND	ND	ND	13.6	40.2	28.1

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R - [illegible]ed

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SD11-06	41-UN-SD11-612	41-UN-SD12-06	41-UN-SD12-612	41-UN-SD13-06	41-UN-SD13-612
Laboratory Sample ID:		9402062-01	9402062-02	9402066-03A	9402066-04A	9402053-05	9402053-06
Date Sampled:		2/4/94	2/4/94			2/3/94	2/3/94
Percent Solids		77.1	79.6	80.1	81.5	45.8	52.9
	UNITS						
Aluminum	MG/KG	1790	1240	674 J	675 J	5890	6230
Arsenic	MG/KG	ND	ND	0.617	ND	1.81	1.97
Barium	MG/KG	8.02	4.76	ND	3.06	18.0	20.3
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	341	129	188 J	126 J	3970	3320
Chromium	MG/KG	ND	ND	2.95 J	ND	11.9	13.8
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	7.34	8.34
Iron	MG/KG	1070 J	524 J	2920 J	969 J	10400 J	12200 J
Lead	MG/KG	9.30 J	4.47 J	1.13	1.62	59.4 J	58.9 J
Magnesium	MG/KG	69.1	47.5	28.7	20.4	450	563
Manganese	MG/KG	ND	ND	6.93 J	2.47 J	28.0	21.9
Mercury	MG/KG	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	4.17	4.48	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	332	485
Selenium	MG/KG	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	1.20	ND	ND	29.7	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND
Thallium	MG/KG	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	ND	10.9	11.8
Zinc	MG/KG	ND	ND	ND	ND	56.9	76.1

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R - rejected

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SD14-06	41-UN-SD14-612	41-UN-SD15	41-UN-SD16	41-UN-SD17	41-UN-SD18	41-UN-SD19
Laboratory Sample ID:		9402053-01	9402053-02	AB7538	AB7535	AB7532	AB7529	AB7526
Date Sampled:		2/3/94	2/3/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94
Percent Solids		62.7	63.6	65.4	85.5	81.7	68.8	81.4
	UNITS							
Aluminum	MG/KG	9000	5000	5140	456	664	596	276
Arsenic	MG/KG	1.08	ND	2.8	ND	ND	ND	ND
Barium	MG/KG	20.0	12.8	9.4	1.4	2.7	2.9	1.5
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	561	377	416	107	48.6	610	538
Chromium	MG/KG	11.2	7.04	6.5	ND	ND	ND	2.3
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	4850 J	3410 J	4390	691	714	952	391
Lead	MG/KG	18.6 J	6.84 J	22.2	1.9	1.5	3.5	2.7
Magnesium	MG/KG	317	175	180	24.2	29.6	30.9	25.5
Manganese	MG/KG	8.38	4.29	6.2	1.3	1.4	3.1	1.7
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	6.12	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	41	32.6	29.8	34.3	43
Thallium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	10.1	ND	10.4	ND	ND	ND	ND
Zinc	MG/KG	15.4	ND	15.7	12.8	5.5	9.5	19.8

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R[illegible]ed

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SD20	41-UN-SD21	41-UN-SD22	41-UN-SD23	41-UN-SD24	41-UN-SD25	41-UN-SD26	41-UN-SD27
Laboratory Sample ID:		AB7523	AB7520	AB7517	AB7514	AB7511	AB7508	AB7505	AB7502
Date Sampled:		08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94	08/23/94
Percent Solids		82	80	55	42.4	69.2	19.7	80.6	80.2
	UNITS								
Aluminum	MG/KG	827	525	830	2820	1170	10200	988	355
Arsenic	MG/KG	ND	ND	3.8	2.5	ND	9.3	ND	ND
Barium	MG/KG	2.8	2.2	11.8	22.8	6.4	161	4.5	2.4
Beryllium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	531	601	2310	7530	884	8420	683	307
Chromium	MG/KG	ND	ND	ND	ND	2.8	ND	ND	ND
Cobalt	MG/KG	ND	ND	ND	ND	2.8	ND	ND	ND
Copper	MG/KG	ND	ND	ND	6.3	ND	19.9	ND	ND
Iron	MG/KG	601	400	4510	36800	1300	104000	510	322
Lead	MG/KG	5	3.4	6.9	13.5	3.5	28.1	3.8	1.7
Magnesium	MG/KG	35.8	29.7	138	154	68.3	321	42.6	27.1
Manganese	MG/KG	2.7	1.7	97.3	306	10.2	180	1.9	1.9
Mercury	MG/KG	0.46	ND	ND	0.63	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	54.3	40.3	171	363	80.9	410	44.6	37.3
Thallium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	9.3	3.5	30	ND	ND
Zinc	MG/KG	17.6	25	42.4	86.7	22.8	155	30.7	18.5

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R - rejected

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-UN-SD28	41-TC-SD06-06	410TC-SD06-612	41-TC-SD07-06	41-TC-SD07-612	41-TC-SD08-06
Laboratory Sample ID:		AB7499	9402082-05A	9402082-06A	9402079-01A	9402079-02A	9402082-01A
Date Sampled:		08/23/94	2/6/94	2/6/94	2/7/94	2/7/94	2/6/94
Percent Solids		74.8	65.0	70.2	76.6	73.9	70.6
	UNITS						
Aluminum	MG/KG	394	2580 J	6600 J	406 J	1270 J	1790 J
Arsenic	MG/KG	ND	0.702	0.864	ND	ND	ND
Barium	MG/KG	2.6	13.5	25.3	4.52	10.4	12.5
Beryllium	MG/KG	ND	ND	0.377	ND	0.235	ND
Calcium	MG/KG	238	1090 J	1230 J	96.3 J	440 J	480 J
Chromium	MG/KG	ND	3.42 J	8.72 J	ND	ND	ND
Cobalt	MG/KG	ND	ND	ND	ND	ND	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND
Iron	MG/KG	300	2840 J	6030 J	434 J	1390 J	1580 J
Lead	MG/KG	1.7	18.7	13.6	1.10	2.34	4.23
Magnesium	MG/KG	27.7	99.8	235	19.1	50.7	61
Manganese	MG/KG	2.2	8.72 J	13.7 J	ND	5.75 J	7.08 J
Mercury	MG/KG	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	381	ND	ND	ND
Selenium	MG/KG	ND	ND	0.862 J	0.629 J	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	45.8	347	ND	ND	ND	ND
Thallium	MG/KG	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	12.7	ND	ND	ND
Zinc	MG/KG	19.9	18.0	19.9	ND	ND	ND

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R - [illegible]

TABLE 4-28
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
UNNAMED TRIBUTARY AND TANK CREEK SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		41-TC-SD08-612	41-TC-SD09-06	41-TC-SD09-612
Laboratory Sample ID:		9402082-02A	9402082-03A	9402082-04A
Date Sampled:		2/6/94	2/6/94	2/6/94
Percent Solids		58.2	25.2	39.4
	UNITS			
Aluminum	MG/KG	6440 J	18800 J	16700 J
Arsenic	MG/KG	ND	3.67	1.68
Barium	MG/KG	33.4	79.9	71.9
Beryllium	MG/KG	ND	1.02	0.744
Calcium	MG/KG	810 J	4790 J	3620 J
Chromium	MG/KG	7.61 J	16.5 J	14.7 J
Cobalt	MG/KG	ND	ND	ND
Copper	MG/KG	ND	ND	ND
Iron	MG/KG	2960 J	15100 J	7470 J
Lead	MG/KG	7.54	28.7	17.1
Magnesium	MG/KG	172	1590	1060
Manganese	MG/KG	8.26 J	46.4 J	31.9 J
Mercury	MG/KG	ND	ND	ND
Nickel	MG/KG	ND	ND	ND
Potassium	MG/KG	ND	1060	916
Selenium	MG/KG	ND	ND	ND
Silver	MG/KG	ND	ND	ND
Sodium	MG/KG	158	1430	1480
Thallium	MG/KG	ND	ND	ND
Vanadium	MG/KG	9.86	28.6	20.2
Zinc	MG/KG	12.8	85.3	24.1

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected
R - rejected

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB01-00	74-FDA-SB02-00	74-FDA-SB03-00	74-FDA-SB04-00	74-FDA-SB05-00	74-FDA-SB06-00	74-FDA-SB07-00
Laboratory Sample ID:		9401109-01	9401109-04	9401108-01	9401108-10	9401108-13	9401116-01A	9401116-05A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/19/94	01/19/94	01/19/94	01/20/94	01/20/94	01/20/94	01/20/94
Percent Solids:		85.4	78.5	86.0	83.9	88.0	82.6	89.2
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	180 J	ND	48.0 J	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	75.0 J	85.0 J	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	8.00 J	16.0 J	13 J	ND
Acetone	UG/KG	ND	ND	ND	27.0 J	210.0 J	23 J	110 J
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	6.00 J	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	0.41 NJ	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	2.45 J	2.85 J	ND	4.79 J	ND	0.31 J	0.57 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB01-00	74-FDA-SB02-00	74-FDA-SB03-00	74-FDA-SB04-00	74-FDA-SB05-00	74-FDA-SB06-00	74-FDA-SB07-00
Laboratory Sample ID:		9401109-01	9401109-04	9401108-01	9401108-10	9401108-13	9401116-01A	9401116-05A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/19/94	01/19/94	01/19/94	01/20/94	01/20/94	01/20/94	01/20/94
Percent Solids:		85.4	78.5	86.0	83.9	88.0	82.6	89.2
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	2.44 J	ND	ND	ND
4,4'-DDT	UG/KG	ND	4.87 J	ND	3.46 J	1.96 J	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible] ected
NJ - estimated/t[illegible] e identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB08-00	74-FDA-SB09-00	74-FDA-SB10-00	74-FDA-SB11-00	74-FDA-SB12-00	74-FDA-SB13-00	74-FDA-SB14-00
Laboratory Sample ID:		9401116-08A	9401116-11A	9401116-14A	9401121-01A	9401121-05A	9401121-08A	9401121-11A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/20/94	01/21/94	01/21/94	01/21/94	01/21/94	01/21/94	01/22/94
Percent Solids:		84.4	83	82.7	90.1	84.3	87.5	81
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	51 J	ND	ND	ND	12 J	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	240 J
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	4 J	ND	8 J	18
Acetone	UG/KG	46 J	ND	33 J	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	ND	ND	4 J	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	3 J	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	3 J	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	30.2 J	ND	ND	ND	ND	ND	1.68 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB08-00	74-FDA-SB09-00	74-FDA-SB10-00	74-FDA-SB11-00	74-FDA-SB12-00	74-FDA-SB13-00	74-FDA-SB14-00
Laboratory Sample ID:		9401116-08A	9401116-11A	9401116-14A	9401121-01A	9401121-05A	9401121-08A	9401121-11A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/20/94	01/21/94	01/21/94	01/21/94	01/21/94	01/21/94	01/22/94
Percent Solids:		84.4	83	82.7	90.1	84.3	87.5	81
	<u>UNITS</u>							
<u>PESTICIDE/PCBS Cont.</u>								
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	13.3 J	ND	ND	2.53 J	ND	ND	ND
4,4'-DDT	UG/KG	24.3 J	ND	ND	ND	0.96 NJ	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
<u>CHEMICAL SURETY</u>								
Hydroxyacetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]cted
NJ - estimated/te[illegible]e identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB15-00	74-FDA-SB16-00	74-FDA-SB17-00	74-FDA-SB18-00	74-FDA-SB19-00	74-FDA-SB20-00	74-FDA-SB21-00
Laboratory Sample ID:		9401132-02	9401132-05	9401132-08	9401132-11	9401132-14	9401132-17	9401138-03
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/22/94	1/22/94	01/22/94	01/22/94	01/22/94	01/22/94	01/23/94
Percent Solids:		89.4	88.4	81.6	83.5	87.7	90.6	89.8
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	240 J	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	59 J	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	7 J	6 J	5 J	7 J	ND
Acetone	UG/KG	ND	ND	23 J	ND	ND	ND	ND
Trichloroethene	UG/KG	ND	2 J	ND	8 J	ND	3 J	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	2.07 NJ	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	0.69 J	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	1.66 J	ND	ND	1.23 J	ND	2.39 J	ND
Endrin	UG/KG	0.42 J	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB15-00	74-FDA-SB16-00	74-FDA-SB17-00	74-FDA-SB18-00	74-FDA-SB19-00	74-FDA-SB20-00	74-FDA-SB21-00
Laboratory Sample ID:		9401132-02	9401132-05	9401132-08	9401132-11	9401132-14	9401132-17	9401138-03
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/22/94	1/22/94	01/22/94	01/22/94	01/22/94	01/22/94	01/23/94
Percent Solids:		89.4	88.4	81.6	83.5	87.7	90.6	89.8
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	0.37 NJ	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	1.82 J	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	1.07 NJ
alpha-Chlordane	UG/KG	0.39 J	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	0.45 J	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]cted
NJ - estimated/te[illegible] identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB22-00	74-FDA-SB23-00	74-FDA-SB24-00	74-FDA-SB25-00	74-FDA-SB26-00	74-FDA-SB27-00	74-FDA-SB28-00
Laboratory Sample ID:		9401138-06	9401138-10	9401140-01	9401140-04	9401135-01A	9401148-01A	9401148-07A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/23/94	01/23/94	01/24/94	01/24/94	01/24/94	01/24/94	01/24/94
Percent Solids:		86.6	86.6	89.1	84.8	88	88.1	88
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	130 J	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	61 J	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	103 J	39 J	ND	ND	46 J	107 J	54 J
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	7 J	ND	ND	ND	7 J	5 J	9 J
Acetone	UG/KG	ND	ND	ND	ND	ND	5 J	6 J
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	0.45 J	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	31 J	3.47 J	ND	0.72 J	ND	2.36 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB22-00	74-FDA-SB23-00	74-FDA-SB24-00	74-FDA-SB25-00	74-FDA-SB26-00	74-FDA-SB27-00	74-FDA-SB28-00
Laboratory Sample ID:		9401138-06	9401138-10	9401140-01	9401140-04	9401135-01A	9401148-01A	9401148-07A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/23/94	01/23/94	01/24/94	01/24/94	01/24/94	01/24/94	01/24/94
Percent Solids:		86.6	86.6	89.1	84.8	88	88.1	88
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	0.44 NJ
4,4'-DDD	UG/KG	ND	67.3 J	ND	ND	ND	ND	1.8 J
4,4'-DDT	UG/KG	ND	ND	1.03 J	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	16.3 J	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	15.3 J	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	ND	ND	ND	190 J	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]cted
NJ - estimated/te[illegible]e identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB29-00	74-FDA-SB30-00	74-FDA-SB31-00	74-FDA-SB32-00	74-FDA-SB33-00	74-FDA-SB34-00	74-FDA-SB35-00
Laboratory Sample ID:		9401148-04A	9401148-10A	9401148-13A	9401148-16A	9401108-04	9401108-06	9401108-07
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/25/94	01/25/94	01/25/94	01/25/94	01/19/94	01/19/94	01/19/94
Percent Solids:		87.4	91.3	88	90	86.7	83.2	93.6
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	160 J	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	82 J	42 J	96 J	100 J	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	6 J	ND	ND	23.0 J	7.00 J	ND
Acetone	UG/KG	ND	6 J	ND	ND	53.0 J	25.0 J	ND
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	0.65 J	ND	0.20 NJ
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	1.15 NJ	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	ND	ND	ND	11.01 J	1.410 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB29-00	74-FDA-SB30-00	74-FDA-SB31-00	74-FDA-SB32-00	74-FDA-SB33-00	74-FDA-SB34-00	74-FDA-SB35-00
Laboratory Sample ID:		9401148-04A	9401148-10A	9401148-13A	9401148-16A	9401108-04	9401108-06	9401108-07
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/25/94	01/25/94	01/25/94	01/25/94	01/19/94	01/19/94	01/19/94
Percent Solids:		87.4	91.3	88	90	86.7	83.2	93.6
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	0.92 J	0.41 J
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	6.23 J	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]cted
NJ - estimated/ten[illegible]ve identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB36-00	74-FDA-SB37-00	74-PDA-SB01-00	74-PDA-SB04-00	74-PDA-SB06-00	74-PDA-SB07-00	74-PDA-SB08-00
Laboratory Sample ID:		9401108-08	9401108-09	9402181-01	9402181-10	9402182-04	9402179-03	9402182-08
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/19/94	01/19/94	02/19/94	02/19/94	02/19/94	02/20/94	02/19/94
Percent Solids:		84.6	87.2	90.8	82.1	73	94.3	92.8
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	54 J	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	39 J	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	866	ND	ND	86 J
di-n-Butylphthalate	UG/KG	83.0 J	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	38 J	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	7.00 J	9.00 J	ND	ND	ND	ND	ND
Acetone	UG/KG	49.0 J	14.0 J	ND	ND	36	ND	9 J
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	2.0 J	ND	ND	ND	ND	1 J
Styrene	UG/KG	ND	1.0 J	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	0.57 NJ	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	0.720 NJ	1.190 J	ND	1.47 J	523 J	8.36 J	2.28 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FDA-SB36-00	74-FDA-SB37-00	74-PDA-SB01-00	74-PDA-SB04-00	74-PDA-SB06-00	74-PDA-SB07-00	74-PDA-SB08-00
Laboratory Sample ID:		9401108-08	9401108-09	9402181-01	9402181-10	9402182-04	9402179-03	9402182-08
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/19/94	01/19/94	02/19/94	02/19/94	02/19/94	02/20/94	02/19/94
Percent Solids:		84.6	87.2	90.8	82.1	73	94.3	92.8
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	0.93 J	3700 J	ND	1.67 J
4,4'-DDT	UG/KG	ND	ND	ND	2.33 J	1119 J	4.86 J	3.03 J
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	UG/KG	ND	ND	ND	ND	ND	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	ND	ND	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/[illegible]e identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-PDA-SB09-00	74-PDA-SB11-00	74-PDA-SB12-00	74-PDA-SB13-00	74-PDA-SB14-00	74-PDA-SB15-00	74-FPA-SB01-00
Laboratory Sample ID:		9402179-06	9401133-02	9401133-03	9401133-01	9401134-01	9401134-02	9402179-12
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/20/94	01/24/94	01/24/94	01/24/94	01/24/94	01/24/94	02/21/94
Percent Solids:		94.1	89.8	90	86.3	88.6	83.1	89.7
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	6 J	ND	ND	ND	ND
Acetone	UG/KG	16 J	ND	4 J	ND	ND	ND	34 J
Trichloroethene	UG/KG	ND	3 J	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	ND	ND	ND	298 J	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	0.32 J	ND	706 NJ	ND	ND	ND
4,4'-DDE	UG/KG	ND	1.56 J	ND	1730 J	ND	0.91 J	11.6 J
Endrin	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-PDA-SB09-00	74-PDA-SB11-00	74-PDA-SB12-00	74-PDA-SB13-00	74-PDA-SB14-00	74-PDA-SB15-00	74-FPA-SB01-00
Laboratory Sample ID:		9402179-06	9401133-02	9401133-03	9401133-01	9401134-01	9401134-02	9402179-12
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/20/94	01/24/94	01/24/94	01/24/94	01/24/94	01/24/94	02/21/94
Percent Solids:		94.1	89.8	90	86.3	88.6	83.1	89.7
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	ND	ND	ND	0.76 NJ	ND	ND
4,4'-DDD	UG/KG	ND	0.98 NJ	ND	ND	ND	ND	2.62 J
4,4'-DDT	UG/KG	ND	1.02 NJ	ND	3840 J	ND	4.22 J	7.2 J
Methoxychlor	UG/KG	ND	ND	ND	166 J	ND	ND	ND
Endrin aldehyde	UG/KG	ND	0.5 NJ	ND	ND	2.29 NJ	ND	ND
alpha-Chlordane	UG/KG	ND	0.44 J	ND	1160 J	ND	ND	ND
gamma-Chlordane	UG/KG	ND	0.79 J	ND	1680 J	ND	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	N/A	N/A	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - [illegible]ected
NJ - estimated/t[illegible]e identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FPA-SB02-00	74-FPA-SB03-00	74-FPA-SB04-00	74-FPA-SB05-00	74-FPA-SB06-00	74-FPA-SB07-00	74-FPA-SB09-00
Laboratory Sample ID:		9402179-15	9402180-02A	9402179-18	9402180-05A	9402180-08A	9402180-12A	9402180-18A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/21/94	02/21/94	02/21/94	02/20/94	02/20/94	02/20/94	02/20/94
Percent Solids:		92.5	87.5	95.2	93.9	90.9	93.7	90.4
	UNITS							
SEMIVOLATILES								
4-Chloro-3-methylphenol	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	UG/KG	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	126 J	ND	ND	ND	ND	ND	ND
Pyrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	ND	23 J	29	ND	ND	ND	29 J
Trichloroethene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Toluene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Styrene	UG/KG	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	UG/KG	ND	ND	ND	ND	ND	ND	ND
PESTICIDE/PCBS								
alpha-BHC	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor	UG/KG	0.55 J	0.43 J	ND	ND	0.61 J	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	1.43 J	0.21 NJ	ND	ND	ND	ND	ND
Dieldrin	UG/KG	ND	ND	ND	ND	3.07 NJ	ND	ND
4,4'-DDE	UG/KG	60.6 J	69.3 J	ND	ND	107 J	0.67 J	ND
Endrin	UG/KG	ND	0.44 NJ	ND	ND	1.06 J	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - not detected
NJ - estimated/tentative identification

TABLE 4-29
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FPA-SB02-00	74-FPA-SB03-00	74-FPA-SB04-00	74-FPA-SB05-00	74-FPA-SB06-00	74-FPA-SB07-00	74-FPA-SB09-00
Laboratory Sample ID:		9402179-15	9402180-02A	9402179-18	9402180-05A	9402180-08A	9402180-12A	9402180-18A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		02/21/94	02/21/94	02/21/94	02/20/94	02/20/94	02/20/94	02/20/94
Percent Solids:		92.5	87.5	95.2	93.9	90.9	93.7	90.4
	UNITS							
PESTICIDE/PCBS Cont.								
Endosulfan II	UG/KG	ND	1.31 NJ	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	76.8 J	40.7 NJ	ND	ND	9.4 NJ	ND	ND
4,4'-DDT	UG/KG	540 J	71.9 J	ND	ND	212 J	0.81 J	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	1.23 J	ND	ND	2.13 J	ND	ND
alpha-Chlordane	UG/KG	4.35 J	1.44 J	ND	ND	2.55 J	ND	ND
gamma-Chlordane	UG/KG	3.74 J	1.3 J	ND	ND	2.18 J	ND	ND
CHEMICAL SURETY								
Hydroxyacetophenone	UG/KG	N/A	N/A	N/A	N/A	N/A	N/A	N/A

UG/KG - microgram per kilogram
J - value is estimated
NA - not analyzed
ND - n[illegible]cted
NJ - estimated/te[illegible]e identification

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FDA-SB01-00	74-FDA-SB02-00	74-FDA-SB03-00	74-FDA-SB04-00	74-FDA-SB05-00	74-FDA-SB06-00	74-FDA-SB07-00
Laboratory Sample ID:		9401109-01	9401109-04	9401108-01	9401108-10	9401108-13	9401116-01A	9401116-05A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:				01/19/94	01/20/94	01/20/94		
Percent Solids:		85.4	78.5	86.0	83.9	88.0	82.6	89.2
	UNITS							
Aluminum	MG/KG	2590	5210	5230.0	3500.0	6960.0	8040	8020
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	0.702 J	ND
Barium	MG/KG	ND	6.38	7.62	5.12	6.53	5.76	7.48
Cadmium	MG/KG	ND	ND	0.588	ND	0.686	ND	ND
Calcium	MG/KG	36.8	125	ND	154.0	ND	44.6	43.6
Chromium	MG/KG	3.11	4.38	3.89	4.36	6.32	5.91	7.71
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	489	649	870.0 J	1060.0 J	984.0 J	942	2990
Lead	MG/KG	5.53	5.23	3.40 J	4.33 J	2.45 J	5.32	4.03
Magnesium	MG/KG	ND	75.3	73.1	69.7	127.0	138	183
Manganese	MG/KG	1.44	2.96	1.81	2.85	3.70	2.4	2.28
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	98.6	139	129
Selenium	MG/KG	0.752	1.12	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	4.03	5.92	7.29	4.41	7.12	7.37	9.47
Zinc	MG/KG	ND	ND	ND	ND	ND	4.01	3.81
Total Cyanide	MG/KG	1.17	1.27	1.16	1.19	1.14	1.21	1.12

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FDA-SB08-00	74-FDA-SB09-00	74-FDA-SB10-00	74-FDA-SB11-00	74-FDA-SB12-00	74-FDA-SB13-00	74-FDA-SB14-00
Laboratory Sample ID:		9401116-08A	9401116-11A	9401116-14A	9401121-01A	9401121-05A	9401121-08A	9401121-11A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		84.4	83	82.7	90.1	84.3	87.5	81
	UNITS							
Aluminum	MG/KG	4810	5210	4240	4150	10600	5050	4220
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	0.897	1.16	ND	ND
Barium	MG/KG	6.86	10.3	5.11	4.67	10.1	5.43	4.69
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	52.9	382	157	ND	90.8	137	144
Chromium	MG/KG	9.86	4.11	3.42	8.36 J	10 J	2.34 J	2.96 J
Copper	MG/KG	5.56	ND	ND	ND	ND	ND	ND
Iron	MG/KG	34200	754	490	1470 J	5790 J	833 J	435 J
Lead	MG/KG	4.73	4.68	4.62	2.75	3.85	4.86	4.44
Magnesium	MG/KG	78.2	107	65.7	40.2	178	74.2	67.3
Manganese	MG/KG	96.2	3.95	1.83	1.48	2.6	3.26	3.29
Mercury	MG/KG	ND	ND	ND	0.015	ND	0.068	0.075
Nickel	MG/KG	4.78	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	80.7	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	11	6.72	ND	4.95	13.2	4.23	ND
Zinc	MG/KG	7.9	5.16	3.2	8.81	6.83	13.7	4.41
Total Cyanide	MG/KG	1.18	1.2	1.21	1.11	1.19	1.14	1.23

MG/KG - milligram per kilogram
J - value is estimated
ND - n[illegible]cted

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FDA-SB15-00	74-FDA-SB16-00	74-FDA-SB17-00	74-FDA-SB18-00	74-FDA-SB19-00	74-FDA-SB20-00	74-FDA-SB21-00
Laboratory Sample ID:		9401132-02	9401132-05	9401132-08	9401132-11	9401132-14	9401132-17	9401138-03
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		89.4	88.4	81.6	83.5	87.7	90.6	89.8
	UNITS							
Aluminum	MG/KG	8650	8580	4440	4830	6510	10900	4600
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	1	ND	ND	ND	ND	ND	ND
Barium	MG/KG	9.39	8.85	6.05	4.03	5.51	13.3	4.14
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	74.6	109	228	85	111	342	51.7
Chromium	MG/KG	9.82	8.94	4.91	3.99	6.26	9.32	4.4
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	4480	5400	701	830	3060	5040	1110
Lead	MG/KG	5.51	2.8	4.63	3.7	3.79	4.8	2.27 J
Magnesium	MG/KG	151	135	70.5	63.7	112	256	67.5
Manganese	MG/KG	2.7	1.6	2.62	2.12	2.9	6.44	1.99
Mercury	MG/KG	ND	ND	0.09	0.067	ND	0.064	ND
Nickel	MG/KG	3.71	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	155	81.8	ND	ND	ND	226	ND
Selenium	MG/KG	0.726 J	0.609	1.2	0.909	0.834	0.899	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	11.4	10.5	ND	5	7.13	15.1	6.03
Zinc	MG/KG	6.25	3.29	3.56	3.33	3.54	5.28	ND
Total Cyanide	MG/KG	1.12	1.13	1.22	1.2	1.14	1.1	1.11

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FDA-SB22-00	74-FDA-SB23-00	74-FDA-SB24-00	74-FDA-SB25-00	74-FDA-SB26-00	74-FDA-SB27-00	74-FDA-SB28-00
Laboratory Sample ID:		9401138-06	9401138-10	9401140-01	9401140-04	9401135-01A	9401148-01A	9401148-07A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		86.6	86.6	89.1	84.8	88	88.1	88
	UNITS							
Aluminum	MG/KG	8910	6290	5110	3530	707	5950	4050
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	0.764	ND	ND	ND	0.688 J
Barium	MG/KG	10.5	8.08	6.08	5.44	11	7.93	6.96
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	138	309	51900	251	288	527	77100
Chromium	MG/KG	7.68	6.11	5.57	2.61	ND	3.93	5.46
Copper	MG/KG	5.07	7.01	ND	ND	ND	ND	ND
Iron	MG/KG	5400	1880	2840	495	437	2050	2110
Lead	MG/KG	4.45 J	11.8 J	4.23	4.75	10.7	4.47	5.12
Magnesium	MG/KG	179	146	790	ND	29.6	114	1180
Manganese	MG/KG	2.62	4.79	46.9	1.71	4.11	3.07	72.6
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	3.46	4.4	ND	3.15	ND	3.2
Potassium	MG/KG	ND	188	ND	ND	ND	196	250
Selenium	MG/KG	ND	ND	ND	ND	0.705 J	ND	ND
Silver	MG/KG	ND	0.116 J	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	116	134	118	ND	105 J	130 J
Vanadium	MG/KG	12.4	11.8	11	ND	ND	4.09	8.29
Zinc	MG/KG	ND	16	13.8	ND	12.8	4.03	18.9
Total Cyanide	MG/KG	1.15	1.15	1.12	1.18	1.14	1.14	1.14

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible] ected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FDA-SB29-00	74-FDA-SB30-00	74-FDA-SB31-00	74-FDA-SB32-00	74-FDA-SB33-00	74-FDA-SB34-00	74-FDA-SB35-00
Laboratory Sample ID:		9401148-04A	9401148-10A	9401148-13A	9401148-16A	9401108-04	9401108-06	9401108-07
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:						01/19/94	01/19/94	01/19/94
Percent Solids:		87.4	91.3	88	90	86.7	83.2	93.6
	UNITS							
Aluminum	MG/KG	5520	4760	6000	7220	3210.0	997.0	36.3
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	ND	ND
Barium	MG/KG	4.91	3.76	9.26	8.98	4.58	4.20	ND
Cadmium	MG/KG	ND	ND	ND	ND	0.543	ND	ND
Calcium	MG/KG	2460	2960	955	2330	51.2	96.4	ND
Chromium	MG/KG	4.82	2.86	4.98	5.15	2.85	2.02	2.03
Copper	MG/KG	ND	ND	ND	ND	ND	22.0	ND
Iron	MG/KG	784	691	1640	2610	895.0 J	148.0 J	31.2 J
Lead	MG/KG	3.9	3.08	15.4	4.43	6.47 J	4.43 J	0.878 J
Magnesium	MG/KG	154	148	185	148	64.5	23.4	ND
Manganese	MG/KG	4.52	6.42	4.19	3.25	2.50	1.70	2.41
Mercury	MG/KG	ND	ND	0.064	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	198	190	170	140	165.0	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	860	125 J	468	339 J	ND	ND	ND
Vanadium	MG/KG	6.28	ND	7.82	8.19	4.42	ND	ND
Zinc	MG/KG	ND	4.94	7.87	3.76	ND	26.7	ND
Total Cyanide	MG/KG	1.14	1.1	1.14	1.11	1.15	1.20	1.07

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FDA-SB36-00	74-FDA-SB37-00	74-PDA-SB01-00	74-PDA-SB02-00	74-PDA-SB03-00	74-PDA-SB04-00
Laboratory Sample ID:		9401108-08	9401108-09	9402181-01	9402181-04	9402181-07	9402181-10
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:		01/19/94	01/19/94				
Percent Solids:		84.6	87.2	90.8	90.2	74.4	82.1
	UNITS						
Aluminum	MG/KG	298.0	5700.0	4010	2190	1570	3030
Antimony	MG/KG	ND	ND	ND	1.72	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	ND
Barium	MG/KG	12.8	4.06	3.54	ND	4.41	7.67
Cadmium	MG/KG	0.584	ND	ND	ND	ND	ND
Calcium	MG/KG	158.0	ND	442	137	333	433
Chromium	MG/KG	ND	4.39	4.14	3.72	2.59	4.96
Copper	MG/KG	ND	ND	ND	ND	ND	ND
Iron	MG/KG	118.0 J	599.0 J	936	575	405	1630
Lead	MG/KG	3.39 J	4.17 J	2.93 J	2.83	2.39 J	4.18 J
Magnesium	MG/KG	49.0	48.0	65.2	38.1	37.6	81.1
Manganese	MG/KG	1.83	2.06	ND	ND	3.82	4.13
Mercury	MG/KG	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	6.84	ND	ND	ND	ND
Zinc	MG/KG	ND	3.49	ND	ND	ND	ND
Total Cyanide	MG/KG	1.18	1.15	1.1	1.11	1.34	1.22

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-PDA-SB06-00	74-PDA-SB07-00	74-PDA-SB08-00	74-PDA-SB09-00	74-PDA-SB10-00	74-PDA-SB11-00	74-PDA-SB12-00
Laboratory Sample ID:		9402182-04	9402179-03	9402182-08	9402179-06	9402179-09	9401133-02	9401133-03
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		73	94.3	92.8	94.1	92.7	89.8	90
	UNITS							
Aluminum	MG/KG	1120	195	562	451	595	793	3030
Antimony	MG/KG	ND	ND	3.43	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	ND	ND
Barium	MG/KG	3.89	2.89	4.57	ND	3.7	8.14	8
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	91.8	102	390	44.4	62.2	136	112
Chromium	MG/KG	ND	ND	ND	1.89	2.52	ND	2.54
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	330	111	368	454	414	420	1530
Lead	MG/KG	3.07	1.58	5.46	1.69	4.12	7.6 J	4.7 J
Magnesium	MG/KG	ND	ND	19.8	17.4	16.3	21	57.8
Manganese	MG/KG	2.38	1.91	3.6	2.16	1.97	2.5	5.03
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	1.09	0.874
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	ND	ND	ND	4.2
Zinc	MG/KG	3.86	2.27	4.22	2.94	3.28	ND	ND
Total Cyanide	MG/KG	1.37	1.06	1.08	1.06	1.08	1.11	1.11

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-PDA-SB13-00	74-PDA-SB14-00	74-PDA-SB15-00	74-FPA-SB01-00	74-FPA-SB02-00	74-FPA-SB03-00	74-FPA-SB04-00
Laboratory Sample ID:		9401133-01	9401134-01	9401134-02	9402179-12	9402179-15	9402180-02A	9402179-18
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:								
Percent Solids:		86.3	88.6	83.1	89.7	92.5	87.5	95.2
	UNITS							
Aluminum	MG/KG	2860	740	3100	3070	2210	3640	308
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	1.15	ND	ND	ND	0.649	ND	ND
Barium	MG/KG	16.3	ND	13	9.66	54.7	3.35	ND
Cadmium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Calcium	MG/KG	1160	40.4	156	992	175000	ND	34.9
Chromium	MG/KG	2.21	ND	2.87	3.98	10.6	3.95	ND
Copper	MG/KG	ND	ND	ND	ND	ND	ND	ND
Iron	MG/KG	1540	416	1820	1240	2530	466	265
Lead	MG/KG	4.92 J	3.47 J	4.24 J	7.08	13.2	1.71	0.946
Magnesium	MG/KG	60.6	20.7	44.1	102	2790	83.7	ND
Manganese	MG/KG	5.26	2.8	2.82	6.8	32.1	3.42	2.5
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	0.092
Nickel	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	351	ND	ND
Selenium	MG/KG	1.14	0.857	0.615	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	219	ND	ND
Vanadium	MG/KG	5.92	ND	4.1	ND	8.6	ND	ND
Zinc	MG/KG	ND	ND	ND	7.1	33.9	ND	ND
Total Cyanide	MG/KG	1.16	1.13	1.2	1.11	1.08	1.14	1.05

MG/KG - milligram per kilogram
J - value is estimated
ND - n[illegible]ected

TABLE 4-30
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FPA-SB05-00	74-FPA-SB06-00	74-FPA-SB07-00	74-FPA-SB08-00	74-FPA-SB09-00
Laboratory Sample ID:		9402180-05A	9402180-08A	9402180-12A	9402180-15A	9402180-18A
Depth:		0-12"	0-12"	0-12"	0-12"	0-12"
Date Sampled:						
Percent Solids:		93.9	90.9	93.7	89.1	90.4
	UNITS					
Aluminum	MG/KG	290	2780	257	4620	1210
Antimony	MG/KG	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	0.621 J	ND	ND	ND
Barium	MG/KG	8.68	8.45	3.93	3.75	6.58
Cadmium	MG/KG	ND	ND	ND	ND	ND
Calcium	MG/KG	70.6	22000	111	ND	50.3
Chromium	MG/KG	ND	4.7	ND	2.95	2.03
Copper	MG/KG	ND	ND	ND	ND	ND
Iron	MG/KG	146	1500	155	1960	649
Lead	MG/KG	0.983	5.98	1.91	2.03	1.77
Magnesium	MG/KG	ND	442	ND	52.6	20
Manganese	MG/KG	2.69	9.77	4.42	3.76	2.93
Mercury	MG/KG	ND	ND	ND	ND	ND
Nickel	MG/KG	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND
Silver	MG/KG	ND	ND	ND	ND	ND
Sodium	MG/KG	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	6.09	ND	5.75	ND
Zinc	MG/KG	ND	11.6	ND	ND	ND
Total Cyanide	MG/KG	1.06	1.1	1.07	1.12	1.11

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-31

COMPARISON OF INORGANIC LEVELS IN SITE 74 SURFACE SOILS TO BACKGROUND LEVELS REMEDIAL INVESTIGATION - CTO - 0212 MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 74 (mg/kg)	Site Background (mg/kg)	Base Background (mg/kg)
Aluminum	36.3 - 10,900	1,000 - 3,110	17.7 - 9,570
Antimony	1.72 - 3.43	ND	0.33 - 8
Arsenic	0.621 - 1.16	ND	0.065 - 3.9
Barium	2.89 - 54.7	3.12 - 16.0	0.65 - 20.8
Beryllium	ND	ND	0.02 - 0.26
Cadmium	0.543 - 0.686	ND	0.04 - 0.6
Calcium	34.9 - 175,000	43.9 - 377	4.25 - 10,700
Chromium	1.89 - 10.6	1.98 - 2.70	0.33 - 12.5
Copper	5.07 - 22	3.92 - 4.56	0.5 - 87.2
Iron	31.2 - 34,200	401 - 1,740	69.7 - 9,640
Lead	0.878 - 15.4	1.14 - 142	0.47 - 142
Magnesium	16.3 - 2,790	16.1 - 70	2.55 - 610
Manganese	1.44 - 96.2	3.13 - 9.44	0.87 - 66
Mercury	0.015 - 0.092	ND	0.01 - 0.08
Nickel	3.15 - 4.78	ND	0.6 - 3.55
Potassium	80.7 - 351	ND	1 - 416
Selenium	0.609 - 1.2	ND	0.075 - 1.3
Silver	0.116 - 0.116	ND	0.0435 - 4.3
Sodium	105 - 860	70.4 - 122	4.7 - 126
Vanadium	4.03 - 15.1	4.69 - 5.21	0.305 - 18.2
Zinc	2.27 - 33.9	ND	0.3 - 28.3
Total Cyanide	1.05 - 1.37	1.08 - 1.21	0.265 - 2.4

ND = Nondetect

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-PDA-SB01-01	74-PDA-SB01-02	74-PDA-SB02-01	74-PDA-SB02-03	74-PDA-SB03-02	74-PDA-SB03-04	74-PDA-SB04-05
Laboratory Sample ID:		9402181-02	9402181-03	9402181-05	9402181-06	9402181-08	9402181-09	9402181-11
Depth:		1-3'	3-5'	1-3'	5-7'	3-5'	7-9'	9-11'
Date Sampled:		02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94
Percent Solids:		89.8	84.9	89.3	85.4	89.0	81.6	86.8
	UNITS							
SEMIVOLATILES								
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	93.0	130.0	580.0	20.0	92.0	37.0	50.0
PESTICIDES								
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	ND	0.720 J
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	ND	0.340 NJ
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-PDA-SB05-02	74-PDA-SB05-03	74-PDA-SB06-02	74-PDA-SB06-04	74-PDA-SB07-01	74-PDA-SB07-05	74-PDA-SB08-02
Laboratory Sample ID:		9402182-02	9402182-03	9402182-06	9402182-07	9402179-04	9402179-05	9402182-09
Depth:		1-3'	5-7'	3-5'	7-9'	1-3'	9-11'	3-5'
Date Sampled:		02/19/94	02/19/94	02/19/94	02/19/94	02/20/94	02/20/94	02/19/94
Percent Solids:		91.8	91.6	91.3	83.3	90.6	91.4	94.6
	UNITS							
SEMIVOLATILES								
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	159.0 J	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	874.0	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	95.0 J	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	ND	37.0	ND	18.0	360.0	31.0	820.0
PESTICIDES								
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	0.330 J
4,4'-DDE	UG/KG	1.38 J	ND	2.20 J	ND	ND	ND	ND
4,4'-DDD	UG/KG	0.590 J	ND	ND	3.61 J	ND	ND	ND
4,4'-DDT	UG/KG	1.66 J	0.860 J	21.4 J	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/t[illegible] identification

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-PDA-SB08-04	74-PDA-SB09-03	74-PDA-SB09-06	74-PDA-SB10-04	74-PDA-SB10-08	74-FPA-SB01-03	74-FPA-SB01-07
Laboratory Sample ID:		9402182-10	9402179-07	9402179-08	9402179-10	9402179-11	9402179-13	9402179-14
Depth:		7-9'	5-7'	11-13'	7-9'	15-17'	5-7'	13-15'
Date Sampled:		02/19/94	02/20/94	02/20/94	02/20/94	02/20/94	02/21/94	02/21/94
Percent Solids:		89.0	95.5	87.9	91.4	92.7	90.1	89.6
	UNITS							
SEMIVOLATILES								
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	106.0 J	ND	110.0 J	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	9.00 J	8.00 J	ND	31.0	43.0	10.8 J	ND
PESTICIDES								
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	0.400 J	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	7.06 J	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FPA-SB02-03	74-FPA-SB02-06	74-FPA-SB03-03	74-FPA-SB03-06	74-FPA-SB04-04	74-FPA-SB04-08	74-FPA-SB05-03
Laboratory Sample ID:		9402179-16	9402179-17	9402180-03A	9402180-04A	9402179-19	9402180-01A	9402180-06A
Depth:		5-7'	11-13'	5-7'	11-13'	7-9'	15-17'	5-7'
Date Sampled:		34386	02/21/94	02/21/94	02/21/94	02/21/94	02/21/94	02/20/94
Percent Solids:		85.5	84.8	87.3	83	94.5	88.8	95.4
	UNITS							
SEMIVOLATILES								
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	51.0 J	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	155.0 J	150.0 J	ND	ND	145.0 J	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	190.0	ND	ND
Acetone	UG/KG	44.0 J	68.0	220.0 J	ND	91.0 J	30.0 J	50.0 J
PESTICIDES								
Heptachlor	UG/KG	ND	ND	0.240 J	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	21.3 J	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	1.85 NJ	ND	ND	ND	ND
4,4'-DDT	UG/KG	1.44 J	0.460 NJ	5.83 J	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/t[illegible] e identification

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FPA-SB05-06	74-FPA-SB06-03	74-FPA-SB06-05	74-FPA-SB07-03	74-FPA-SB07-07	74-FPA-SB08-03	74-FPA-SB08-07
Laboratory Sample ID:		9402180-07A	9402180-10A	9402180-11A	9402180-13A	9402180-14A	9402180-16A	9402180-17A
Depth:		11-13'	5-7'	9-11'	5-7'	13-15'	5-7'	13-15'
Date Sampled:		02/21/94	02/20/94	02/20/94	02/20/94	02/20/94	34385	02/20/94
Percent Solids:		87.9	86.5	89.0	95.5	91.3	94.4	86.8
	UNITS							
SEMIVOLATILES								
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	37.0 J	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND
VOLATILES								
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	43.0 J	82.0 J	ND	88.0 J	61.0 J	ND	93.0 J
PESTICIDES								
Heptachlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	4.07 J	ND	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	2.65 J	ND	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND	0.480 NJ	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-FPA-SB09-04	74-FPA-SB09-07	74-GW03A-03	74-GW03A-04	74-GW04-03	74-GW04-05	74-GW05-01	74-GW05-04
Laboratory Sample ID:		9402180-19A	9402180-20A	9401110-01	9401110-02	9401101-01	9401101-02	9401066-04	9401066-05
Depth:		7-9'	13-15'	4-6'	6-7'	4-6'	8-10'	0-2'	6-8'
Date Sampled:		02/20/94	02/20/94	01/18/94	01/18/94	01/18/94	01/18/94	01/11/94	01/11/94
Percent Solids:		85.6	84.8	90.4	83.4	87.8	88.8	91.0	91.2
	UNITS								
SEMIVOLATILES									
bis(2-Ethylhexyl)phthalate	UG/KG	ND	ND	ND	ND	ND	46.0 J	ND	ND
Diethylphthalate	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	ND	ND	ND	ND	65.0 J	78.0 J	ND	ND
VOLATILES									
Methylene chloride	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	UG/KG	500.0 J	ND	ND	ND	ND	ND	420.0 J	ND
PESTICIDES									
Heptachlor	UG/KG	ND	ND	1.25 J	1.59 J	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	ND	ND	ND	ND	1.05 NJ	ND
4,4'-DDD	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND	ND	0.780 NJ	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	0.770 NJ	ND	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/te[illegible] identification

TABLE 4-32
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-GW07-01	74-GW07-02	74-GW08-03	74-GW08-06
Laboratory Sample ID:		9402151-03A	9402151-04A	9402151-01A	9402151-02A
Depth:		0-2'	2-4'	4-6'	10-12'
Date Sampled:		02/18/94	02/18/94	02/18/94	02/18/94
Percent Solids:		81.7	82.8	80.1	86.2
	UNITS				
SEMIVOLATILES					
bis(2-Ethylhexyl)phthalate	UG/KG	56.0 J	54.0 J	240.0 J	46.0 J
Diethylphthalate	UG/KG	ND	ND	ND	ND
di-n-Butylphthalate	UG/KG	44.0 J	ND	43.0 J	ND
VOLATILES					
Methylene chloride	UG/KG	ND	ND	ND	ND
Acetone	UG/KG	ND	ND	6.00 J	17.0
PESTICIDES					
Heptachlor	UG/KG	ND	ND	ND	ND
Aldrin	UG/KG	ND	ND	ND	ND
Heptachlor epoxide	UG/KG	ND	ND	ND	ND
4,4'-DDE	UG/KG	ND	ND	ND	ND
4,4'-DDD	UG/KG	ND	ND	1.20 J	ND
4,4'-DDT	UG/KG	ND	ND	ND	ND
Methoxychlor	UG/KG	ND	ND	ND	ND
Endrin aldehyde	UG/KG	ND	ND	ND	ND

UG/KG - microgram per kilogram
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-PDA-SB01-01	74-PDA-SB01-02	74-PDA-SB02-01	74-PDA-SB02-03	74-PDA-SB03-02	74-PDA-SB03-04	74-PDA-SB04-05
Laboratory Sample ID:		9402181-02	9402181-03	9402181-05	9402181-06	9402181-08	9402181-09	9402181-11
Depth:		1-3'	3-5'	1-3'	5-7'	3-5'	7-9'	9-11'
Date Sampled:		02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94	02/19/94
Percent Solids:		89.8	84.9	89.3	85.4	89.0	81.6	86.8
	UNITS							
Aluminum	MG/KG	5000.0	2470.0	7780.0	3440.0	6390.0	1690.0	2110.0
Antimony	MG/KG	ND	ND	ND	ND	ND	1.90	1.97
Arsenic	MG/KG	ND	ND	0.606 J	2.76	1.46	ND	ND
Barium	MG/KG	5.82	ND	9.58	3.47	6.80	ND	ND
Calcium	MG/KG	172.0	ND	54.6	38.6	83.5	ND	ND
Chromium	MG/KG	6.06	3.79	8.55	3.75	6.17	2.60	3.21
Iron	MG/KG	1970.0	497.0	3090.0	1420.0	1860.0	455.0	382.0
Lead	MG/KG	3.38 J	2.54 J	5.08 J	2.61 J	4.15 J	2.05 J	1.34 J
Magnesium	MG/KG	94.5	61.6	204.0	77.6	143.0	40.0	50.9
Manganese	MG/KG	ND	ND	2.92	ND	2.18	1.83	ND
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	4.79	ND	8.44	ND	ND	ND	ND
Zinc	MG/KG	ND	ND	ND	ND	ND	ND	ND
Total Cyanide	MG/KG	1.11	1.18	1.12	1.17	1.12	1.22	1.15

MG/KG - milligram per kilogram
J - value is estimated
ND - n[illegible]cted

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-PDA-SB05-02	74-PDA-SB05-03	74-PDA-SB06-02	74-PDA-SB06-04	74-PDA-SB07-01	74-PDA-SB07-05	74-PDA-SB08-02
Laboratory Sample ID:		9402182-02	9402182-03	9402182-06	9402182-07	9402179-04	9402179-05	9402182-09
Depth:		1-3'	5-7'	3-5'	7-9'	1-3'	9-11'	3-5'
Date Sampled:		02/19/94	02/19/94	02/19/94	02/19/94	02/20/94	02/20/94	02/19/94
Percent Solids:		91.8	91.6	91.3	83.3	90.6	91.4	94.6
	UNITS							
Aluminum	MG/KG	887.0	2780.0	5450.0	896.0	7670.0	2300.0	2810.0
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	1.74	ND	ND	0.778	ND	ND
Barium	MG/KG	4.34	ND	5.06	ND	17.5	3.24	4.69
Calcium	MG/KG	783.0	ND	125.0	ND	104.0	34.0	ND
Chromium	MG/KG	ND	ND	4.88	ND	8.97	3.25	2.03
Iron	MG/KG	326.0	1600.0	845.0	147.0	4060.0	380.0	676.0
Lead	MG/KG	6.95	1.79	1.91	1.58	3.88	1.60	1.82
Magnesium	MG/KG	29.2	47.1	98.1	ND	223.0	58.8	49.5
Manganese	MG/KG	21.7	ND	2.15	ND	3.75	ND	ND
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	210.0	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	5.09	ND	ND	9.15	ND	ND
Zinc	MG/KG	6.30	2.73	3.81	ND	3.78	4.08	2.54
Total Cyanide	MG/KG	1.09	1.09	1.10	1.20	1.10	1.09	1.06

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-PDA-SB08-04	74-PDA-SB09-03	74-PDA-SB09-06	74-PDA-SB10-04	74-PDA-SB10-08	74-FPA-SB01-03	74-FPA-SB01-07
Laboratory Sample ID:		9402182-10	9402179-07	9402179-08	9402179-10	9402179-11	9402179-13	9402179-14
Depth:		7-9'	5-7'	11-13'	7-9'	15-17'	5-7'	13-15'
Date Sampled:		02/19/94	02/20/94	34385	02/20/94	02/20/94	02/21/94	02/21/94
Percent Solids:		89.0	95.5	87.9	91.4	92.7	90.1	89.6
	UNITS							
Aluminum	MG/KG	2840.0	349.0	1000.0	1420.0	7560.0	5120.0	4160.0
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND	ND	0.874	ND
Barium	MG/KG	ND	ND	ND	ND	8.96	5.26	5.08
Calcium	MG/KG	ND	ND	ND	ND	44.2	102.0	208.0
Chromium	MG/KG	3.78	2.94	2.35	3.84	6.66	5.17	5.00
Iron	MG/KG	400.0	208.0	254.0	353.0	1320.0	1210.0	653.0
Lead	MG/KG	0.796	1.03	1.05	1.53	1.02	3.08	2.43
Magnesium	MG/KG	45.2	19.0	26.1	49.1	207.0	131.0	102.0
Manganese	MG/KG	ND	1.55	ND	ND	4.14	2.50	2.94
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	302.0	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Zinc	MG/KG	2.97	ND	ND	2.51	4.08	3.55	3.19
Total Cyanide	MG/KG	1.12	1.05	1.14	1.09	1.08	1.11	1.12

MG/KG - milligram per kilogram
J - value is estimated
ND - n[illegible] [illegible]ected

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FPA-SB02-03	74-FPA-SB02-06	74-FPA-SB03-03	74-FPA-SB03-06	74-FPA-SB04-04	74-FPA-SB04-08	74-FPA-SB05-03
Laboratory Sample ID:		9402179-16	9402179-17	9402180-03A	9402180-04A	9402179-19	9402180-01A	9402180-06A
Depth:		5-7'	11-13'	5-7'	11-13'	7-9'	15-17'	5-7'
Date Sampled:		02/21/94	02/21/94	02/21/94	02/21/94	02/21/94	02/21/94	02/20/94
Percent Solids:		85.5	84.8	87.3	83	94.5	88.8	95.4
	UNITS							
Aluminum	MG/KG	8610.0	4850.0	8480.0	5380	5030.0	3510.0	432.0
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	0.564 J	ND	1.23	ND	ND
Barium	MG/KG	13.1	5.24	11.1	4.05	6.88	10.0	ND
Calcium	MG/KG	714.0	280.0	496.0	338	49.8	2250.0	ND
Chromium	MG/KG	9.91	6.11	7.62	4.85	4.88	3.85	ND
Iron	MG/KG	2770.0	952.0	3100.0	869	1400.0	1750.0	123.0
Lead	MG/KG	5.06	1.85	3.13	2.35	2.19	7.42	1.20
Magnesium	MG/KG	191.0	103.0	215.0	114	135.0	133.0	15.4
Manganese	MG/KG	4.06	2.16	4.34	3.58	2.29	6.78	1.58
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	191.0	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	11.0	5.98	10.1	ND	4.53	5.00	ND
Zinc	MG/KG	3.86	3.25	ND	ND	3.04	11.9	ND
Total Cyanide	MG/KG	1.17	1.18	1.14	1.2	1.06	1.13	1.05

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FPA-SB05-06	74-FPA-SB06-03	74-FPA-SB06-05	74-FPA-SB07-03	74-FPA-SB07-07	74-FPA-SB08-03	74-FPA-SB08-07
Laboratory Sample ID:		9402180-07A	9402180-10A	9402180-11A	9402180-13A	9402180-14A	9402180-16A	9402180-17A
Depth:		11-13'	5-7'	9-11'	5-7'	13-15'	5-7'	13-15'
Date Sampled:		02/21/94	02/20/94	02/20/94	02/20/94	02/20/94	02/20/94	02/20/94
Percent Solids:		87.9	86.5	89.0	95.5	91.3	94.4	86.8
	UNITS							
Aluminum	MG/KG	3720.0	8540.0	3810.0	905.0	3110.0	1070.0	2760.0
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	0.861 J	ND	ND	ND	ND	ND
Barium	MG/KG	2.92	14.1	5.48	ND	2.77	ND	ND
Calcium	MG/KG	ND	745.0	264.0	ND	ND	ND	ND
Chromium	MG/KG	3.88	8.09	5.82	2.17	3.49	1.92	4.40
Iron	MG/KG	570.0	4940.0	700.0	326.0	534.0	266.0	451.0
Lead	MG/KG	1.45	4.62	2.63	0.751	1.33	1.50	2.13
Magnesium	MG/KG	85.9	184.0	102.0	26.7	78.4	29.8	75.0
Manganese	MG/KG	2.73	3.42	3.42	2.06	3.42	2.44	4.23
Mercury	MG/KG	ND	ND	0.056	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	14.2	ND	ND	ND	ND	ND
Zinc	MG/KG	ND	ND	ND	ND	ND	ND	ND
Total Cyanide	MG/KG	1.14	1.16	1.12	1.05	1.10	1.06	1.15

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-FPA-SB09-04	74-FPA-SB09-07	74-GW03A-03	74-GW03A-04	74-GW04-03	74-GW04-05	74-GW05-01	74-GW05-04
Laboratory Sample ID:		9402180-19A	9402180-20A	9401110-01	9401110-02	9401101-01	9401101-02	9401066-04	9401066-05
Depth:		7-9'	13-15'	4-6'	6-7'	4-6'	8-10'	0-2'	6-8'
Date Sampled:		02/20/94	02/20/94	01/18/94	01/18/94	01/18/94	01/18/94	01/11/94	01/11/94
Percent Solids:		85.6	84.8	90.4	83.4	87.8	88.8	91.0	91.2
	UNITS								
Aluminum	MG/KG	5630.0	9380.0	3630.0	1840.0	5310.0	2760.0	3260.0	2250.0
Antimony	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	MG/KG	ND	0.538 J	ND	ND	ND	ND	ND	ND
Barium	MG/KG	6.74	8.59	5.07	ND	5.02	ND	ND	ND
Calcium	MG/KG	69.2	40.7	ND	ND	ND	ND	111.0	ND
Chromium	MG/KG	5.39	9.26	3.54	ND	4.54	4.73	3.33	2.38
Iron	MG/KG	929.0	1630.0	393.0	243.0	1620.0	1020.0	370.0	399.0
Lead	MG/KG	1.78	2.74	2.02 J	1.18 J	3.18 J	2.71 J	2.99 J	1.68 J
Magnesium	MG/KG	153.0	250.0	76.9	29.0	94.4	51.2	31.0	30.2
Manganese	MG/KG	4.38	4.21	2.27	2.34	1.72	3.22	2.56	ND
Mercury	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	MG/KG	ND	197.0	ND	ND	ND	ND	ND	ND
Selenium	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	MG/KG	ND	7.90	3.93	ND	4.62	ND	4.10	ND
Zinc	MG/KG	ND	ND	ND	ND	ND	ND	ND	ND
Total Cyanide	MG/KG	1.17	1.18	1.11	1.20	1.14	1.13	1.10	1.10

MG/KG - milligram per kilogram
J - value is estimated
ND - not detected

TABLE 4-33
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
FORMER DISPOSAL/POTENTIAL DISPOSAL/FORMER PEST CONTROL AREAS SUBSURFACE SOIL
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL INORGANICS

Client Sample ID:		74-GW07-01	74-GW07-02	74-GW08-03	74-GW08-06
Laboratory Sample ID:		9402151-03A	9402151-04A	9402151-01A	9402151-02A
Depth:		0-2'	2-4'	4-6'	10-12'
Date Sampled:		02/18/94	02/18/94	02/18/94	02/18/94
Percent Solids:		81.7	82.8	80.1	86.2
	UNITS				
Aluminum	MG/KG	5640.0	4690.0	720.0	4410.0
Antimony	MG/KG	ND	ND	ND	ND
Arsenic	MG/KG	ND	ND	ND	ND
Barium	MG/KG	4.48	6.48	ND	5.40
Calcium	MG/KG	96.3	ND	ND	ND
Chromium	MG/KG	4.47	3.44	ND	4.19
Iron	MG/KG	920.0	1060.0	246.0	609.0
Lead	MG/KG	5.48 J	2.90 J	1.43 J	1.52 J
Magnesium	MG/KG	55.3	81.1	ND	89.2
Manganese	MG/KG	2.33	ND	ND	ND
Mercury	MG/KG	ND	ND	ND	ND
Potassium	MG/KG	ND	ND	ND	ND
Selenium	MG/KG	0.818	ND	ND	ND
Vanadium	MG/KG	6.59	5.59	ND	ND
Zinc	MG/KG	5.02	4.47	ND	3.00
Total Cyanide	MG/KG	1.22	1.21	1.25	1.16

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

TABLE 4-34

COMPARISON OF INORGANIC LEVELS IN SITE 74
SUBSURFACE SOILS TO BASE BACKGROUND LEVELS
REMEDIAL INVESTIGATION - CTO 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 74 (mg/kg)	Base Background (mg/kg)
Aluminum	349 - 9,380	16.9 - 11,000
Antimony	1.9 - 1.97	0.355 - 6.9
Arsenic	0.538 - 2.76	0.033 - 15.4
Barium	2.77 - 17.5	0.65 - 22.6
Calcium	34 - 2,250	4.75 - 4,410
Chromium	1.92 - 9.91	0.65 - 66.4
Iron	123 - 4,940	63.3 - 90,500
Lead	0.751 - 7.42	0.465 - 21.4
Magnesium	15.4 - 250	2.85 - 852
Manganese	1.55 - 21.7	0.395 - 19.9
Mercury	0.055R - 0.056	0.01 - 0.68
Potassium	191 - 302	1.05 - 1,250
Selenium	0.818 - 0.818	0.085 - 2.4
Vanadium	3.93 - 14.2	0.34 - 69.4
Zinc	2.51 - 11.9	0.32 - 26.6
Total Cyanide	1.05 - 1.25	NA

NA = Not Analyzed

TABLE 4-35
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
GROUNDWATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-GW01-01	74-GW03A-01	74-GW04-01	74-GW07-01	74-GW08-01
Laboratory Sample ID:		9402138-03	9402139-03	9402138-01	9402198-01A	9402198-03A
Date Sampled:		2/16/94	2/16/94	2/16/94	2/22/94	2/22/94
	UNITS					
SEMIVOLATILES						
di-n-Butylphthalate	UG/L	ND	ND	2.00 J	ND	ND
VOLATILES						
Acetone	UG/L	ND	2.04 J	ND	2.00 J	ND
PESTICIDES						
Lindane (gamma-BHC)	UG/L	ND	ND	ND	ND	0.040 J
Heptachlor	UG/L	0.010 NJ	ND	ND	ND	ND
Endosulfan II	UG/L	ND	ND	ND	ND	0.020 J
alpha-Chlordane	UG/L	ND	ND	ND	ND	0.020 NJ

UG/L - microgram per liter
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-36
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
GROUNDWATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL TOTAL METALS

Client Sample ID:		74-GW01-01	74-GW02-01	74-GW03A-02	74-GW04-01	74-GW05-01	74-GW06-01	74-GW07-02	74-GW08-01
Laboratory Sample ID:		9402138-03	9402132-01	AB7974	9402138-01	9402137-01	9402140-01	AB7980	9402198-03A
Date Sampled:		2/16/94	2/16/94	8/25/94	2/16/94	2/16/94	2/16/94	8/26/94	2/22/94
	UNITS								
Aluminum	UG/L	64100.0 J	52800.0 J	1600	18800.0 J	18300.0 J	40200.0 J	10400 J	11400.0 J
Arsenic	UG/L	2.86 J	18.1	3.5	ND	4.06	ND	3.2	ND
Barium	UG/L	110.0	117.0	28.2	61.6	80.7	63.8	80.1	38.9
Beryllium	UG/L	1.22	2.25	ND	ND	0.842	ND	ND	ND
Calcium	UG/L	815.0	3000.0	554	918.0	3860.0	7720.0	686	3440
Chromium	UG/L	56.6	45.1	ND	15.9	18.6	34.2	ND	ND
Cobalt	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Copper	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Iron	UG/L	10100.0 J	96100.0 J	821	4520.0 J	8550.0 J	4780.0 J	5110	1380
Lead	UG/L	15.3	9.67	ND	7.71 J	10.8	6.11	5.3	3.10 J
Magnesium	UG/L	2160.0	2480.0	480	1900.0	1840.0	1130.0	1900	924
Manganese	UG/L	19.2	115.0	17.2	8.47	39.9	34.1	18	16.9
Mercury	UG/L	0.244	ND	ND	ND	ND	ND	ND	ND
Nickel	UG/L	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	UG/L	3070	2000	ND	1290	1170	2000	1660	ND
Selenium	UG/L	ND	1.80 J	ND	ND	ND	ND	ND	ND
Sodium	UG/L	3570	2140	3560	5220	7210	2580	5520	2530.00
Vanadium	UG/L	78.2	301.0	ND	ND	22.0	ND	14.3	ND
Zinc	UG/L	ND	417.0 J	94.9	ND	69.9 J	ND	154	19.1

UG/L - microgram per liter
J - value is estimated
ND - [illegible]ected

TABLE 4-37
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
GROUNDWATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL DISSOLVED METALS

Client Sample ID:		74-GW01D-01	74-GW02D-01	74-GW03AD-02	74-GW04D-01	74-GW05D-01	74-GW06D-01	74-GW07D-02	74-GW08D-01
Laboratory Sample ID:		9402138-04	9402132-02	AB7986	9402138-02	9402137-02	9402140-02	AB7996	9402198-04A
Date Sampled:		2/16/94	2/16/94	8/25/94	2/16/94	2/16/94	2/16/94	8/26/94	2/22/94
	UNITS								
Aluminum	UG/L	215.0 J	437.0 J	1780	372.0 J	1130.0 J	ND	153	ND
Antimony	UG/L	ND	ND	ND	ND	ND	ND	ND	8.26
Arsenic	UG/L	ND	ND	3.90	ND	ND	ND	ND	ND
Barium	UG/L	15.9	28.5	32.8	27.5	45.6	ND	63.8	ND
Cadmium	UG/L	ND	ND	ND	ND	ND	ND	5.6	ND
Calcium	UG/L	806.0	2840.0	870	1060.0	4110.0	5700.0	835	3720.0
Copper	UG/L	ND	ND	18.4	ND	ND	ND	20.3	ND
Iron	UG/L	ND	350.0 J	1040	ND	380.0 J	ND	749	ND
Magnesium	UG/L	1050.0	1670.0	692.0	1640.0	1460.0	499.0	1730	730.0
Manganese	UG/L	ND	ND	25.4	ND	20.9	17.7	11.8	16.0
Mercury	UG/L	ND	ND	1.4	ND	ND	ND	ND	0.166
Potassium	UG/L	ND	ND	ND	ND	ND	ND	1020	ND
Silver	UG/L	24.2	ND	ND	ND	ND	ND	ND	ND
Sodium	UG/L	3460	2140	4770	5550	7540	2800	6320	3120.00
Zinc	UG/L	ND	64.2 J	93.9	ND	ND	ND	27.4	ND

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-38

SUMMARY OF ROUND ONE GROUNDWATER FIELD PARAMETERS
SITE 74
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Well No. / Date of Measurement	Depth of Well (feet)[1]	Purge Volume (gallons)	Field Parameters: Well Volume	Field Parameters: Specific Conductance at 25 deg. C (micromhos/cm)	Field Parameters: Temperature (deg. C)	Field Parameters: pH (S.U.)
74GW01			≈1	38	14.5	4.42
02/16/94			*Very silty and very slow recharge. Sampled after bailed dry and recharged.			
74GW02	26.12	5	1	48	16	4.86
02/15/94			2	55	15.5	4.66
			3	54	16.5	4.51
74GW03A	21.59	7	1	195	17	4.60
02/16/94			2	198	16.25	4.63
			3	193	16	4.67
74GW04	22.78	5	1	60	16	4.21
02/16/94			2	60	16	4.30
			3	60	16	4.32
74GW05	17.55	8	1	94	14.5	4.27
02/16/94			2	108	14	4.08
			3	108	14	4.18
74GW06	26.54	6	1	55	18	5.94
02/16/94			2	52	18	5.42
			3	52	18	5.76
74GW07	19.40	10	1	83	13.5	5.64
			2	85	14.4	6.66
02/22/94			3	84	14.8	6.98
			5	86	14.2	7.26
74GW08	25.5	10	1	72	16	6.25
02/22/94			2	60	16	6.12
			3	49	15.5	5.97
			4	49	15.5	5.95
			5	43	15.5	6.18

Notes: [1] Well depth taken from top of PVC riser.

TABLE 4-39
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
PESTICIDE DISPOSAL AREA SURFACE WATER
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		74-PDA-SW01	74-PDA-SW02	74-PDA-SW03
Laboratory Sample ID:		9401136-01	9401136-02	9401136-03
Date Sampled:		01/24/94	01/24/94	01/24/94
	UNITS			
Aluminum	UG/L	492.0 J	309.0 J	127.0 J
Calcium	UG/L	11500.0	11700.0	10400.0
Iron	UG/L	273.0	274.0	138.0
Lead	UG/L	5.84	6.04 J	1.62 J
Magnesium	UG/L	856.0	881.0	782.0
Potassium	UG/L	719	448	ND
Sodium	UG/L	19800	21700	13400

UG/L - microgram per liter
J - value is estimated
ND - not detected

TABLE 4-40

COMPARISON OF TOTAL METALS IN SURFACE WATER
AT SITE 74 TO BASE UPGRADIENT LEVELS
REMEDIAL INVESTIGATION - CTO 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Henderson Pond (µg/L)	Base Upgradient (µg/L)
Aluminum	127 - 492	178 - 1,350
Antimony	ND	ND
Arsenic	ND	ND
Barium	ND	13.4 - 27.2
Beryllium	ND	ND
Cadmium	ND	3 - 3
Calcium	10,400 - 11,700	600 - 41,600
Chromium	ND	ND
Cobalt	ND	8 - 8
Copper	ND	4 - 129
Iron	138 - 274	413 - 1,460
Lead	1.62 - 6.04	1.17 - 10.4
Magnesium	782 - 881	588 - 2,410
Manganese	ND	6.2 - 40
Mercury	ND	0.52 - 0.52
Nickel	ND	1,380 - 1,380
Potassium	448 - 719	341 - 2,210
Selenium	ND	ND
Silver	ND	ND
Sodium	13,400 - 21,700	3,930 - 22,100
Thallium	ND	ND
Vanadium	ND	1.9 - 10
Zinc	ND	18 - 111

TABLE 4-41
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
PESTICIDE DISPOSAL AREA SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
ORGANICS

Client Sample ID:		74-PDA-SD01-06	74-PDA-SD02-06	74-PDA-SD03-06
Laboratory Sample ID:		9401137-01	9401137-02	9401137-03
Date Sampled:		01/24/94	01/24/94	01/24/94
Percent Solids		78.8	63.5	80.0
	UNITS			
SEMIVOLATILES				
3,3'-Dichlorobenzidine	UG/KG	ND	ND	140.0 J
VOLATILES				
Trichloroethene	UG/KG	8.00 J	ND	ND
PESTICIDE/PCBS				
4,4'-DDE	UG/KG	1.85 J	0.900 J	ND
Endosulfan II	UG/KG	0.630 J	ND	0.800 J
4,4'-DDT	UG/KG	ND	0.820 NJ	ND
Methoxychlor	UG/KG	ND	0.830 J	ND
Endrin aldehyde	UG/KG	ND	ND	1.35 NJ

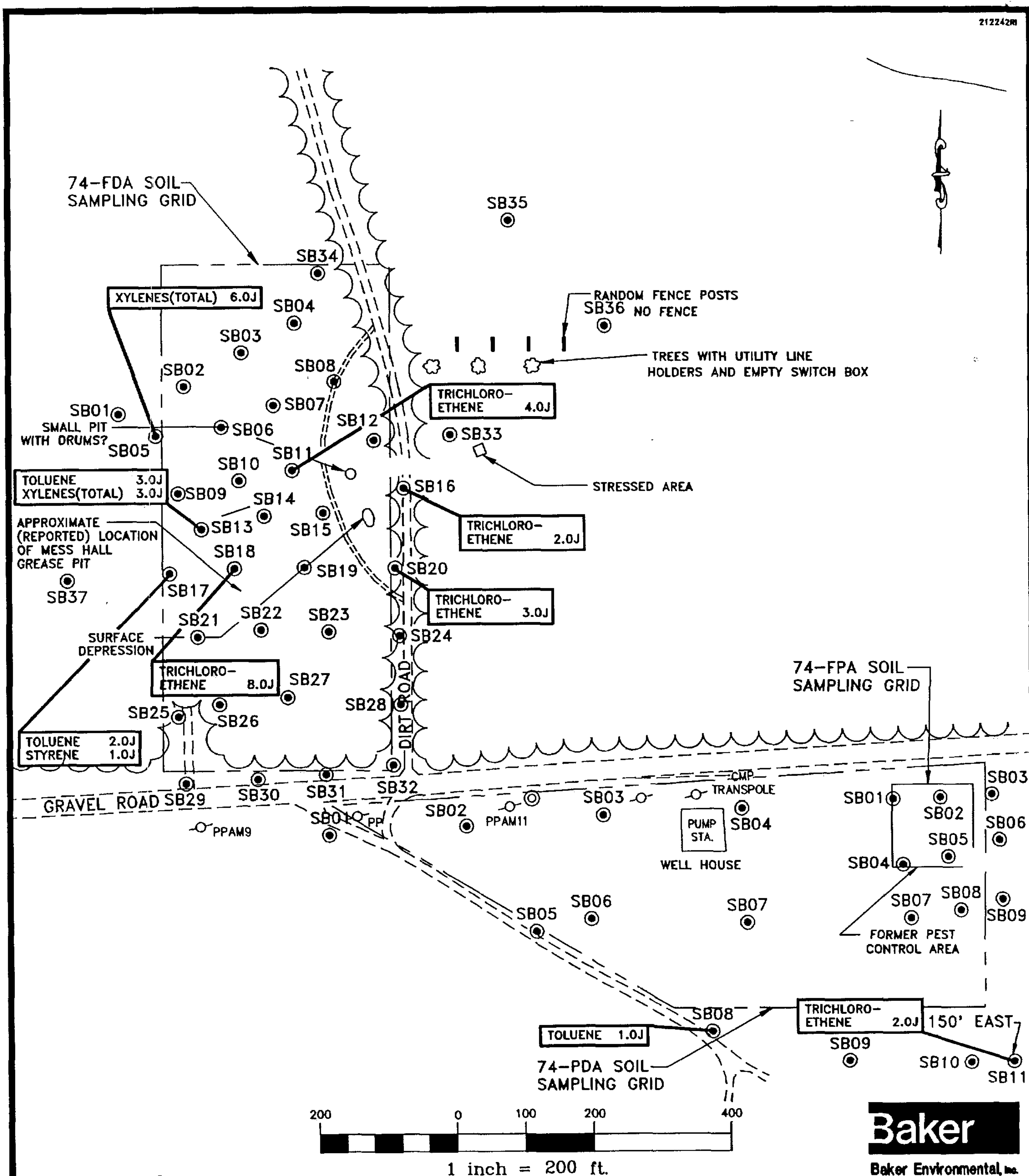
UG/KG - *microgram per kilogram*
J - value is estimated
ND - not detected
NJ - estimated/tentative identification

TABLE 4-42
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
PESTICIDE DISPOSAL AREA SEDIMENT
MCB CAMP LEJEUNE, NORTH CAROLINA
REMEDIAL INVESTIGATION - CTO-0212
TAL METALS

Client Sample ID:		74-PDA-SD01-06	74-PDA-SD02-06	74-PDA-SD03-06
Laboratory Sample ID:		9401137-01	9401137-02	9401137-03
Date Sampled:		01/24/94	01/24/94	01/24/94
Percent Solids		78.8	63.5	80.0
	UNITS			
Aluminum	MG/KG	584.0	3320.0	2160.0
Barium	MG/KG	ND	13.0	5.73
Calcium	MG/KG	178.0	725.0	208.0
Chromium	MG/KG	ND	3.13	1.80
Iron	MG/KG	199.0	1530.0	1300.0
Lead	MG/KG	4.00 J	6.06 J	2.67 J
Magnesium	MG/KG	19.3	102.0	48.9
Manganese	MG/KG	3.32	5.27	2.76
Selenium	MG/KG	ND	ND	1.02
Vanadium	MG/KG	ND	ND	4.40
Zinc	MG/KG	ND	12.6	ND

MG/KG - milligram per kilogram
J - value is estimated
ND - [illegible]ected

SECTION 4.0 FIGURES

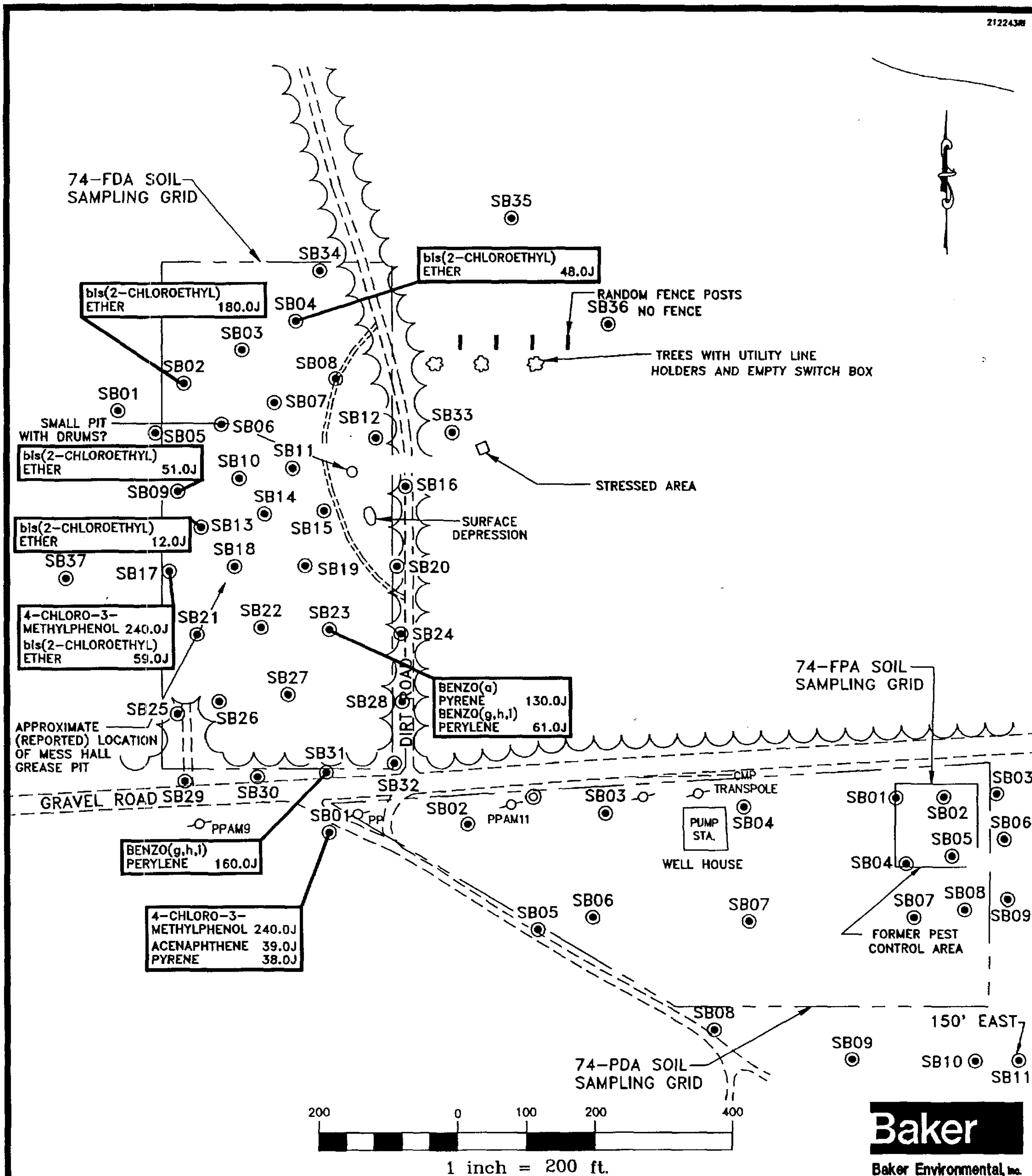


LEGEND

SB01 SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-30
POSITIVE DETECTIONS OF VOLATILES IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



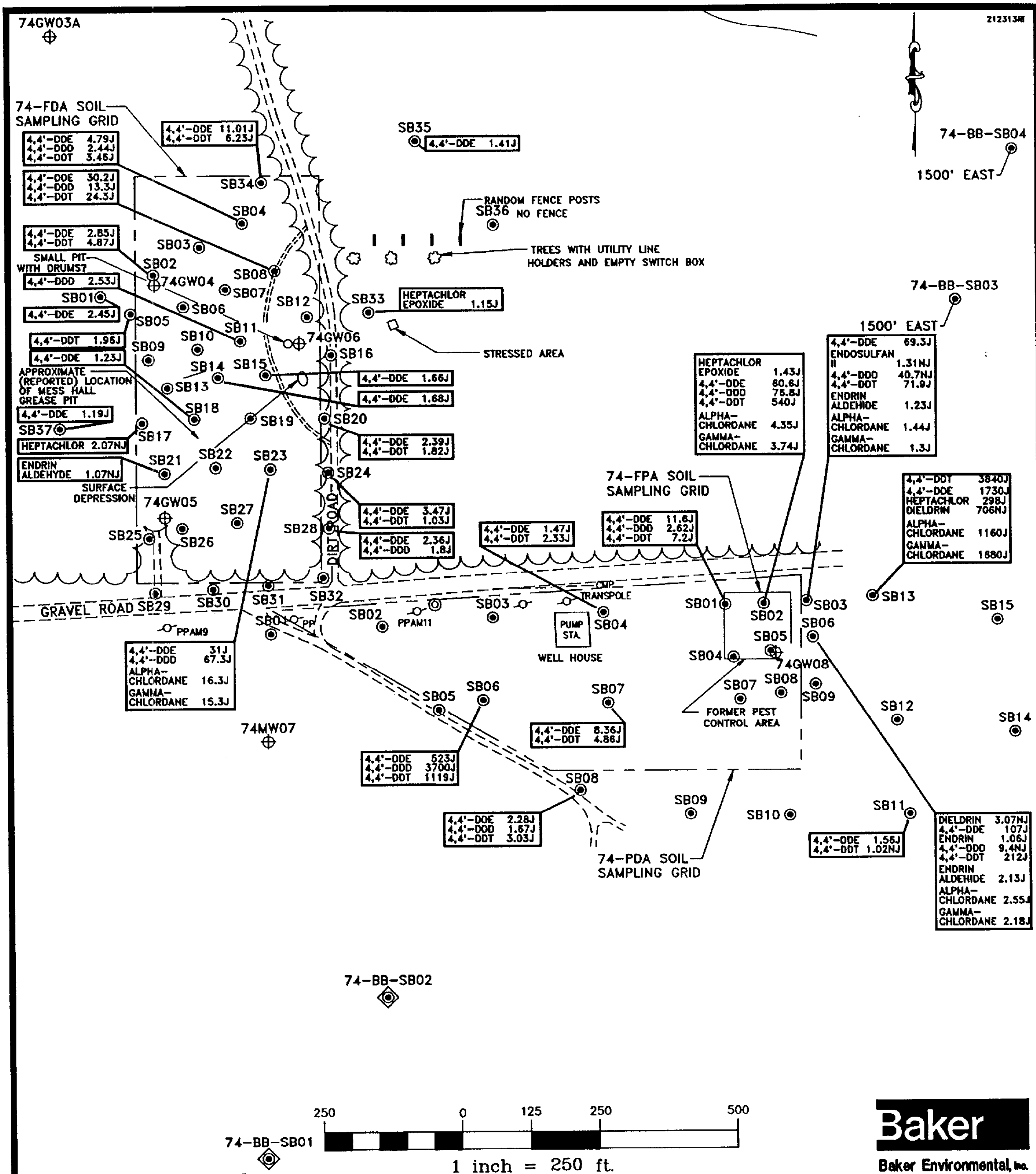
LEGEND

SB01 SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-31
POSITIVE DETECTIONS OF SEMIVOLATILES IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

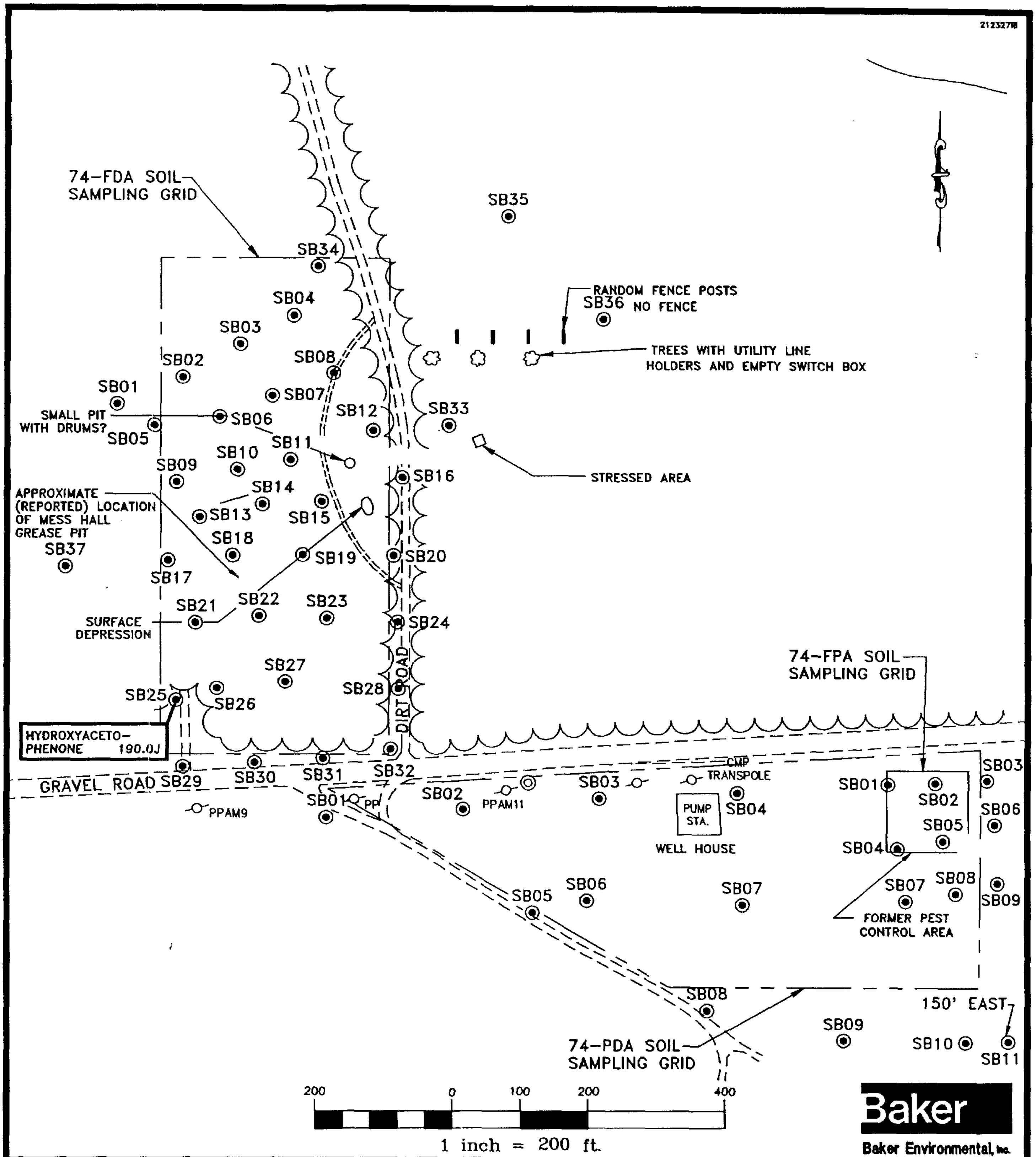


LEGEND

74GW03A	SHALLOW MONITORING WELL LOCATION
SB01	SOIL BORING LOCATION
74-BB-SB02	BACKGROUND SOIL BORING LOCATION

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-32
POSITIVE DETECTIONS OF PESTICIDES ABOVE 1 ug/kg IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



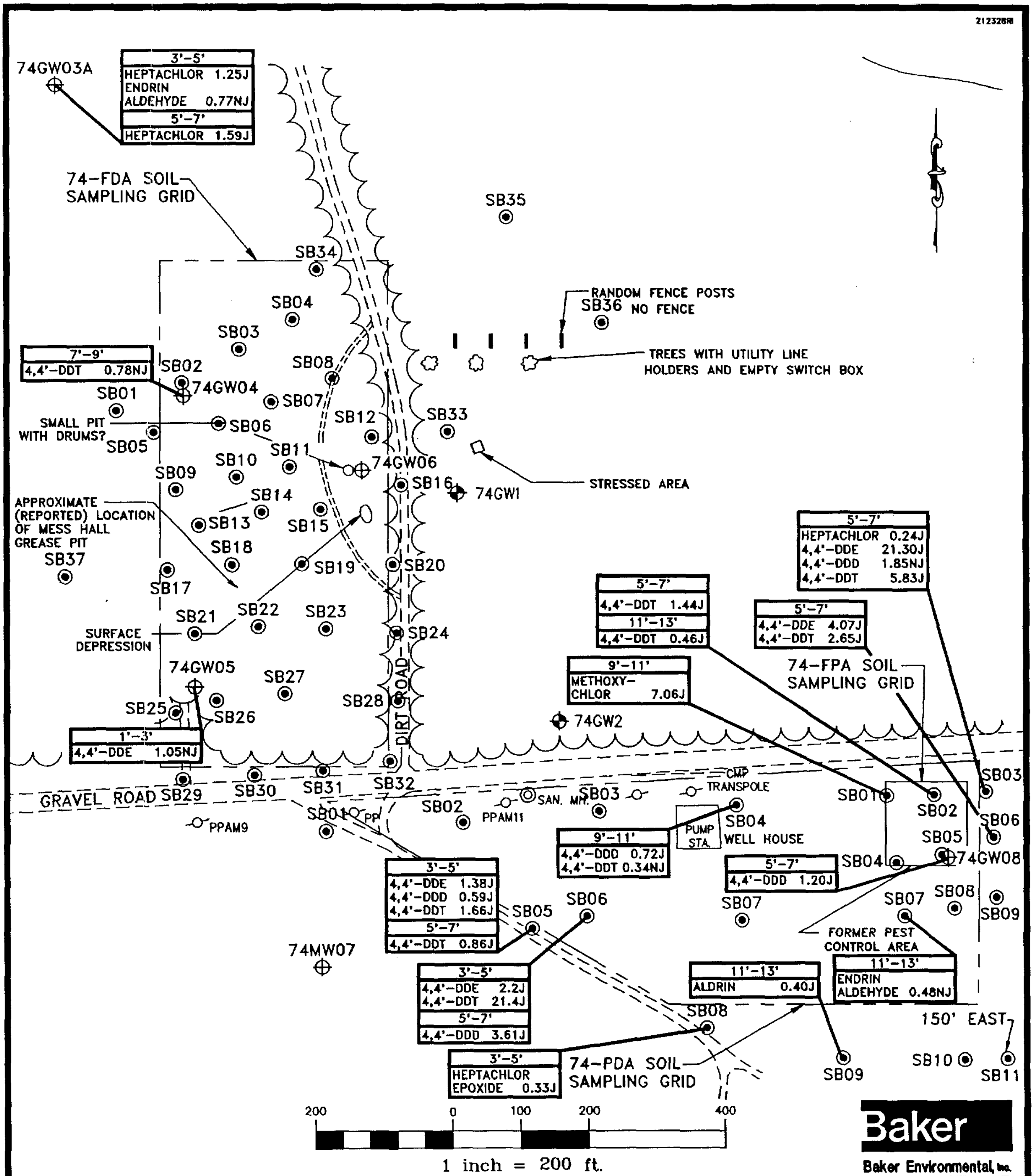
LEGEND

SB01 SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-33
POSITIVE DETECTIONS OF CHEMICAL SURETY MATERIALS IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

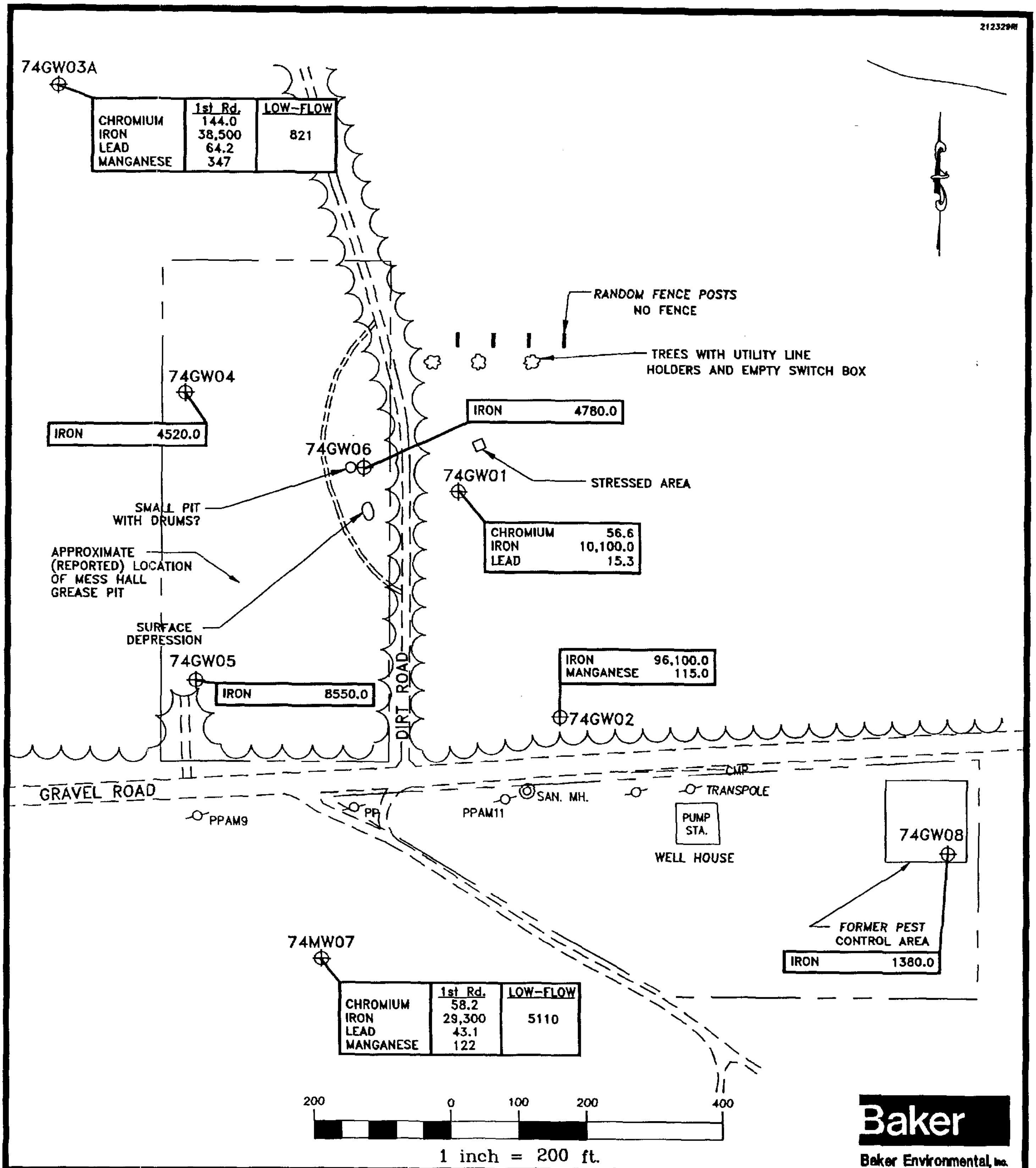
74GW03A SHALLOW MONITORING WELL LOCATION

SB01 SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-34
POSITIVE DETECTIONS OF PESTICIDES IN SUBSURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



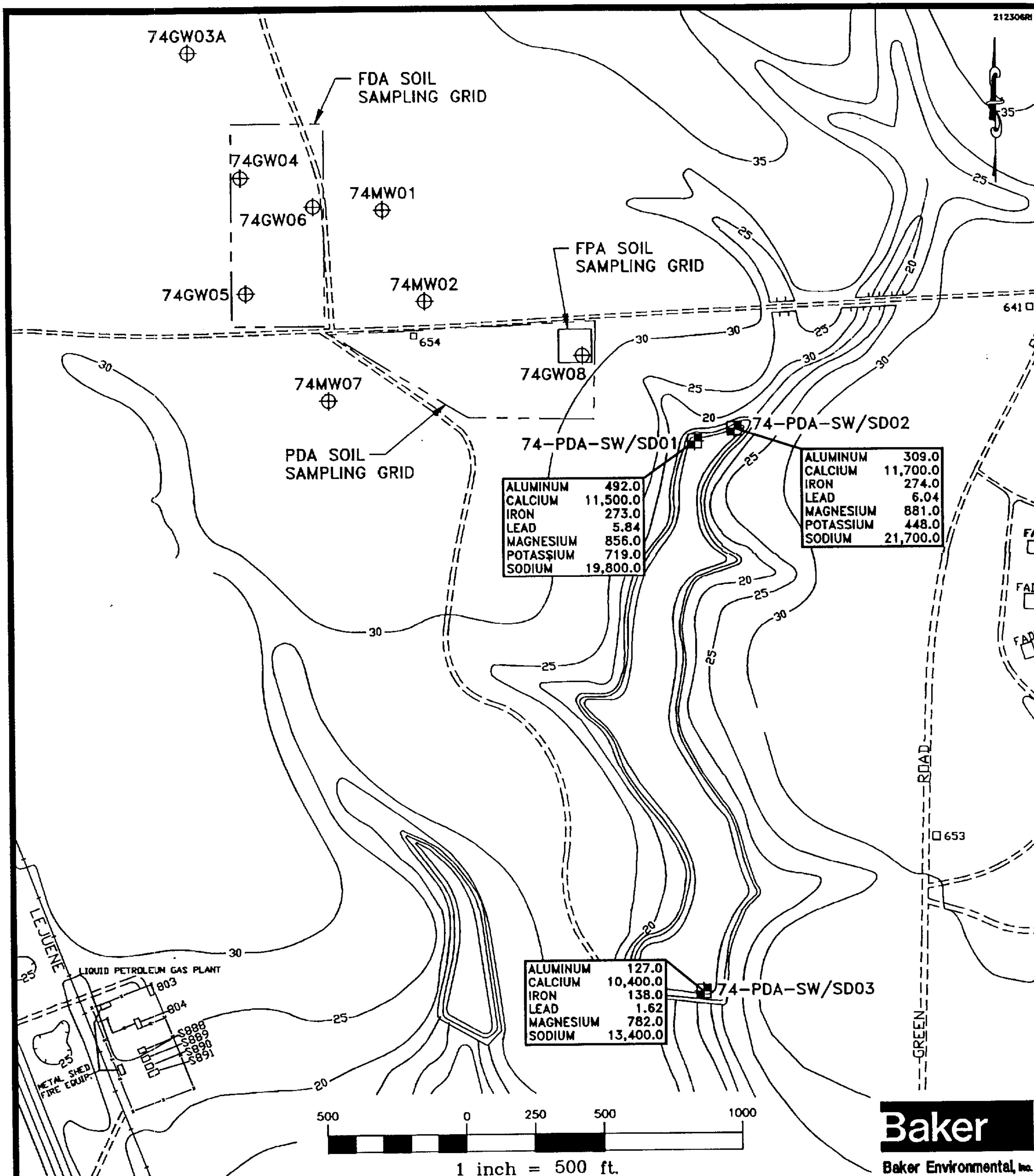
LEGEND

74GW03A ⊕ SHALLOW MONITORING WELL

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

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-35
POSITIVE DETECTIONS OF TAL METALS ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS
SITE 74 – MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

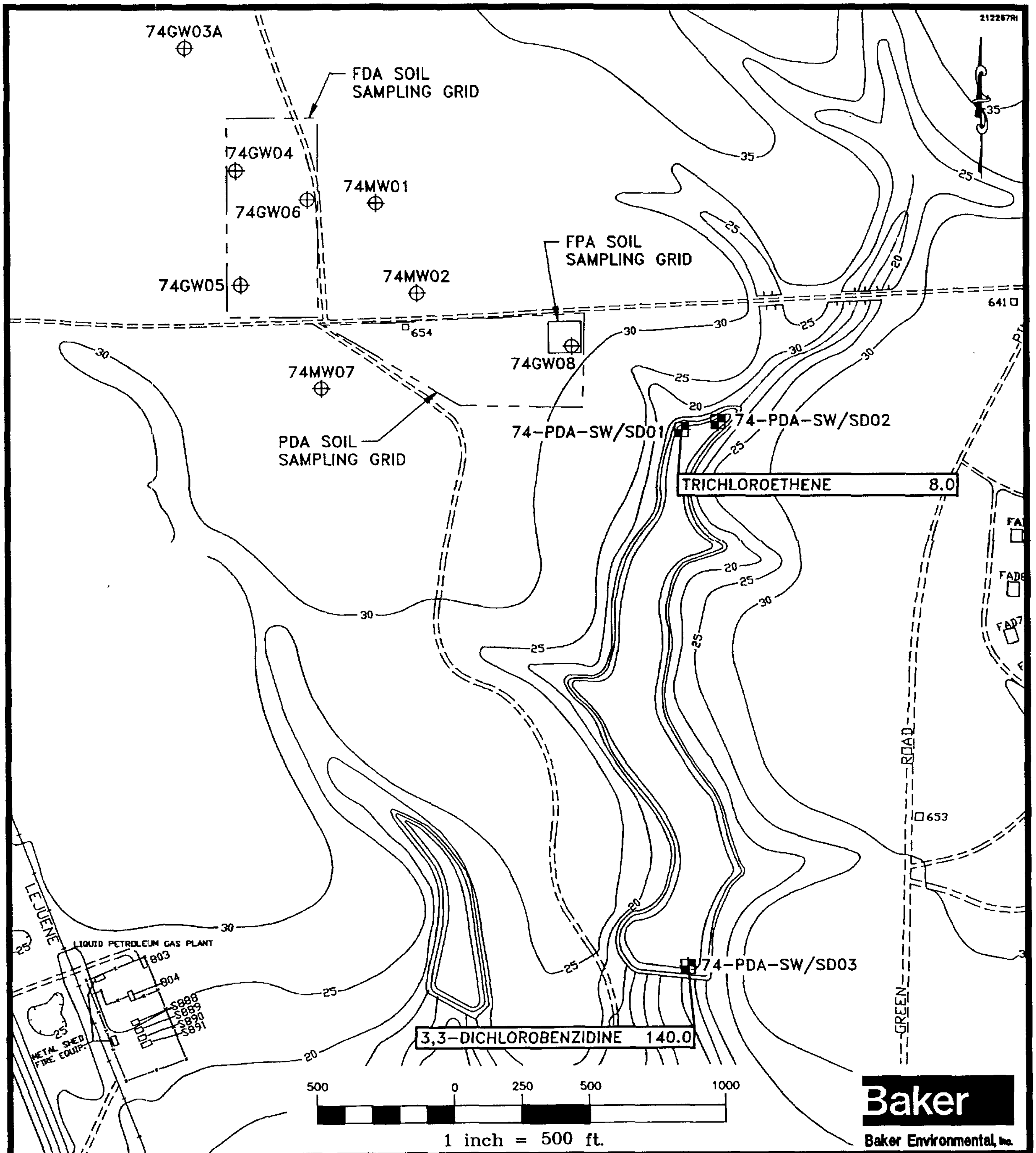


LEGEND

74-PDA-SW/SD01 SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, FEB. 1994

FIGURE 4-36
POSITIVE DETECTIONS OF TAL METALS IN SURFACE WATER – SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



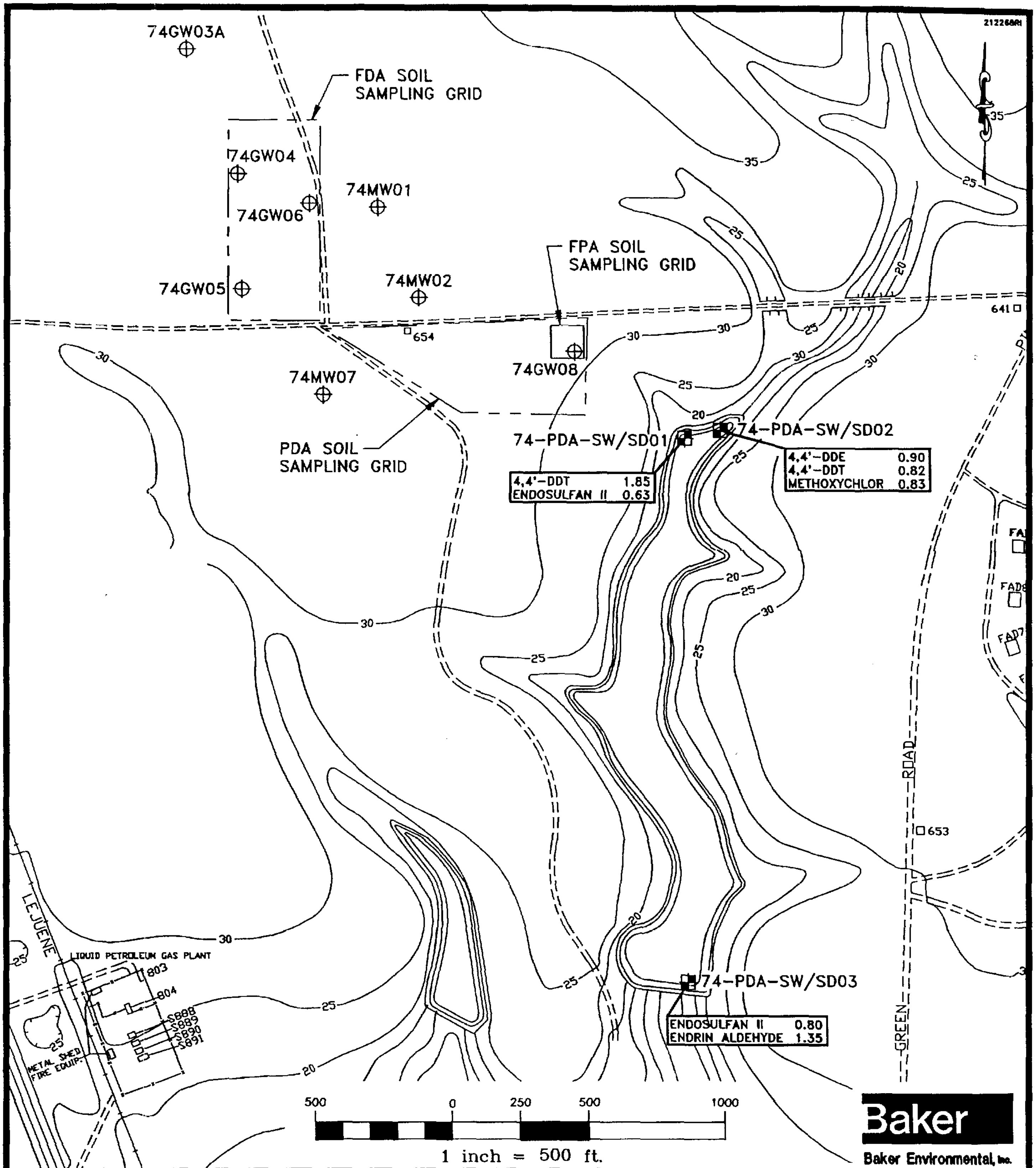
LEGEND

74-PDA-SW/SD01 — SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: LANTDIV, FEB. 1994

FIGURE 4-37
POSITIVE DETECTIONS OF VOLATILES AND SEMIVOLATILES IN SEDIMENT – SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

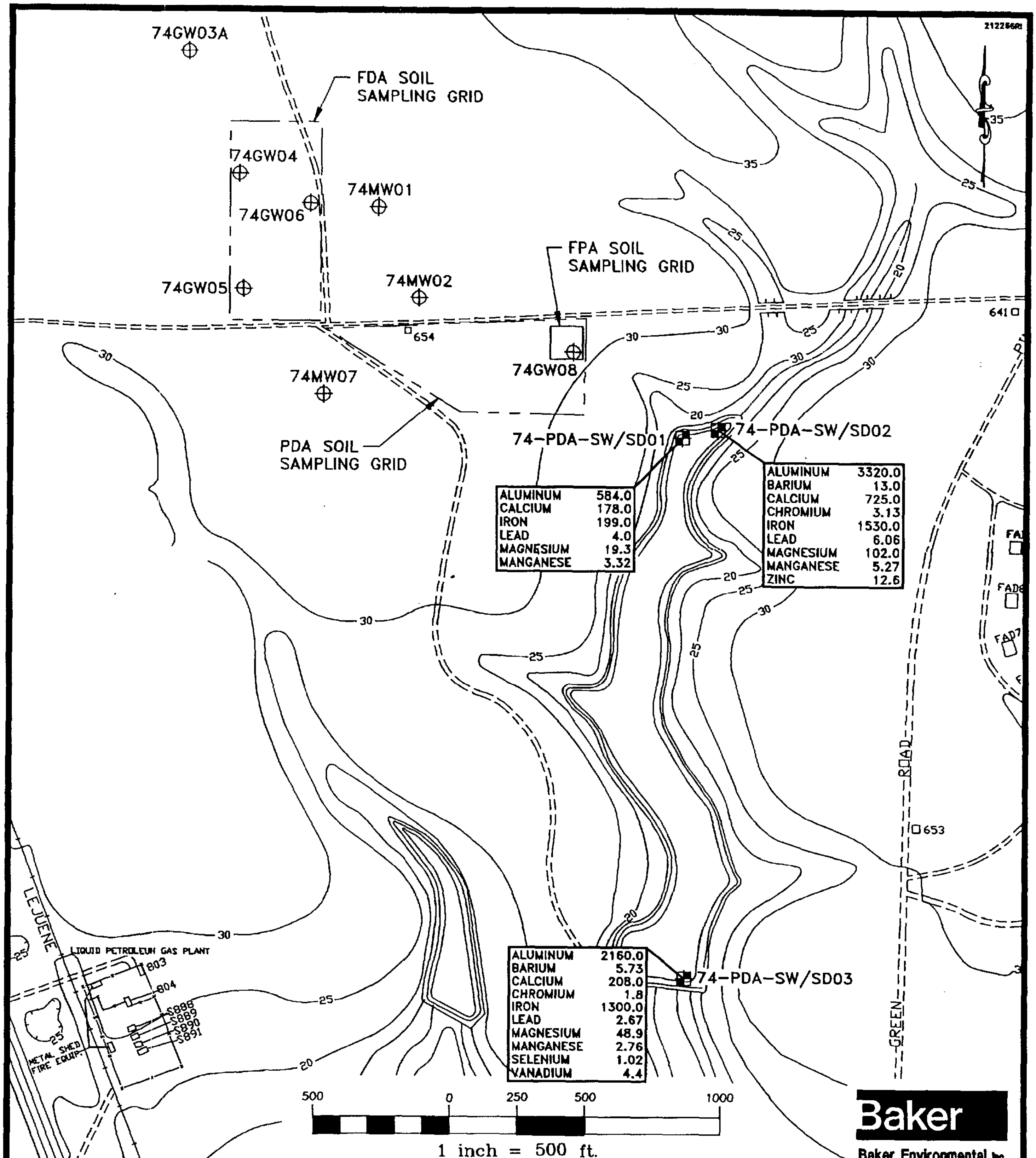


LEGEND

74-PDA-SW/SD01 SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, FEB. 1994

FIGURE 4-38
POSITIVE DETECTIONS OF PESTICIDES IN SEDIMENT – SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74-PDA-SW/SD01 SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, FEB. 1994

FIGURE 4-39
POSITIVE DETECTIONS OF TAL METALS IN SEDIMENT – SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

5.0 CONTAMINANT FATE AND TRANSPORT

The potential for a contaminant to migrate and persist in an environmental medium is critical when evaluating the potential for a chemical to elicit an adverse human health or ecological effect. The environmental mobility of a chemical is influenced by its physical and chemical properties, the physical characteristics of the site, and the site chemistry. This section presents a discussion of the various physical and chemical properties of contaminants detected at OU No. 4 that impact the fate and transport of the contaminants in the environment. The basis for this discussion of contaminant fate and transport is discussed in Section 4.0, Nature and Extent of Contamination.

5.1 Chemical and Physical Properties Impacting Fate and Transport

Table 5-1 presents the physical and chemical properties associated with the organic contaminants detected during this investigation. These properties determine the inherent environmental mobility and fate of a contaminant. These properties include:

- Vapor pressure
- Water solubility
- Octanol/water partition coefficient
- Organic carbon adsorption coefficient (sediment partition)
- Specific gravity
- Henry's Law constant
- Mobility index

A discussion of the environmental significance of each of these properties follows.

Vapor pressure provides an indication of the rate at which a chemical may volatilize. It is of primary significance at environmental interfaces such as surface soil/air and surface water/air. Volatilization is not as important when evaluating groundwater and subsurface soils. Vapor pressure for monocyclic aromatics are generally higher than vapor pressures for PAHs. Contaminants with higher vapor pressures will enter the atmosphere at a quicker rate than the contaminants with low vapor pressures.

The rate at which a contaminant is leached from soil by infiltrating precipitation is proportional to its water solubility. More soluble contaminants are usually more readily leached than less soluble contaminants. The water solubilities indicate that the volatile organic contaminants including monocyclic aromatics are usually several orders-of-magnitude more soluble than PAHs.

The octanol/water partition coefficient (K_{ow}) is a measure of the equilibrium partitioning of contaminants between octanol and water. A linear relationship between octanol/water partition coefficient and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor - BCF) has been established (Lyman et al., 1982). The coefficient is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available.

The organic carbon adsorption coefficient (K_{oc}) indicates the tendency of a chemical to adhere to soil particles organic carbon. Contaminants with high soil/sediment adsorption coefficients generally have low water solubilities and vice versa. For example, contaminants such as PAHs are relatively immobile in the environment and are preferentially bound to the soil. The compounds are not subject to aqueous transport to the extent of compounds with higher water solubilities. Erosional properties of surface soils may, however, enhance the mobility of these bound soils contaminants.

Specific gravity is the ratio of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a contaminant will have a tendency to float or sink (as an immiscible liquid) in water if it exceeds its corresponding water solubility.

Vapor pressure and water solubility are of use in determining volatilization rates from surface water bodies and from groundwater. These two parameters can be used to estimate an equilibrium concentration of a contaminant in the water phase and in the air directly above the water. This can be expressed as Henry's Law Constant.

A quantitative assessment of mobility has been developed that uses water solubility (S), vapor pressure (VP), and organic carbon partition coefficient (K_{oc}) (Laskowski, 1983). This value is referred to as the Mobility Index (MI). It is defined as:

$$MI = \log((S*VP)/K_{oc})$$

A scale to evaluate MI is presented by Ford and Gurba (1894):

Relative MI	**Mobility Description**
> 5	extremely mobile
0 to 5	very mobile
-5 to 0	slightly mobile
-10 to -5	immobile
< -10	very immobile

5.2 Contaminant Transport Pathways

Based on the evaluation of existing conditions at Sites 41 and 74, the following potential contaminant transport pathways have been identified.

- On-site atmospheric deposition of windblown dust.
- Leaching of sediment contaminants to surface water.
- Migration of contaminants in surface water.
- Leaching of soil contaminants to groundwater.
- Migration of groundwater contaminants off site.
- Groundwater infiltration from the shallow aquifer to the deep aquifer.

Contaminants released to the environment could also undergo the following during transportation:

- Physical transformations: volatilization, precipitation
- Chemical transformations: photolysis, hydrolysis, oxidation, reduction
- Biological transformation: biodegradation
- Accumulation in one or more media

The following paragraphs describe the potential transport pathways listed above.

5.2.1 On-Site Deposition of Windblown Dust

Wind can act as a contaminant transport pathway agent by eroding exposed soil and exposed sediment and blowing it off site. This is influenced by: wind velocity, the grain size/density of the soil/sediment particles and the amount of vegetative cover over the soil or sediment.

A majority of the surface area of each site is vegetated (i.e., grass, trees), which would serve to retard airborne migration of site contaminants.

5.2.2 Leaching of Sediment Contaminants to Surface Water

When in contact with surface water, contaminants attached to sediment particles can disassociate from the sediment particle into surface water. This is primarily influenced by the physical and chemical properties of the contaminant, (i.e., water solubility, K_{oc}) and the physical and chemical properties of the sediment particle (i.e., grain size, f_{oc}).

Surface water sample analytical results indicate that there has not been significant leaching of sediment contaminants into surface water (Section 4.0), based on the infrequent occurrence and level of contamination.

5.2.3 Leaching of Soil Contaminants to Groundwater

Contaminants that adhere to soil particles or have accumulated in soil pore spaces can leach and migrate vertically to the groundwater. This is influenced by the depth to the water table, precipitation, infiltration, physical and chemical properties of the soil, and physical and chemical properties of the contaminant.

Groundwater samples were collected from shallow and deep monitoring wells at Site 41, and shallow wells only at Site 74. The groundwater analytical results can be compared to soil sample analytical results to determine if contaminants detected in soil have migrated or may migrate in the future, to underlying groundwater.

5.2.4 Migration of Groundwater Contaminants

Contaminants leaching from soils to underlying groundwater can migrate as dissolved constituents in groundwater in the direction of groundwater flow. Three general processes govern the migration of dissolved contaminants caused by the flow of water: (1) advection, movement caused by flow of groundwater; (2) dispersion, movement caused by irregular mixing of waters during advection; and (3) retardation, principally chemical mechanisms which occur during advection. Subsurface transport of the immiscible contaminants is governed by a set of factors different from those of dissolved contaminants. The potential movement of immiscible organic liquids (non-aqueous phase liquids) will not be discussed in this section.

Advection is the process which most strongly influences the migration of dissolved organic solutes. Groundwater, under water table aquifer conditions (i.e., unconfined aquifer), generally flows from regions of the subsurface where the water table is under a higher head to regions (i.e., recharge areas) of where the water table is under a lower head (i.e., discharge areas). Hydraulic gradient is the term used to describe the magnitude of this force (i.e., the slope of the water table). In general, the gradient usually follows the topography for shallow, uniform sandy aquifers which are commonly found in coastal regions. In general, groundwater flow velocities, in sandy aquifers, under natural gradient conditions are probably between 10 meters/year to 100 meters/year (Lyman, et al., 1982).

Thus, when monitoring wells or potable supply wells in sand aquifers are located hundreds of meters downgradient of a contaminant source, the average travel time for the groundwater to flow from the source to the well point is typically on the order of years. In the zone of influence created by a high capacity production well or well field, however, the artificially increased gradient could substantially increase the local velocity, and the average travel times for groundwater flow are increased.

Dispersion results from two basic processes, molecular diffusion and mechanical mixing. The kinetic activity of dissolved solutes result in diffusion of solutes from a zone of high concentration to a lower concentration. Dispersion and spreading during transport result in the dilution of contaminants (maximum concentration of contaminant decreases with distance from the plume). For simple hydrogeological systems, the spreading is reported to be proportional to the flow rate. Furthermore, dispersion in the direction of flow is often observed to be markedly greater than dispersion in the directions transverse (perpendicular) to the flow. In the absence of detailed studies to determine dispersive characteristics at all the sites, longitudinal and transverse dispersivities are estimated based on similar hydrogeological systems (Mackay, et al., 1985).

Some dissolved contaminants may interact with the aquifer solids encountered along the flow path through adsorption, partitioning, ion exchange, and other processes. The interactions result in the contaminant distribution between aqueous phase and aquifer solids, diminution of concentrations in the aqueous phase, and retardation of the movement of the contaminant relative to groundwater flow. The higher the fraction of the contaminant sorbed, the more retarded its transport. Certain halogenated organic solvents sorption is affected by hydrophobility (antipathy for dissolving in water) and the fraction of solid organic matter in the aquifer solids (organic carbon content). If the aquifer below is homogeneous, sorption of hydrophobic organic solute should be constant in space and time. If the sorptive interaction is at equilibrium and completely reversible, the solute should move at a constant average velocity equal to the groundwaters average velocity divided by the retardation factor.

Organic contaminants can be transformed into other organic compounds by a complex set of chemical and biological mechanisms. The principal classes of chemical reactions that can affect organic contaminants in water are hydrolysis and oxidation. However, it is believed that most chemical reactions occurring in the groundwater zone are likely to be slow compared with transformations mediated by microorganisms. Certain organic groundwater contaminants can be biologically transformed by microorganisms attached to solid surfaces within the aquifer. Factors which affect the rates of biotransformation of organic compounds include: water temperature and pH, the number of species of microorganisms present, the concentration of substrate, and presence of microbial toxicants and nutrients, and the availability of electron acceptors. Transformation of a toxic organic solute is no assurance that it has been converted to harmless or even less harmless hazardous products. Biotransformation of common groundwater contaminants, such as TCE, TCA, and PCE, can result in the formation of such intermediates as vinyl chloride (Mackay, et al., 1985).

The interaction of non-ionic organic compounds with solid phases can also be used to predict the fate of the highly nonpolar organic contaminants (i.e., 4,4'-DDT, PCBs). Sorptive binding is proportional to the organic content of the sorbent. Sorption of non-ionic organic pesticides can be attributed to an active fraction of the soil organic matter (Lyman et al., 1982). The uptake of neutral organics by soils results from their partitioning to the solutes aqueous solubility and to its liquid-liquid (e.g., octanol-water) partition coefficient (Chiou, 1979). Currently, literature information is available on the interrelation of soil organic properties to the binding of pesticides, herbicides, and high molecular weight pollutants such as PCBs. Organic matrices in natural systems that have varying origins, degrees of humification, and degrees of association with inorganic matrices exhibit dissimilarities in their ability to sorb non-ionic organic contaminants.

The soils and sediments formed or deposited on the land surface can act as a reservoir for inorganic contaminants. Soils contain surface-active mineral and humic constituents involved in reactions that affect metal retention. The surfaces of fine-grained soil particles are very active chemically; surface sites are negatively or positively charged or they are electronically neutral. Oppositely charged metallic counterions from solutions in soils (i.e., groundwater) are attracted to these charged surfaces. The relative proportions of ions attracted to these various sites depends on the degree of acidity or alkalinity of the soil, on its mineralogical composition, and on its content of organic matter. The extent of adsorption depends on either the respective charges on the adsorbing surface and the metallic cation. In addition to these adsorption reactions, precipitation of new mineral phases also may occur if the chemical composition of the soil solution becomes supersaturated with respect to the insoluble precipitates. Of the probable precipitates, the most important of these phases are hydroxides, carbonates, and sulfides. The precipitation of hydroxide minerals is important for metals such as iron and aluminum, the precipitation of carbonate minerals is significant for calcium and barium, and the precipitation of sulfide minerals dominates the soil chemistry of zinc, cadmium, and mercury. A number of precipitates may form if metals are added to soils, the concentration of metal in solution, will be controlled, at equilibrium, by the solid phase that results in the lowest value of the activity of the metallic ion in solution (Evans, 1989).

Table 5-2 presents the general processes which influence the aquatic fate of contaminants at OU No. 4.

The following paragraphs summarize the site-specific fate and transport data for some potential contaminants of concern at OU No. 4.

5.3 Fate and Transport Summary

The following paragraphs summarize the contaminant group fate and transport data for contaminants detected in media collected at OU No. 4.

5.3.1 Volatile Organic Compounds

VOCs (i.e., vinyl chloride, TCE, and PCA) tend to be mobile in environmental media as indicated by their presence in groundwater and their corresponding MI values. Their environmental mobility is a function of high water solubilities, high vapor pressures, low K_{ow} and K_{oc} values, and high mobility indices.

Without a continuing source, VOCs do not generally tend to persist in environmental media because photolysis, oxidation, and biodegradation figure significantly in their removal.

5.3.2 Polycyclic Aromatic Hydrocarbons

Low water solubilities, high K_{ow} and K_{oc} indicate a strong tendency for PAHs to adsorb to soils. Of the PAHs, fluoranthene, is probably the best marker compound, since it is consistently the most abundant of the PAHs measured and provides the strongest correlation with total PAH values. Benzo(g, h, i) perylene is usually the most abundant compound in soils with low PAH values but becomes less important with increasing total PAH values. Other PAH are benzo(a)anthracene, chrysene, pyrene, benzo(g,h,i) perylene, benzo(b)fluoranthene and phenanthrene. Their mobility indices indicate that they are relatively immobile from a physical-chemical standpoint. An exception is naphthalene, which is considered only slightly immobile because of somewhat higher water solubility (Jones, et al., 1989).

PAHs generally lack adequate vapor pressures to be transmitted via vaporization and subsequent airborne transport. However, surface and shallow surface soil particles containing PAHs could potentially be subject to airborne transport and subsequent deposition, especially during mechanical disturbances such as vehicle traffic or digging (Jones, et al., 1989).

PAHs are somewhat persistent in the environment. In general their persistence increases with increasing ring numbers. Photolysis and oxidation may be important removal mechanisms in surface waters and surficial soils, while biodegradation could be an important fate process in groundwater, surface soils or deeper soils. PAHs are ubiquitous in nature. The presence of PAHs in the soil may be the result of aerially deposited material, and the chemical and biological conditions in the soil which result in selective microbial degradation/breakdown.

5.3.3 Pesticides/Polychlorinated Biphenyls

Pesticides/PCBs are persistent and immobile contaminants in environmental media. Pesticides travel at varying rates through soil, mainly due to their affinity for soil surfaces. The soil sorption coefficient (K_d) is the distribution of a pesticide between soil and water. In general, the K_d values are higher for high organic carbon soil than for low organic carbon soils. Therefore, soils with high K_d values will retain pesticides (i.e., 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD). As evidenced by the ubiquitous nature of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD, volatilization is an important transport process from soils and waters.

PCBs have low vapor pressures, low water solubilities, and high K_{oc} and K_{ow} values. Adsorption of these contaminants to soil and sediment is the major fate of these contaminants in the environment.

5.3.4 Inorganics

Inorganics can be found as solid complexes at ambient temperature and pressure in soils at the site. Inorganic ions exist in pure solutions as hydrated ions. Groundwater, as opposed to a pure solution, is a highly complex chemical system which is heavily influenced by the mineralogy of the substrate. Factors affecting the transport of inorganics in saturated soils are interactive and far more complex and numerous than those affecting the transport of organic contaminants.

The most complicated pathway for inorganic contaminants is migration in subsurface soils and groundwaters, where oxidation reduction potential (Eh) and pH play critical roles. Table 5-3 presents and assessment of relative inorganic environmental mobilities as a function of Eh and pH. Soils at MCB Camp Lejeune are relatively neutral, therefore, inorganics in the subsurface soil should be relatively immobile.

Transport of inorganic species in groundwater is mainly a function of the inorganic's solubility in solution under the chemical conditions of the soil-solution matrix. The inorganic must be dissolved (i.e. in solution) for leaching and transport by advection with the groundwater to occur. Generally, dynamic and reversible processes control solubility and transport of the dissolved metal ions. Such process include precipitation/dissolution, adsorption/desorption, and ion exchange.

Inorganics could be sorbed onto colloidal materials, theoretically increasing their inherent mobility in saturated porous media. It is important to note, however, that colloids themselves are not mobile in most soil/water systems.

Inorganics such as arsenic and chromium depend upon speciation to influence their mobility. Speciation varies with the chemistry of the environmental medium and temporal factors. These variables make the site-specific mobility of an inorganic constituent difficult to assess.

SECTION 5.0 TABLES

TABLE 5-1

ORGANIC PHYSICAL AND CHEMICAL PROPERTIES
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Chemical	Vapor Pressure (mm Hg)	Water Solubility (mg/L)	Octanol/Water Coefficient (log K_{ow})	Sediment Partition (log K_{oc})	Specific Gravity (g/cm^3)	Henry's Law Constant (atm-m^3/mole)	Mobility Index	Comments
Volatiles:								
Benzene	76	1780	2.13	1.92	0.879	5.55E-03	3.2	Very mobile
Bromodichloromethane	50	4500	2.10	1.79	--	2.41E-03	3.6	Very mobile
Chlorobenzene	8.8	500	2.84	2.64	1.1066	3.58E-03	1	Very mobile
1,1-Dichloroethene	500	400	1.48	2.26	1.218	1.90E-01	3.0	Very mobile
1,2-Dichloroethene	200	600	1.48	2.17	1.26	5.32E-03	2.9	Very mobile
Ethylbenzene	7	152	3.15	2.93	0.867	6.44E-03	0.1	Very mobile
Tetrachloroethene	14	150	2.6	2.6	1.626	2.87E-03	0.75	Very mobile
Toluene	22	515	2.69	2.54	0.867	5.90E-03	1.5	Very mobile
1,1,2,2-Trichloroethane	5	2900	2.56	1.92	1.60	3.83E-04	2.2	Very mobile
Trichloroethene	60	1100	2.29	2.09	1.46	1.17E-03	2.7	Very mobile
Vinyl chloride	2660	1100	0.6	1.91	0.9121	8.14E-02	4.6	Very mobile
Xylenes (total)	6	180	3.02	2.84	0.87	4.64E-03	0.19	Very mobile
Semivolatiles:								
Benzo(a)anthracene	5.0E-09	0.014	5.61	5.34	NA	1.0E-06	-15.5	Very Immobile
Benzo(b)fluoranthene	10E-06 to 10E-07	0.009	6.57	6.26	NA	1.22E-05	-14	Very Immobile
Benzo(k)fluoranthene	9.6E-11	0.0016	6.84	6.22	NA	3.87E-05	-19	Very Immobile
Benzo(a)pyrene	5.0E-09	0.0038	6.04	5.72	NA	4.9E-07	-16.4	Very Immobile
Chrysene	10E-06 to 10E-11	0.006	5.61	5.44	1.274	1.1E-06	-13.7	Very Immobile
1,4-Dichlorobenzene	6.0E-01	49	3.39	3.22	1.458	3.1E-03	-1.8	Slightly mobile
Fluoranthene	10E-06 to 10E-04	0.265	5.33	4.84	NA	6.5E-06	-9.4	Immobile

TABLE 5-1 (Continued)

ORGANIC PHYSICAL AND CHEMICAL PROPERTIES
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Chemical	Vapor Pressure (mm Hg)	Water Solubility (mg/L)	Octanol/Water Coefficient (log K_{ow})	Sediment Partition (log K_{oc})	Specific Gravity (g/cm^3)	Henry's Law Constant (atm-m^3/mole)	Mobility Index	Comments
Ideno(1,2,3-cd)pyrene	1E-10	5.3E-04	6.51	6.20	1.070	6.95E-08	-19.5	Very Immobile
Pyrene	6.85	0.14	5.32	4.91	NA	5.1E-06	-11.9	Very Immobile
Pesticides/PCBs:								
Aldrin	2.31E-05	0.01	4.45	3.01	NA	1.6E-05	-11	Immobile
alpha-BHC	2.5E-05	2.0	3.46	3.81	NA	6.0E-06	-7.8	Immobile
beta-BHC	2.8E-07	0.70	3.35	3.80	NA	4.5E-07	-10	Immobile
Chlordane	1.0E-05	1.85	3.19	2.78	NA	4.8E-05	-7.9	Immobile
delta-BHC	1.7E-05	17	3.29	4.14	1.87	3.84E-07	-6.8	Immobile
Dieldrin	1.87E-04	0.1	5.6	4.31	1.75	4.57E-10	-12	Very Immobile
4,4-DDT	1.9E-07	0.0034	6.19	4.89	NA	1.58E-05	-14	Very immobile
4,4-DDD	10.2E-07	0.09	5.99	4.47	NA	2.2E-08	-12	Very immobile
4,4-DDE	6.5E-06	0.04	4.28	3.66	NA	6.8E-05	-10	Immobile
Endosulfan I	9.0E-03	0.10	3.47	3.62	NA	1.0E-05	-6.5	Immobile
Endrin	2.0E-07	0.26	5.6	4.06	NA	4.0E-07	-11	Very Immobile
Heptachlor	3.0E-04	0.18	4.15	5.3	1.57	4.0E-03	-8.4	Immobile
Heptachlor Epoxide	3.0E-04	0.35	3.99	5.0	NA	3.9E-04	-7.9	Immobile
PCB-1254	7.7E-05	0.03	6.03	4.59	1.50	2.80E-03	-10	Immobile
PCB-1260	4.1E-05	0.003	4.87	6.11	1.58	7.1E-03	-12	Immobile

Notes: NA - Not Applicable

Sources:
1. Verscheuren, K. 1983. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York.
2. Lyman, et al. 1982. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds.
3. USEPA. 1982. Aquatic Fate Process Data for Organic Priority Pollutants. Final Report.

TABLE 5-2

PROCESSES INFLUENCING FATE OF ORGANIC POLLUTANTS
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Processes					
	Sorption	Volatilization	Biodegradation	Photolysis-Direct	Hydrolysis	Bioaccumulation
Pesticides/PCBs						
Aldrin	+	+	?	-	-	+
Chlordane	+	+	?	-	-	+
DDD	+	+	-	-	-	+
DDE	+	+	-	+	-	+
DDT	+	+	-	-	+	+
Dieldrin	+	+	-	+	-	+
Endosulfan and Endosulfan Sulfate	+	+	+	?	+	-
Endrin and Endrin Aldehyde	?	?	?	+	-	+
Heptachlor	+	+	-	?	++	+
Heptachlor Epoxide	+	-	?	?	-	+
PCBs	+	+	+(1)	?	-	+
Halogenated Aliphatic Hydrocarbons						
Chloromethane (methyl chloride)	-	+	-	-	-	-
Dichloromethane (methylene chloride)	-	+	?	-	-	-
1,1-Dichloroethane (ethylidene chloride)	-	+	?	-	-	-
1,2-Dichloroethane (ethylene dichloride)	-	+	?	-	-	-
1,1,2-Trichloroethane	?	+	-	-	-	?
Chloroethene (vinyl chloride)	+	-	-	-	-	-
1,1,-Dichloroethene (vinylidene chloride)	?	+	?	-	-	?
Trichloroethene	-	+	?	-	-	-
Tetrachloroethene (perchloroethylene)	-	+	+	-	-	-

TABLE 5-2 (Continued)

PROCESSES INFLUENCING FATE OF ORGANIC POLLUTANTS
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Processes					
	Sorption	Volatilization	Biodegradation	Photolysis-Direct	Hydrolysis	Bioaccumulation
Bromodichloromethane	?	?	?	?	-	+
Dichlorodifluoromethane	?	+	-	?	-	?
Monocyclic Aromatics						
Benzene	+	+	-	-	-	-
Ethylbenzene	?	+	?	-	-	-
Toluene	+	+	?	-	-	-
Phenol	-	+	+	-	-	-
2,4-Dimethyl phenol (2,4-xylenol)	-	-	?	+	-	-
Phthalate Esters						
Dimethyl phthalate	+	-	+	-	-	+
Diethyl phthalate	+	-	+	-	-	+
Di-n-butyl phthalate	+	-	+	-	-	+
Di-n-octyl phthalate	+	-	+	-	-	+
Bis (2-ethylhexyl) phthalate	+	-	+	-	-	+
Butyl benzyl phthalate	+	-	+	-	-	+
Polycyclic Aromatic Hydrocarbons						
Acenaphthene(3)	+	-	+	+	-	-
Acenaphthylene(3)	+	-	+	+	-	-
Fluorene(3)	+	-	+	+	-	-
Naphthalene	+	-	+	+	-	-
Anthracene	+	+	+	+	-	-
Fluoranthene(3)	+	+	+	+	-	-

TABLE 5-2 (Continued)

PROCESSES INFLUENCING FATE OF ORGANIC POLLUTANTS
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Processes					
	Sorption	Volatilization	Biodegradation	Photolysis-Direct	Hydrolysis	Bioaccumulation
Phenanthrene[3]	+	+	+	+	-	-
Benzo(a)anthracene	+	+	+	+	-	-
Benzo(b)fluoranthene[3]	+	-	+	+	-	-
Benzo(k)fluoranthene[3]	+	-	+	+	-	-
Chrysene[3]	+	-	+	+	-	-
Pyrene[3]	+	-	+	+	-	-
Benzo(g,h,i)perylene[3]	+	-	+	+	-	-
Benzo(a)pyrene	+	+	+	+	-	-
Dibenzo(a,h)anthracene[3]	+	-	+	+	-	-
Ideno(1,2,3-cd)pyrene[3]	+	-	+	+	-	-

++ Predominate fate determining process
\+ Could be an important fate process
\- Not Likely to be an important process
? Importance of process uncertain or not known

Notes: (1) Biodegradation is the only process known to transform polychlorinated biphenyls under environmental conditions, and only the lighter compounds are measurably biodegraded. There is experimental evidence that the heavier polychlorinated biphenyls (five chlorine atoms or more per molecule) can be photolyzed by ultraviolet light, but there are no data to indicate that this process is operative in the environment.
(2) Based on information for 4-nitrophenol.
(3) Based on information for PAHs as a group. Little or no information for these compounds exists.

Source: USEPA. 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Groundwater - Part I.

TABLE 5-3

RELATIVE MOBILITIES OF INORGANICS AS A FUNCTION OF ENVIRONMENTAL CONDITIONS (Eh, pH)
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Relative Mobility	Environmental Conditions			
	Oxidizing	Acidic	Neutral/ Alkaline	Reducing
Very high			Se	
High	Se, Zn	Se, Zn, Cu, Ni, Hg, Ag		
Medium	Cu, Ni, Hg, Ag, As, Cd	As, Cd	As, Cd	
Low	Pb, Ba, Se	Pb, Ba, Be	Pb, Ba, Be	
Very Low	Fe, Cr	Cr	Cr, Zn, Cu, Ni, Hg, Ag	Cr, Se, Zn, Cu, Ni, Hg, Pb, Ba, Be, Ag

Notes:

Se = Selenium	Cd = Cadmium
Zn = Zinc	Ba = Barium
Cu = Copper	Pb = Lead
Ni = Nickel	Fe = Iron
Hg = Mercury	Cr = Chromium
Ag = Silver	Be = Beryllium
As = Arsenic	Zn = Zinc

Source: Swartzbaugh, et al. "Remediating Sites Contaminated with Heavy Metals." Hazardous Materials Control, November/December 1992.

6.0 BASELINE RISK ASSESSMENT

6.1 Introduction

The Baseline Risk Assessment (BRA) investigates the potential for contaminants of potential concern to affect human health and/or the environment, both now and in the future, under a "no further remedial action scenario." The BRA process evaluates the data generated during the sampling and analytical phase of the RI, identifying areas of interest and contaminants of concern with respect to geographical, demographic, and physical and biological characteristics of the study area. These, combined with the current understanding of physical and chemical properties of the site-associated constituents (with respect to environmental fate and transport processes), are then used to estimate the concentrations of contaminants at the end points of logical exposure pathways. Finally, contaminant intakes by hypothetical receptors are determined and combined with the toxicological properties of the contaminants to estimate (inferentially) the potential public health impacts posed by constituents detected at the sites.

This BRA is conducted in accordance with current USEPA Risk Assessment Guidance (USEPA, 1989a and USEPA, 1991a), and USEPA Region IV Supplemental Risk Guidance (USEPA, 1992d).

The components of the BRA include:

- Identification of contaminants of potential concern
- The exposure assessment
- The toxicity assessment
- Risk characterization
- Uncertainty analysis
- Conclusions of the BRA and potential site risk

The BRA is divided into seven sections, including the introduction. Section 6.2 establishes the criteria for the selection of contaminants of potential concern (COPCs). The COPCs are chosen, for each media at each site, from an overall list of contaminants detected at the site. Section 6.3 discusses the site characteristics, identifies potential human exposure pathways, and describes potential current and future exposure scenarios. Section 6.4 presents the estimation of potential exposure, discussing the estimation of daily intakes, incremental cancer risks and hazard indices. In addition, advisory criteria for the evaluation of human health is discussed. Section 6.5 discusses the risk characterization. Section 6.6 discusses the sources of uncertainty in the BRA. Section 6.7 provides the conclusion for the potential human health impacts in the form of total site risks. Referenced tables and figures are presented after the text portion of this section.

6.2 Contaminants of Potential Concern

COPCs are site-related contaminants used to quantitatively estimate human exposures and associated potential health effects. Five environmental media were investigated during this RI: surface soils, subsurface soils, groundwater, surface water, and sediments. This section presents the selection of COPCs for these media. The discussion of findings presented in Section 4.0, Nature and Extent of Contamination, was used as the basis for this section.

6.2.1 Criteria for Selecting Contaminants of Potential Concern

The criteria used in selecting the COPCs from the constituents detected during the field sampling and analytical phase of the investigation are:

- Historical information
- Prevalence
- Mobility
- Persistence
- Toxicity
- Examination of Federal and State criteria and standards
- Comparison to Risk-Based Concentrations (RBCs)
- Comparison to investigation associated field and laboratory blank data
- Comparison to background or naturally occurring levels
- Comparison to anthropogenic levels

The criteria chosen to establish the COPCs are based on the guidance in the USEPA's Risk Assessment Guidance for Superfund (USEPA, 1989a). A comparison to contaminant-specific criteria is also considered in the selection of COPCs. A brief description of the selection criteria used in choosing final COPCs is presented below. It is not required that a contaminant meet all criteria categories to be retained as a COPC.

6.2.1.1 Historical Information

In order to estimate potential human health effects associated with contaminants identified at OU No. 4, the study area is divided into three areas of concern: Site 41 and Site 74. The OU is divided into these areas based upon their current accessibility and usage. The following is a description of these areas of concern:

- Site 41 was used as an open burn dump from 1946 to 1970. The dump received construction debris and several types of wastes including petroleum, oil and lubricants, solvents, batteries, mirex in bags, and ordnance. It is known that drums of chemical training agents, which may contain small quantities of blistering agents, were disposed at Site 41. The site area is heavily wooded and vegetated. The area of the former dump is approximately 30 acres.

- There are two areas of concern at Site 74: the Grease Pit Disposal Area and the Former Pest Control Area. The grease pit reportedly measures 135 feet long by 30 feet wide by 12 feet deep (ESE, 1991). However, this pit was not observed during the June 1992 site visit, nor was it detected by geophysical techniques. The second area of concern, the Former Pest Control Area, reportedly measures 100 feet by 100 feet; however, the area was not recognizable during the 1992 site visit. The general area is heavily overgrown with vegetation and looks similar to the surrounding area.

  There are presently no disposal activities on site. Drums containing either pesticides or transformer oil containing PCBs and pesticide-soaked bags were also reportedly disposed near the grease pit. Drums containing chemical surety materials may also be present since it was reported that drums that were supposed to be disposed at Site 69 were taken to Site 74.

The association of contaminants with site activities based on historical information is used along with the following procedures to determine retention or elimination of contaminants.

6.2.1.2 Prevalence

The frequency of positive detections in sample sets and the level at which a contaminant is detected in a given medium are factors that determine a chemical's prevalence. The judicious use of data is used in setting limits on the inclusion of infrequently detected contaminants. The occurrence of a chemical must be evaluated with respect to the number of samples taken to determine the frequency criterion which warrants the inclusion of a chemical as a COPC. Contaminants that are infrequently detected, (i.e., less than 5 percent, when at least 20 samples of a medium are available) may be artifacts in the data due to sampling or analytical practices. A contaminant may not be retained for quantitative evaluation in the BRA if: (1) it is detected infrequently in an environmental medium, (2) it is absent or detected at low concentrations in other media, or (3) site history does not provide evidence the contaminant to be present.

6.2.1.3 Mobility

The physical and chemical properties of a contaminant are responsible for its transport in the environment. These properties, in conjunction with site conditions, determine whether a contaminant will tend to volatilize into the air from surface soils or surface waters, or be transported via advection or diffusion through soils, groundwaters, and surface waters. Physical and chemical properties also describe a contaminant's tendency to adsorb onto soil/sediment particles. Environmental mobility can correspond to either an increased or decreased potential to affect human health and/or the environment.

6.2.1.4 Persistence

The persistence of a contaminant in the environment depends on factors such as the microbial content of soil and water, organic carbon content, the concentration of the contaminant, climate, and the ability of the microbes to degrade the contaminant under site conditions. In addition, chemical degradation (i.e., hydrolysis), photochemical degradation and certain fate processes such as sorption may contribute to the elimination or retention of a particular compound in a given medium.

6.2.1.5 Toxicity

The potential toxicity of a contaminant is an important consideration when selecting COPCs for further evaluation in the human health assessment. For example, the weight-of-evidence (WOE) classification should be considered in conjunction with concentrations detected at the site. Some effects considered in the selection of COPCs include carcinogenicity, mutagenicity, teratogenicity, systemic effects, and reproductive toxicity. Bioaccumulation and bioconcentration properties may affect the severity of the toxic response in an organism and/or subsequent receptors and are evaluated if relevant data exist.

Despite their inherent toxicity, certain inorganic contaminants are essential nutrients. Essential nutrients need not be considered for further consideration in the quantitative risk assessment if they are present in relatively low concentration (i.e., below 2 times the average base-specific background levels or slightly elevated above naturally occurring levels), or if the contaminant is toxic at doses much higher than those which could be assimilated through exposures at the site.

6.2.1.6 State and Federal Criteria and Standards

Contaminant concentrations can be compared to contaminant-specific established State and Federal criteria and standards such as Maximum Contaminant Levels (MCLs) or Ambient Water Quality Criteria (AWQC).

The only enforceable Federal regulatory standards for water are the Federal MCLs. In addition to the Federal standards, the State of North Carolina has developed the North Carolina Water Quality Standards (NCWQS) for groundwater and surface water. Regulatory guidelines were used for comparative purposes to infer the potential health risks and environmental impacts when necessary. Relevant regulatory guidelines include AWQC and Health Advisories.

In general, chemical-specific criteria and standards are not available for soil. Therefore, base-specific background concentrations were compiled to evaluate background levels of organic and inorganic constituents in the surface and subsurface soil. Organic contaminants were not detected in the base-specific background samples. Therefore, it is likely that all organic contaminants detected in the surface and subsurface soil, are attributable to the practices which have or are currently taking place within the areas of concern. Additionally, in order to evaluate soil concentrations, the risk-based concentrations (RBCs) for residential soil ingestion developed by USEPA (Region III) were used as guidance criteria to evaluate soil concentrations. The RBCs were used as a benchmark for evaluating site investigation data and to assist in predicting single-contaminant health risks. These values were used in conjunction with other criteria in the selection of COPCs.

A brief explanation of the criteria and standards used for the evaluation of COPCs is presented below.

Maximum Contaminant Levels - MCLs are enforceable standards for public water supplies promulgated under the Safe Drinking Water Act and are designed for the protection of human health. MCLs are based on laboratory or epidemiological studies and apply to drinking water supplies consumed by a minimum of 25 persons. They are designed for prevention of human health effects associated with a lifetime exposure (70-year lifetime) of an average adult (70 kg) consuming 2 liters of water per day. MCLs also consider the technical feasibility of removing the contaminant from the public water supply.

North Carolina Water Quality Standards (Groundwater) - NCWQSs are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or which otherwise render the groundwater unsuitable for its intended purpose.

Health Advisories - HAs are guidelines developed by the USEPA Office of Drinking Water for nonregulated constituents in drinking water. These guidelines are designed to consider both acute and chronic toxic effects in children (assumed body weight 10 kg) who consume 1 liter of water per day or in adults (assumed body weight 70 kg) who consume 2 liters of water per day. HAs are generally available for acute (1 day), and subchronic (10 days), and chronic (longer-term) exposure scenarios. These guidelines are designed to consider only threshold effects and, as such, are not used to set acceptable levels of potential human carcinogens.

Ambient Water Quality Criteria - AWQCs are non-enforceable regulatory guidelines and are of primary utility in assessing acute and chronic toxic effects in aquatic systems. They may also be used for identifying the potential for human health risks. AWQCs consider acute and chronic effects in both freshwater and saltwater aquatic life, and potential carcinogenic and noncarcinogenic health effects in humans from ingestion of both water (2 liters/day) and aquatic organisms (6.5 grams/day), or from ingestion of water alone (2 liters/day). The AWQCs for the protection of human health for potential carcinogenic substances are based on the USEPA's specified incremental cancer risk range of one additional case of cancer in an exposed population of 10,000,000 to 100,000 (i.e. the 10E-7 to 10E-5 range).

North Carolina Water Quality Standards (Surface Water) - The NCWQSs for surface water are the standard concentrations, that either alone or in combination with other wastes, in surface waters that will not render waters injurious to aquatic life or wildlife, recreational activities, public health, or impair the waters for any designated use.

Region IV Sediment Screening Values - Federal sediment quality criteria for the protection of aquatic life are being developed. In the interim, the EPA Region IV Waste Management Division recommends the use of sediment values compiled by the National Oceanic and Atmospheric Administration (NOAA) as screening values for evaluating the potential for chemical constituents in sediments to cause adverse biological effects. NOAA developed this screening method through evaluation of biological effects data for aquatic (marine and freshwater) organisms, obtained through equilibrium partitioning calculations, spiked-sediment bioassays, and concurrent biological and chemical field surveys. For each constituent having sufficient data available, the concentrations causing adverse biological effects were arrayed, and the lower 10 percentile (called an Effects Range-Low, or ER-L) and the median (called an Effects Range-Median, or ER-M) were determined.

If sediment contaminant concentrations are above the ER-M, adverse effects on the biota are considered probable. If contaminant concentrations are between the ER-L and the ER-M, adverse effects are considered possible, and EPA recommends conducting sediment toxicity tests as a follow-up. If contaminant concentrations are below the ER-L, adverse effects are considered unlikely.

6.2.1.7 Risk-Based Concentrations (RBCs)

The RBCs were developed by the USEPA, Region III as benchmark concentrations for evaluating site investigation data. RBCs are not intended as stand-alone decision-making tools, but as a screening tool to be used in conjunction with other information to help in the selection of COPCs. Selecting COPCs using RBCs is accomplished by the comparison of the maximum concentrations of each contaminant detected in each medium to its corresponding RBC. The RBCs were developed using conservative default exposure scenarios suggested by the USEPA, and the latest available toxicity indices for carcinogenic and systemic chemicals. The RBC corresponds to a Hazard Quotient of 0.1 and a lifetime cancer risk of 1E-6. The RBCs represent protective environmental concentrations at which the USEPA would not typically take action (USEPA, Region III, 1994a).

6.2.1.8 Contaminant Concentrations in Blanks

The association with contaminants detected in field related blanks (i.e., trip blanks, equipment rinsates and/or field blanks) or laboratory method blanks with the same contaminants detected in analytical samples may eliminate non-site-related contaminants from the list of COPCs. Blank data should be compared with results from samples with which the blanks are associated. However, due to the difficulty in determining this association between certain blanks and data, the maximum contaminant concentrations reported in the blanks will be compared to the entire sample data set to evaluate COPCs. In accordance with the National Functional Guidelines for Organics common lab contaminants (i.e., acetone, 2-butanone, methylene chloride, toluene, and phthalate esters) should be considered attributable to site activities only if the concentrations in the sample exceed ten times the maximum amount detected in any blank. If a contaminant is not a common lab contaminant, then concentrations that are less than 5 times the concentration found in any blank are believed to be non-site-related. The elimination of a sample result will directly correlate to a reduction in the prevalence of the contaminant in that media. Consequently, a contaminant that may have been included on the basis of prevalencey would be eliminated as a COPC if elimination due to blank concentration reduces the prevalence of a contaminant to less than five percent.

The maximum concentrations of detected common laboratory contaminants in blanks are as follows:

- Acetone 190 µg/L
- Methylene Chloride 8.0 µg/L
- Toluene 1.0 µg/L
- Di-n-butylphthalate 2.0 µg/L
- bis(2-ethylhexyl)phthalate 4.0 µg/L

Blanks containing organic constituents that are not considered common laboratory contaminants (i.e., all other TCL compounds) are considered as positive results only when observed concentrations exceeded five times the maximum concentration detected in any blank (USEPA, 1989b). All TCL compounds at less than five times the maximum level of contamination noted in any blank are considered to be not detected in that sample. The maximum concentrations of all other detected blank contaminants are as follows:

- Chloroform 10 µg/L
- Bromodichloromethane 4.0 µg/L
- Dibromochloromethane 2.0 µg/L
- Total Xylenes 4.0 µg/L
- Heptachlor 0.03 µg/L

When assessing soil concentrations, the Contract Required Quantitation Limits (CRQL) and percent moisture were accounted for in order to correlate solid and aqueous quantitation limits. For example, when assessing semivolatile contaminants the CRQL for solid samples is 33 to 66 times (depending on the contaminant) that of aqueous samples. Therefore, in order to assess contaminant levels in soil samples using an aqueous blank concentration, the concentration must be multiplied by 5 or 10 (noncommon or common lab contaminant) and then multiplied by 33 or 66 to correct for the variance in the CRQL. This value is then divided by the percent moisture determined for the sample.

6.2.1.9 Background Naturally Occurring Levels

Naturally occurring levels of chemicals are present under ambient conditions. In general, comparison with naturally occurring levels is applicable only to inorganic analytes, because a majority of organic contaminants are not naturally occurring. Background samples were collected from areas that are known to be uninfluenced by site contamination. An inorganic concentration was considered site-related only if it exceeded two times the mean concentration estimated for the site-specific background samples. The mean for the surface soil inorganics was estimated using 17 data points. The mean for the subsurface soil inorganics was estimated using inorganic results from six sample locations. Consequently, a 95th U.C.L. cannot statistically be estimated for these sample sets.

6.2.1.10 Anthropogenic Levels

Ubiquitous anthropogenic background concentrations result from non-site related sources such as combustion of fossil fuels (i.e., automobiles), plant synthesis, natural fires and factories. A good example of ubiquitous, anthropogenic chemicals in environmental are the PAHs. In general, anthropogenic chemicals were not eliminated as COPCs without considering other selection criteria. It is difficult to determine that such chemicals are present at the site due to operations not related to the site or the surrounding area. Omitting anthropogenic background chemicals from the risk assessment could result in the loss of important information for those potentially exposed.

The remaining sections apply the aforementioned selection criteria beginning with the prevalence of detected analytical results in each medium of interest to establish a preliminary list of COPC for Sites 41 and 74. Once this task is completed, a final list of media-specific COPCs will be selected based on the remaining criteria (persistence, mobility, toxicity, ARARs, RBCs, blank concentrations, background concentrations, and anthropogenic concentrations).

6.2.2 Selection of Contaminants of Potential Concern

The following sections present an overview of the analytical data obtained for each medium and site during the RI and the subsequent retention or elimination of COPCs using the aforementioned criteria for selection of COPCs.

6.2.2.1 Site 41

Surface Soil

Forty six (46) surface soil samples were submitted for analysis of VOCs. Concentrations of methylene chloride (13 of 46 samples) and toluene (3 of 46 samples) are related to the levels of these contaminants reported in the investigation associated QA/QC blanks. Acetone was detected in 11 of 46 samples, however, the acetone levels in 10 of the 11 samples is attributed to QA/QC blanks. Consequently, the prevalence of this contaminant is less than five percent and is not warranted for retention as a COPC.

In the surface soil, the PAHs anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene are retained as COPCs based on prevalence (at least 3 detections in 46 samples). Additionally, the SVOC bis(2-chloroethyl)ether is retained due to prevalence. Other SVOCs including 1,4-

dichlorobenzene, 2-methylnaphthalene, acenaphthene, carbazole, dibenzofuran, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, and naphthalene are not prevalent (detected in less than three samples) and are not retained as COPCs.

Several pesticides and PCBs were detected in the 46 surface soil samples. However, only the following are detected at a frequency that warranted retention as COPCs: heptachlor, heptachlor epoxide, dieldrin, 4,4'-DDE, endosulfan II, 4,4'-DDD, 4,4'-DDT, endrin aldehyde, alpha-chlordane, and gamma-chlordane.

Inorganic constituents arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, vanadium, and zinc, are prevalent in the surface soil at concentrations greater than two times the average base-specific background concentration, therefore, are retained as COPCs.

Other inorganics (i.e., calcium, potassium, sodium) are not retained as COPCs. These inorganics are believed to nontoxic or are considered essential nutrients.

Presented in Table 6-1 are the surface soil concentration ranges and frequency for the positively detected organic compounds. Table 6-2 presents the surface soil inorganic ranges and frequency along with a comparison to the base-specific background concentrations.

Subsurface Soil

The VOCs trichloroethene, benzene, chloromethane, and ethylbenzene were infrequently detected (less than five percent) in the subsurface soil and did not warrant retention as COPCs. The concentrations of methylene chloride (maximum 26 μg/kg) are attributable to the blank concentrations (80 μg/L). Acetone was detected in 34 of 66 samples. However, the prevalence of this contaminant is less than five percent if concentrations due to blank contamination are eliminated. Consequently, this compound is not retained as a COPC.

SVOCs were detected in the 66 subsurface soil samples. Of the SVOCs detected only 2-methlynaphthalene, benzo(g,h,i)perylene, benzo(a)pyrene, fluoranthene, naphthalene, phenanthrene, and pyrene were detected at a frequency greater than five percent (at least 4 positive detects). Therefore, using prevalence as a criteria these contaminants are retained as COPCs. The phthalate esters, although prevalent, are not retained as COPCs due to their presence in investigation related QA/QC samples and knowledge of site history. Note that the variations in the analytical detection limits is taken into account when assessing the concentrations in the soil using aqueous blanks.

Several pesticides and PCBs were detected in the 66 subsurface soil samples. Of these contaminants, the following are detected at a frequency greater than five percent and retained as COPCs: heptachlor, aldrin, heptachlor epoxide, endosulfan I, dieldrin, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, endrin, endosulfan II, endrin aldehyde, alpha-chlordane, gamma-chlordane, PCB-1254 and PCB-1260. Other pesticide compounds which are not frequently detected (less than 3 of 66 samples) included delta-BHC, gamma-BHC, methoxychlor, and endrin ketone. These compounds are not retained as COPCs.

Inorganic constituents which are prevalent in the subsurface soil at concentrations greater than two times the average base-specific concentration, therefore, were retained as COPCs included arsenic, barium, beryllium, chromium, copper, lead, manganese, mercury, vanadium, zinc, and cyanide.

Presented in Table 6-3 are the subsurface soil concentration ranges and frequency for the positively detected organic compounds. Table 6-4 presents the subsurface soil inorganic ranges and frequency along with a comparison to the base-specific background concentrations.

Groundwater

Eighteen (18) groundwater samples were collected for VOCs. VOC contaminants 1,1,1-Trichloroethane, benzene, and chlorobenzene were detected at a concentration less than the CRQL in 1 of 18 groundwater samples. The infrequent detection at a concentration less than the CRQL does not warrant the retention of these contaminants as COPCs. The presence of acetone (maximum 12 µg/L) is attributable to the concentrations detected in the blanks (190 µg/L). Therefore, this contaminant is not retained as a COPC.

Eighteen (18) groundwater samples were submitted for analysis of SVOCs. SVOCs were absent in all of the groundwater samples. Therefore, no SVOCs are retained as COPCs.

Eighteen (18) groundwater samples were analyzed for pesticides and PCBs. Pesticide and PCB contaminants were determined to be absent in the groundwater. Therefore, no pesticides and PCBs warrant retention as COPCs.

Several total inorganic constituents including arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, selenium, vanadium, and zinc are retained as COPCs using prevalence as a screening criteria.

Table 6-5 presents a comparison of the organic and inorganic groundwater findings to the applicable State and Federal groundwater criteria. Note that contaminants which may not warrant retention as COPCs for risk evaluation are included on the table for qualitative evaluation.

Surface Water

During the investigation surface water samples were obtained from the Unnamed Tributary and Tank Creek. These surface water body do not support recreational activities such as swimming which would present a human health exposure pathway. Consequently, COPCs are not selected to estimate human health risks. However, in order to qualitatively evaluate the potential environmental impact to surface water, analytical findings are compared to North Carolina and Federal surface water criteria. Tables 6-6 presents the qualitative evaluation of contaminants detected in the surface water to North Carolina and Federal standards and criteria.

Sediment

The sediment samples collected from the surface water bodies investigated at this site were not used to estimate potential human health risks. Presently, an exposure pathway does not exist for human exposure to these sediments. These samples were obtained in order to assess potential impact to the environment. Therefore, Table 6-7 presents a qualitative comparison of contaminant levels detected in the sediment to NOAA sediment quality criteria.

6.2.2.2 Site 74

Surface Soil

Sixty (60) surface soil samples were analyzed for VOCs. The prevalence of trichloroethene (5 of 60 samples) warrants the retention of this compound as a COPC. The presence of methylene chloride (maximum concentration 23 µg/kg), toluene (maximum concentration 3 µg/kg), and acetone (maximum concentration 210 µg/kg) are attributable to the investigation associated QA/QC blanks. Therefore, these compounds are not retained as COPCs. The prevalence of styrene (1 of 60 samples) and total xylenes (2 of 60 samples) is less than five percent. Consequently, these compounds are not retained as COPCs.

Sixty (60) surface soil samples were analyzed for SVOCs. Compounds which were detected but not prevalent include: 4-chloro-3-methylphenol, acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, bis(2-ethylhexyl)phthalate, diethylphthalate, and pyrene. These compounds were detected at a frequency of less than five percent and therefore are not warranted for retention as COPCs. Bis(2-chloroethyl)ether was prevalent in the surface soil, however, the maximum concentration of this contaminant (180 µg/kg) is less than the Region III RBC (580 µg/kg) for residential soil. Consequently, adopting Region IV guidance this compound is not retained as a COPC. Di-n-butylphthalate was detected in 13 of 60 samples. The prevalence of this contaminant warrants retention as a COPC. However, evaluation of sample contaminant levels to the investigation related QA/QC blanks reduces the prevalence of this contaminant to less than five percent. Therefore, this contaminant is not retained for evaluation in the risk assessment. Note that the variations in the analytical detection limits is taken into account when assessing the concentrations in the soil using aqueous blanks.

Several pesticides were detected in the 60 surface soil samples collected for pesticide/PCB analysis. The following pesticides are prevalent in the surface soil and warranted retention as COPCs: heptachlor, heptachlor epoxide, dieldrin, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, endrin aldehyde, alpha-chlordane, gamma-chlordane. Additionally, the following pesticides are not retained due to frequency of detection less than five percent: alpha-BHC, aldrin, endrin, endosulfan II, and methoxychlor.

Inorganic constituents arsenic, barium, chromium, manganese, nickel, selenium, vanadium, zinc, and cyanide are prevalent in the sixty (60) surface soil samples. Additionally, the maximum concentration of these metals is greater than two times the average base-specific concentration. Therefore, these metals are retained as COPCs. Other inorganics are not retained because they are either infrequently detected, less than two times the average base-specific background, are essential nutrients, or common salts not evaluated in a human health risk assessment.

Presented in Table 6-8 are the surface soil concentration ranges and frequency for the positively detected organic compounds. Table 6-9 presents the surface soil inorganic ranges and frequency along with a comparison to the base-specific background concentrations.

Subsurface Soil

The VOCs, methylene chloride and acetone, were detected in 1 of 47 and 32 of 47 subsurface soil samples, respectively. Methylene chloride was detected in less than five percent of the samples, therefore, it was not retained as a COPC. The concentrations of acetone (maximum 820 µg/kg) are less than ten times the concentration (1900 µg/L) detected in the investigation associated QA/QC blanks, therefore, this compound is not retained as a COPC.

The SVOCs, bis(2-ethylhexyl)phthalate, diethylphthalate, and di-n-butylphthalate are prevalent, however, not at a concentration which could not be attributed to investigation related QA/QC samples. Evaluation of sample contaminant levels to the investigation related QA/QC blanks reduces the prevalence of these contaminants to less than five percent. Therefore, these contaminant are not retained for evaluation in the risk assessment. Note that the variations in the analytical detection limits is taken into account when assessing the concentrations in the soil using aqueous blanks. Additionally, these compounds are not present in other media and are not believed to be associated with past history of the site. Therefore, these compounds are not retained as COPCs.

The pesticides, heptachlor, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT were prevalent in the subsurface soil at greater than five percent. Due to their toxic potential and association with site history, these pesticides are retained as COPCs. Additional pesticides, aldrin, heptachlor epoxide, methoxychlor, and endrin aldehyde are not prevalent in the subsurface soil (less than five percent), therefore, they are not retained as COPCs.

Inorganic constituents arsenic, barium, chromium, manganese, vanadium, zinc, and cyanide are prevalent in subsurface soils at concentrations greater than two times the average base-specific background, therefore, they are retained as COPCs. Although prevalent in the subsurface soil, lead concentrations do not exceed two times the background concentration. Consequently, lead is not warranted for retention as a COPC.

Presented in Table 6-10 are the subsurface soil concentration ranges and frequency for the positively detected organic compounds. Table 6-11 presents the subsurface soil inorganic ranges and frequency along with a comparison to the base-specific background concentrations.

Groundwater

Acetone was the only VOC detected in the eight groundwater samples collected from this site. However, the concentration of acetone (maximum 2.04 µg/L) is less than 10 times the level of acetone detected in the investigation associated QA/QC samples. Consequently, acetone is not retained as a COPC.

Di-n-butylphthalate (2 µg/L) was the only SVOC detected in the eight groundwater samples collected from this site. However, this concentration was less than 10 times the concentration detected in the investigation related QA/QC samples (20 µg/L), therefore, this compound is not retained as a COPC.

The pesticides heptachlor, endosulfan II, alpha-chlordane, and gamma-BHC were detected at concentrations below the CRQL in one of seven samples. Therefore, based on frequency of detection and concentration, these compounds are not retained as COPCs.

Several total inorganic constituents including arsenic, barium, beryllium, chromium, lead, manganese, vanadium, and zinc are retained as COPCs, for the human health risk assessment, using prevalence as a selection criteria. Although, not retained for evaluation in the human health risk assessment, mercury and selenium are refined as COPCs for comparison to State and Federal criteria.

Table 6-12 presents a comparison of the organic and inorganic groundwater findings to the applicable State and Federal groundwater criteria.

Surface Water

Three surface water samples were collected from Henderson Pond, which is located in the approximate area of the site. This surface water body does not support recreational activities such as swimming which would present a human health exposure pathway. Consequently, COPCs are not selected to estimate human health risks. However, in order to qualitatively evaluate the potential environmental impact to surface water, analytical findings are compared to North Carolina and Federal surface water criteria. Table 6-13 presents the qualitative evaluation of contaminants detected in the surface water to North Carolina and Federal standards and criteria.

Sediment

The sediment samples collected from Henderson Pond were not used to estimate potential human health risks. Presently, an exposure pathway does not exist for human exposure to these sediments. These samples were obtained in order to assess potential impact to the environment. Therefore, Table 6-14 presents a qualitative comparison of contaminant levels detected in the sediment to NOAA sediment quality criteria.

6.2.2.3 Summary of COPCs

Table 6-15 presents a detailed summary of the potential COPCs identified in each environmental medium sampled at OU No. 4 (Sites 41 and 74). Work sheets used in the selection of COPCs are presented in Appendix N.

6.3 Exposure Assessment

This section develops the potential human exposure pathways for each site and the rationale for their evaluation. Potential source areas and potential migration routes in conjunction with contaminant fate and transport information are combined to produce a site conceptual model. Exposure pathways to be retained for quantitative evaluation are subsequently selected, based on the conceptual site model.

6.3.1 Site Conceptual Model of Potential Exposure

A site conceptual model of potential sources, migration pathways and human receptors was developed to encompass all current and future potential routes of exposure at all three sites. Figure 6-1 presents the conceptual site model. Inputs to the site conceptual site model included qualitative descriptions of current and future land use patterns in the vicinity of each site. All available analytical data and meteorological data are considered in addition to a general understanding of the demographics of the surrounding habitats. For this information, the following list of potential receptors has been developed for inclusion in the quantitative health risk analysis:

- Current military personnel
- Future on-site residents (child and adult)
- Future construction worker

Contaminants detected in the surface and subsurface soils were discussed in Section 4.0 (Nature and Extent of Contamination) and in the selection of COPCs section. The migration of COPCs from these sources could potentially occur by the following routes:

- Vertical migration of potential contaminants from surficial soils to subsurface soils.
- Leaching of potential contaminants from subsurface soils to the water-bearing zones.
- Vertical migration from shallow water-bearing zones to deeper flow systems.
- Horizontal migration in groundwater in the direction of groundwater flow.
- Groundwater discharge into local streams.
- Wind erosion and subsequent deposition of windblown dust.

The potential for a contaminant to migrate spatially and persist in environmental media are important in the estimation of potential exposure.

6.3.2 Exposure Pathways

This section describes the potential exposure pathways presented on Figure 6-1 associated with each medium and each potential human receptor group, then qualitatively evaluates each pathway for further consideration in the quantitative risk analysis. Tables 6-16 and 6-17 present the matrices of potential human exposure scenarios for Sites 41 and 74, respectively.

6.3.2.1 Surface Soils

Surface soil samples were collected on-site from Sites 41 and 74. Potential exposures for all current and future receptors identified above to these soils may possibly occur through incidental ingestion, absorption via dermal contact, and inhalation of airborne particulates of surface soil containing COPCs. Dermal intakes will also result following dermal contact with soils containing COPCs. Incidental ingestion of soil may also occur by oral contact with hands, arms, or food items which soil particles have adhered.

Receptors most likely to be exposed via dermal contact, incidental ingestion and inhalation of air-borne particulates are the same for each area of concern due to the current and future potential land use.

6.3.2.2 Subsurface Soils

Potential exposure to subsurface soils is limited to potential site construction workers. In the event of construction in the areas of concern, workers may be exposed to subsurface soil. Therefore, future potential exposures via ingestion and dermal contact are retained for evaluation.

6.3.2.3 Groundwater

Currently the shallow groundwater in the area of the sites is not used as a potable supply for residents or base personnel. However, under a future scenario (albeit unlikely due to poor transmissivity and insufficient flow) the major potential exposure pathways for the use of on-site groundwater are ingestion, dermal contact, and the inhalation of volatile contaminants by residents while showering.

6.3.2.4 Surface Water/Sediments

The general physical characteristics of the surface water bodies included in this investigation are currently not suitable for recreational activities (i.e., swimming and wading). If recreational activities were to occur in these surface water bodies, the activity patterns (reduced duration and frequency) would limit uptake. Additionally, the exposure duration will generally be less for recreational users of a surface water body, and workers are not expected to be exposed via this pathway (USEPA, 1989a). Therefore, current and future potential exposure to surface water and sediment via ingestion and dermal contact are not retained for evaluation.

6.3.2.5 Air

A potential human exposure pathway exists in air through the inhalation of airborne particulates from surface soils containing COPCs. Airborne particulate emissions may result from the wind erosion and the entrainment of soil particles in ambient air. COPCs adhering to these airborne soil particles may be inhaled by potential future on-site residents (i.e., child and adult) and current military personnel.

Therefore, inhalation of airborne particulate emissions by potential future residents and current military personnel is retained for quantitative evaluation. Off-site receptors would be exposed to concentrations much lower than those detected in on-site air samples as a result of the dilution characteristics of ambient air and the wooded areas which separate the facility from the nearby communities. Therefore, nearby residents are not evaluated.

6.3.3 Quantification of Exposure

The concentrations used in the estimation of chronic daily intakes (CDIs) must be representative of the type of exposure being considered.

Exposure to groundwaters, sediments and surface waters can occur discretely or at a number of sampling locations. These media are transitory in that concentrations change frequently over time. Averaging transitory data obtained from multiple locations is difficult and requires many more data points at discrete locations than exist within OU No. 4. As a result, the best way to represent groundwater, sediment, and surface water contaminants from an exposure standpoint is to use a representative exposure concentration.

Soils are less transitory than the aforementioned media and in most cases, exposure occurs over a wider area (i.e., residential exposure). Therefore, an upper confidence interval was used to represent a soil exposure concentration.

Soil data collected from each of these areas is used separately in estimating the potential human health risks under current and future exposure scenarios.

The human health assessment for future groundwater use considered groundwater data collected from all of the monitoring wells within a site and estimated risks to individuals per area of concern.

Since all the data sets originate from a skewed underlying distribution and since lognormal distribution best fits the majority of environmental data sets, the lognormal distribution was used to represent all facility media. This ensures conservatism in the estimation of chronic daily intake associated with potential exposures. Ninety-five percent upper confidence levels (95 percent U.C.L.) derived for lognormal data sets produce concentrations in excess of the 95 percent confidence interval derived assuming normality. For the sake of conservatism, the 95 percent U.C.L. for the lognormal distribution was used for each contaminant in a given data set for quantifying potential exposure. For exposure areas with limited amounts of data or extreme variability in measured data, the 95 percent U.C.L. can be greater than the maximum measured concentration, therefore, in cases where the 95 percent U.C.L. for a contaminant exceeds the maximum detected value in a given data set, the maximum result was used in the estimate of exposure of the 95 percent U.C.L. However, the true mean may still be higher than this maximum value (i.e., the 95 percent U.C.L. indicates a higher mean is possible), especially if the most contaminated portion of the site has not been sampled.

Data and frequency summaries and statistical summaries are presented in Appendices O and P, respectively.

6.3.4 Calculation of Chronic Daily Intakes (CDI)

In order to numerically estimate the risks for current and future human receptors at each site, a CDI must be estimated for each COPC in every retained exposure pathway.

Appendix Q contains the specific CDI equations for each exposure scenario of interest. These equations were adopted from USEPA's Risk Assessment Guidance for Superfund, Volume I (USEPA, 1989a).

The following paragraphs present the general equations and input parameters used in the calculation of CDIs for each potential exposure pathway. Input parameters are taken from USEPA's default exposure factors guidelines where available and applicable. All inputs not defined by USEPA are derived from USEPA documents concerning exposure or best professional judgment. All exposure assessments incorporate the representative contaminant concentrations in the estimation of intakes. Therefore, only one exposure scenario is developed for each exposure route/receptor combination.

Carcinogenic risks were calculated as an incremental lifetime risk, and therefore incorporate terms describing the exposure duration (ED) in years over the course of a lifetime (70 years x 365 days/year, or 25,550 days).

Noncarcinogenic risks, on the other hand, are estimated using the concept of an average annual exposure. The intake incorporates terms describing the exposure time and/or frequency that represent the number of hours per day and the number of days per year that exposure occurs. In general, noncarcinogenic risks for many exposure routes (e.g., soil ingestion) are greater for children than adults because of the differences in body weights, similar exposure frequencies and higher ingestion rates.

Future residential exposure scenarios consider 1 to 6 year old children weighing 15 kg, and adults weighing 70 kg on average. For current/future military personnel an ED of 4 years is used to estimate a military residence. A one year ED is used for future construction worker scenarios.

6.3.4.1 Incidental Ingestion of Soil

The CDI for COPCs detected in soil is estimated for all potential human receptors and is expressed as:

$$CDI = \frac{C \ x \ IR \ x \ CF \ x \ Fi \ x \ EF \ x \ ED}{BW \ x \ AT}$$

Where:

C	=	Contaminant concentration in soil (mg/kg)
IR	=	Ingestion rate (mg/day)
CF	=	Conversion factor (1E-6 kg/mg)
Fi	=	Fraction ingested from source (dimensionless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The following paragraphs discuss the exposure assumptions used in the estimation of potential COPCs associated with the potential ingestion of soils.

Military Personnel

During the course of daily activities at each site, military personnel could potentially be exposed to potential COPCs by the incidental ingestion of surface soils.

The ingestion rate (IR) for residential adults (100 mg/day) is conservatively applied to evaluate ingestion of surface soils by military personnel.

An exposure frequency (EF) of 350 days/year is used to assess military personnel. It is conservatively assumed that military personnel are on base all year for the exception of two weeks (14 days vacation).

An averaging time (AT) of 70 years x 365 days/year or 25,550 days was used for exposure to potentially carcinogenic compounds while an averaging time of 1,460 days (4 years x 365 days/year) was used for noncarcinogenic exposures. An adult average body weight (BW) of 70 kg was used (USEPA, 1989a).

Future On-Site Residents

Future on-site residents could potentially be exposed to COPCs in the surficial soils during recreational activities or landscaping activities around their homes. Children and adults could potentially be exposed to COPCs in soils by incidental ingestion occurring through hand to mouth behavior.

The residential ED is divided in two parts. First, a six-year exposure duration is evaluated for young children which accounts for the period of highest soil ingestion (200 mg/day), and second a 24-year exposure is assessed for older children and adults by using a lower soil ingestion rate (100 mg/day) (USEPA, 1991a). The EFs for both receptor groups is assumed to be 350 days per year.

The BW, for a resident child is assumed to be 15 kg, representing younger individuals than those considered to be potential trespassers. The rationale is that the younger child (1 to 6 years), as a resident, will have access to affected on-site soils. The BW for the future resident adult is assumed to be 70 kg.

ATs of 25,550 days (70 years x 365 days/year) for potential carcinogens and 8,760 days (24 years x 365 days/year) for noncarcinogenic constituents is used for estimating potential CDIs for adults. An AT of 2,190 days (6 years x 365 days/year) is used to estimate potential CDIs for children potentially exposed to noncarcinogens.

Future Construction Worker

During the course of excavation activities construction workers could potentially be exposed to potential COPCs through the incidental ingestion of subsurface soil. The IR for future construction workers exposed to subsurface soils is assumed to be 480 mg/day (USEPA, 1991a). An EF of 90 days per year is used in conjunction with an ED of one year (USEPA, 1991a). An adult BW of 70 kg is used (USEPA, 1989a).

A summary of the exposure factors used in the estimation of soil CDIs associated with incidental ingestion are presented in Table 6-18.

6.3.4.2 Dermal Contact with Soil

Chronic daily intakes associated with potential dermal contact of soils containing COPCs is expressed using the following equation:

$$CDI = \frac{C \ x \ CF \ x \ SA \ x \ AF \ x \ ABS \ x \ EF \ x \ ED}{BW \ x \ AT}$$

Where:

C	=	Contaminant concentration in soil (mg/kg)
CF	=	Conversion factor (kg/mg)
SA	=	Skin surface available for contact (cm^2)
AF	=	Soil to skin adherence factor (mg/cm^2)
ABS	=	Absorption factor (dimensionless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The following paragraphs discuss the exposure assumptions used in the estimation of potential COPCs with the potential dermal contact with soils.

Military Personnel

During the course of daily activities, there is a potential for base personnel to absorb COPCs by dermal contact.

It was assumed that military personnel have approximately 5,800 cm^2 (USEPA, 1992b) of skin surface (SA) available for dermal exposure with COPCs. Exposed body parts are the hands, head, forearms and lower legs are 25% of the total body surface area (23,000 cm^2). Thus, applying 25% to the upper-bound total body surface area results in a default of 5,800 cm^2 for military personnel.

Values for ED, EF, BW, and AT are the same as those used for the incidental ingestion of soil scenario.

Future On-Site Residents

Future on-site residents could also be potentially exposed to COPCs in on-site soil through dermal contact experienced during activities near their home.

Skin surface areas (SA) used in the on-site resident exposure scenario are developed for a reasonable worst case scenario for an individual wearing a short sleeve shirt, shorts, and shoes. The exposed skin surface area is limited to the head, hands, forearms, and lower legs. Thus, applying 25 percent of the total body surface area resulted in a default of 5,800 cm^2 for adults. The exposed skin surface for a child (2,300 cm^2) is estimated using an average of the 50th (0.866 m^2) and the 95th (1.06 m^2) percentile body surface for a six year old child multiplied by 25 percent. The child SA was calculated using information presented in <u>Dermal Exposure Assessment: Principles and Applications</u> (USEPA, 1992b).

Per USEPA Region IV guidance the absorption factors (ABS) factors for organics (1%) and inorganics (0.1%) were applied for this estimation of risk.

Values for ED, EF, BW, and AT are the same as those discussed for the incidental ingestion scenario presented previously.

Data on soil adherence factor (AF) are limited. A value of 1.0 mg/cm^2 (USEPA, Region IV, 1992d) is used in this assessment.

Future Construction Worker

Dermal contact with subsurface soil COPCs could potentially occur during excavation activities.

The SA used for the construction worker exposure scenario is developed for an individual wearing a short-sleeve shirt, long pants, and boots. The exposed skin surface area (4,300 cm^2) is limited to the head (1,180 cm^2), arms (2,280 cm^2), and hands (840 cm^2) (USEPA, 1992b).

The EF and ED are the same as those discussed for incidental ingestion of subsurface soil.

Data on soil AF are limited. A value of 1.0 mg/cm^2 (USEPA Region IV, 1992c) is used in this assessment.

A summary of the soil exposure assessment input parameters for dermal contact are presented in Table 6-19.

6.3.4.3 Inhalation of Fugitive Particulates

Exposure to fugitive particulates are estimated for future residents and civilian base personnel. These populations may be exposed during daily recreational or work-related activities. The chronic daily intake of contaminants associated with the inhalation of particulates is estimated using the following equation:

$$CDI = \frac{C \ x \ IR \ x \ EF \ x \ ED \ x \ 1/PEF}{BW \ x \ AT}$$

Where:

C	=	Contaminant concentration in soil (mg/kg)
IR	=	Inhalation rate (m^3/hr)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
1/PEF	=	Particulate emission factor (m^3/kg)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The particulate emissions factor (PEF) relates the concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from surface contamination. This relationship is derived by Cowherd (1985). The particulate emissions from contaminated sites are due to wind erosion, and, therefore, depend on erodibility of the surface material. A default PEF obtained from USEPA, 1989a is used in this assessment.

The following paragraphs discuss the exposure assumptions used in the estimation of potential COPCs with the potential inhalation of particulates.

Military Personnel

During work related activities, there is a potential for military personnel to inhale COPCs emitted as fugitive dust. A conservative inhalation rate 20 m^3/day was used for military personnel (USEPA, 1991a). Values for ED, EF, BW, and AT are the same as those used for the incidental ingestion scenario.

Future On-Site Residents

Future on-site residents could also be potentially exposed to COPCs in on-site soil through inhalation of particulates during activities near their home.

An IR of 20 m^3/day is used to assess the on-site adult. An inhalation rate of 10 m^3/day is used to assess a child. This value was derived from a child conducting light (0.8 m^3/hr.) to moderate (2.0 m^3/hr.) activity for 8 hours per day (USEPA, 1989b). The EF, ED, BW, and AT are the same as those used for the incidental ingestion scenario.

Table 6-20 presents the exposure factors used to estimate CDIs associated with the particulate inhalation scenario.

6.3.4.4 Ingestion of Groundwater

Shallow groundwater is not currently being used as a potable supply at any of the sites. Development of the shallow aquifer for potable use is unlikely because of the general water quality in the shallow zone and poor flow rates. However, there remains the possibility that upon closure of this facility, residential housing could be constructed and deep groundwater used for potable purposes in the future. Deep groundwater from each of the sites is currently used for potable purposes. However, base supply wells are subject to routine operation, maintenance, and monitoring and those which have been determined to be contaminated have been permanently abandoned.

The CDI of contaminants associated with the future potential consumption of groundwater are estimated using the following general equation:

$$CDI = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

Where:

C	=	Contaminant concentration is groundwater (mg/L)
IR	=	Ingestion rate (L/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The following paragraphs discuss the exposure assumptions used in the estimation of potential COPCs with the potential ingestion of groundwater.

Future On-Site Residents

Exposure to COPCs via ingestion of groundwater is retained as a potential future exposure pathway for both children and adults.

The IR of 1.0 L/day is used for the amount of water consumed by a 1 to 6 year old child with a BW of 15 kg. This ingestion rate provides a health conservative exposure estimate (for systemic, noncarcinogenic toxicants) designed to protect young children who could potentially be more affected than adolescents, or adults. This value assumes that children obtain all the tap water they drink from the same source for 350 days/year [which represents the exposure frequency (EF)]. AT of 2,190 days (6 years x 265 days/year) is used for noncarcinogenic compound exposure.

The IR for adults is 2 liters/day (USEPA, 1989a). The ED used for the estimation of adult CDIs is 30 years (USEPA, 1989b), which represents the national upper-bound (90th percentile) time at one residence. The averaging time for noncarcinogens is 10,950 days. An AT of 25,550 days (70 years x 365 days/year) is used to evaluate exposure for both children and adults to potential carcinogenic compounds.

Table 6-21 presents a summary of the input parameters for the ingestion of groundwater scenarios.

6.3.4.5 Dermal Contact with Groundwater

Shallow groundwater is not currently being used as a potable supply at any of the sites. However, there remains the possibility that upon closure of this facility residential housing could be constructed and groundwater used for residential purposes in the future.

The CDI associated with the dermal contact with groundwater is estimated using the following general equation:

$$CDI = \frac{C \ x \ SA \ x \ PC \ x \ ET \ x \ EF \ x \ ED \ x \ CF}{BW \ x \ AT}$$

Where:

C	=	Contaminant concentration is groundwater (mg/L)
SA	=	Surface area available for contact (cm^2)
PC	=	Dermal permeability constant (cm/hr)
ET	=	Exposure time (hour/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
CF	=	Conversion factor (1 L/1000 cm^3)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The following paragraphs discuss the exposure assumptions used in the estimation of potential COPCs with potential dermal contact with groundwater.

Future On-Site Residents

Children and adults could contact COPCs through dermal contact with groundwater while bathing or showering.

An EF of 350 days/year is used assuming that site groundwater would be used as the sole-source for bathing. The whole body skin SA available for dermal absorption is estimated to be 10,000 cm^2 for children and 23,000 cm^2 for adults (USEPA, 1992b). The permeability constant (PC) reflects the movement of a chemical across the skin and into the blood stream. The permeability of a chemical is an important property in evaluating actual absorbed dose, yet many compounds do not have literature PC values. For contaminants in which a PC value are not established, the PC for water (1.55E-03 cm/hr), is used (USEPA, 1992b). This value may in fact be a realistic estimate of the absorption rate of a chemical when COPC concentrations are in the part-per-billion range.

An ET of 0.25 hour/day used to conservatively estimate the duration of bathing or showering. The ED, BW, and AT were the same as those used for the ingestion of groundwater scenario.

Table 6-22 presents the exposure factors used to estimate CDIs associated with the future dermal contact with COPCs in groundwater.

6.3.4.6 Inhalation of Volatile Organics While Showering

In order to quantitatively assess the inhalation of contaminants volatilized from shower water, the model developed by Foster and Chrostowski (1986) is utilized. Contaminant concentrations in air, due to VOCs while showering, are modeled by estimating the following: the rate of chemical releases into air (generation rate), the buildup of VOCs in the shower room air while the shower was on, the decay of VOCs in the shower room after the shower is turned off, and the quantity of airborne VOCs inhaled while the shower is both on and off. The contaminant concentrations calculated to be in the air are then used as the concentration term.

The CDI associated with the inhalation of airborne (vapor phase) VOCs from groundwater while showering is estimated using the following general equation:

$$CDI = \frac{C \ x \ IR \ x \ ET \ x \ EF \ x \ ED}{BW \ x \ AT}$$

Where:

C	=	Contaminant concentration in air (mg/m^3)
IR	=	Inhalation rate (m^3/hr)
ET	=	Exposure time (hr/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT_c	=	Averaging time carcinogen (days)
AT_{nc}	=	Averaging time noncarcinogen (days)

Future On-Site Residents

Both children and adults could inhale vaporized volatile organic COPCs during showering. It is assumed that showering would take place over 350 days/year, using site groundwater as the sole source, for children weighing 15 kg, and adults weighing 70 kg (USEPA, 1989a). An inhalation rate (IR) of 0.6 m^3/hr is used for both receptors (USEPA, 1989a). An exposure time (ET) of 0.25 hrs/day is used for both receptors (USEPA, 1989a). The ED and AT remained the same as for groundwater ingestion.

Table 6-23 presents the exposure factors used to estimate CDIs associated with the inhalation of VOCs from groundwater while showering.

Appendix Q contains the specific CDI equations for each exposure scenario of interest.

6.4 Toxicity Assessment

Section 6.3 identified potential exposure pathways and potentially affected populations for this BRA. This section will review the available toxicological information for the potential COPCs.

6.4.1 Toxicological Evaluation

The purpose of this section is to define the toxicological values used to evaluate the potential exposure to the potential COPCs identified in Section 6.2. A toxicological evaluation characterizes the inherent toxicity of a compound. It consists of the review of scientific data to determine the nature and extent of the potential human health and environmental effects associated with potential exposure to various contaminants.

Human data from occupational exposures are often insufficient for determining quantitative indices of toxicity because of uncertainties in exposure estimates, and inherent difficulties in determining causal relationships established by epidemiological studies. For this reason, animal bioassays are conducted under controlled conditions and their results are extrapolated to humans. There are several stages to this extrapolation. First, to account for species differences, conversion factors are used to extrapolate from test animals to humans. Second, the relatively high doses administered to test animals must be extrapolated to the lower doses more typical of human exposures. For potential noncarcinogens, safety factors and modifying factors are applied to animal results when developing acceptable human doses. For potential carcinogens, mathematical models are used to extrapolate effects at high doses to effects at lower doses. Epidemiological data can be used for inferential purposes to establish the credibility of the experimentally derived indices.

The available toxicological information indicates that many of the potential COPCs have both potential carcinogenic and noncarcinogenic health effects in humans and/or experimental animals. Although the potential COPCs may potentially cause adverse health and environmental impacts, dose-response relationships and the potential for exposure must be evaluated before the risk to receptors can be determined. Dose-response relationships correlate the magnitude of the dose with the probability of toxic effects, as discussed in the following section.

6.4.2 Dose-Response Evaluation

An important component of the risk assessment is the relationship between the dose of a compound (amount to which an individual or population is potentially exposed) and the potential for adverse health effects resulting from the exposure to that dose. Dose-response relationships provide a means by which potential public health impacts may be evaluated. The published information on doses and responses is used in conjunction with information on the nature and magnitude of exposure to develop an estimate of risk.

Standard carcinogenic slope factors (CSFs) and/or reference doses (RfDs) have been developed for many of the COPCs. This section provides a brief description of these parameters.

6.4.2.1 Carcinogenic Slope Factor

CSFs are used to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen (USEPA, 1989a). This factor is generally reported in units of $(mg/kg/day)^{-1}$ and is derived through an assumed low-dosage linear multistage model and an extrapolation from high to low dose-responses determined from animal studies. The value used in reporting the slope factor is the upper 95th percent confidence limit.

These slope factors are also accompanied by USEPA WOE classifications which designate the strength of the evidence that the COPC is a potential human carcinogen.

In assessing the carcinogenic potential of a chemical, the Human Health Assessment Group (HHAG) of USEPA classifies the chemical into one of the following groups, according to the weight of evidence from epidemiologic and animal studies:

Group A	-	Human Carcinogen (sufficient evidence of carcinogenicity in humans)
Group B	-	Probable Human Carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans)
Group C	-	Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)
Group D	-	Not Classifiable as to Human Carcinogenicity (inadequate or no evidence)
Group E	-	Evidence of Noncarcinogenicity for Humans (no evidence of carcinogenicity in adequate studies)

6.4.2.2 Reference Dose

The RfD is developed for chronic and/or subchronic human exposure to chemicals and is based solely on the noncarcinogenic effects of chemical substances. It is defined as an estimate of a daily exposure level for the human population, including sensitive populations, that is likely to be without an appreciable risk of adverse effects during a lifetime. The RfD is usually expressed as dose (mg) per unit body weight (kg) per unit time (day). It is generally derived by dividing a no-observed-(adverse)-effect-level (NOAEL or NOEL) or a lowest observed-adverse-effect-level (LOAEL) for the critical toxic effect by an appropriate "uncertainty factor (UF)". Effect levels are determined from laboratory or epidemiological studies. The UF is based on the availability of toxicity data.

UFs usually consist of multiples of 10, where each factor represents a specific area of uncertainty naturally present in the extrapolation process. These UFs are presented below and were taken from the "Risk Assessment Guidance Document for Superfund, Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1989a):

- A UF of 10 is to account for variation in the general population and is intended to protect sensitive populations (e.g., elderly, children).
- A UF of 10 is used when extrapolating from animals to humans. This factor is intended to account for the interspecies variability between humans and other mammals.
- A UF of 10 is used when a NOAEL derived from a subchronic instead of a chronic study is used as the basis for a chronic RfD.
- A UF of 10 is used when a LOAEL is used instead of a NOAEL. This factor is intended to account for the uncertainty associated with extrapolating from LOAELs to NOAELs.

In addition to UFs, a modifying factor (MF) is applied to each reference dose and is defined as:

- A MF ranging from >0 to 10 is included to reflect a qualitative professional assessment of additional uncertainties in the critical study and in the entire data base for the chemical not explicitly addressed by the preceding uncertainty factors. The default for the MF is 1.

Thus, the RfD incorporates the uncertainty of the evidence for chronic human health effects. Even if applicable human data exist, the RfD still maintains a margin of safety so that chronic human health effects are not underestimated.

Toxicity factors and the USEPA WOE classifications are presented in Table 6-24. The hierarchy (USEPA, 1989a) for choosing these values was as follows:

- Integrated Risk Information System (IRIS)
- Health Effects Assessment Summary Table (HEAST)

The IRIS data base is updated monthly and contains both verified CSFs and RfDs. The USEPA has formed the Carcinogen Risk Assessment Verification Endeavor (CRAVE) Workgroup to review and validate toxicity values used in developing CSFs. Once the slope factors have been verified via extensive peer review, they appear in the IRIS data base. Like the CSF Workgroup, the USEPA has formed a RfD Workgroup to review existing data used to derive RfDs. Once the reference doses has been verified, they also appear in IRIS.

HEAST on the other hand, provides both interim (unverified) and verified CSFs and RFDs. This document is published quarterly and incorporates any applicable changes to its data base.

6.5 Risk Characterization

This section presents and discusses the estimated incremental lifetime cancer risks (ICRs) and hazard indices (HIs) for identified potential receptor groups which could be exposed to COPCs via the exposure pathways presented in Section 6.3.

These quantitative risk calculations for potentially carcinogenic compounds estimate ICRs levels for an individual in a specified population. This unit risk refers to the cancer risk that is over and above the background cancer risk in unexposed individuals. For example, an ICR of 1E-06 indicates that, for a lifetime exposure, one additional case of cancer may occur per one million exposed individuals.

The ICR to individuals is estimated from the following relationship:

$$ICR = \sum_{i=1}^{n} CDI_i \; x \; CSF_i$$

where CDI_i is the chronic daily intake (mg/kg/day) for compound i and CSF_i is the cancer slope [(mg/kg/day)-1] for contaminant i. The CSF is defined in most instances as an upper 95th percentile confidence limit of the probability of a carcinogenic response based on experimental animal data, and the CDI is defined as the exposure expressed as a mass of a substance contracted per unit body weight per unit time, averaged over a period of time (i.e., six years to a lifetime). The above equation was derived assuming that cancer is a non-threshold process and that the potential excess risk level is proportional to the cumulative intake over a lifetime.

In contrast to the above approach for potentially carcinogenic effects, quantitative risk calculations for noncarcinogenic compounds assume that a threshold toxicological effect exists. The total noncarcinogenic acceptable risk level is a HI less than or equal to 1.0. This noncancer risk level indicates a level at or below which adverse systemic effects are not expected in the exposed population. Therefore, the potential for noncarcinogenic effects are calculated by comparing CDIs with threshold levels (reference doses).

Noncarcinogenic effects are estimated by calculating the hazard index (HI) which is defined as:

$$HI = HQ_1 + HQ_2 + \ldots HQ_n$$

$$= \sum_{i=1}^{n} HQ_i$$

$$\gamma \text{ where } HQ_i = CDI_i / RfD_i$$

HQi is the hazard quotient for contaminant i, CDI_i is the chronic daily intake (mg/kg/day) of contaminant i, and RfD_i is the reference dose (mg/kg/day) of the contaminant i over a prolonged period of exposure.

6.5.1 Human Health Risks

The following paragraphs present the quantitative results of the human health evaluation for each medium and area of concern at Sites 41 and 74.

Estimated ICRs are compared to the USEPA's acceptable target risk range of 1E-04 to 1E-06. A value of 1.0 is used for examination of the HI. The HI is calculated by comparing estimated CDIs with threshold levels below which, noncarcinogenic health effects are not expected to occur. Any HI equal to or exceeding 1.0 suggests that noncarcinogenic health effects may be possible. If the HI is less than 1.0, then systemic human health effects are considered unlikely.

6.5.1.1 Site 41

Soil

Table 6-25 presents the total ICR and HI values estimated for the exposure via incidental ingestion, dermal contact, and inhalation of particulates of on-site surface and subsurface soil. Potential risks via these routes of exposure are estimated for current military personnel and future residential (children and adults) receptors. Potential risks from subsurface soil contamination via ingestion and dermal contact are assessed for a future construction worker. Total ICR values estimated for each receptor are less than the lower bound target risk range, suggesting that the adverse health effects are unlikely to develop from exposure to surface or subsurface soil. Additionally, the total HI values estimated for each receptor are less than unity (1), therefore, it is unlikely that exposure to surface or subsurface contamination would produce and adverse systemic health effect.

Groundwater

The ICR and HI values estimated for potential future residential receptors (children and adults) from ingestion and dermal contact of groundwater and inhalation of vapors are presented on Table 6-26. The total ICR value for future residential children (6E-04) and adults (1E-03) exceeds the USEPA's upper bound risk range (1E-04). Therefore, adverse health effects to future residents from ingestion, dermal contact, and inhalation are plausible. The total HI estimated for potential future residential children (16) and adults (8) exceeds unity (1.0), suggesting that adverse systemic health effects are likely. The ICR and HI values are driven by the presence of total metals arsenic, chromium, and manganese.

6.5.1.2 Site 74

Soil

Table 6-27 presents the total ICR and HI values estimated for exposure via incidental ingestion, dermal contact, and inhalation of particulates of on-site surface and subsurface soil. Potential risks via these routes of exposure are estimated for current military personnel and future residential (children and adults) receptors. Potential risks from subsurface soil contamination via ingestion and dermal contact are assessed for a future construction worker. Total ICR value estimated for each receptor is less than the lower bound target risk range, suggesting that the likelihood of adverse health effects is unlikely from exposure to surface or subsurface soil. Additionally, the total HI value estimated for each receptor is less than unity (1), therefore, it is unlikely that exposure to surface or subsurface contamination will produce and adverse systemic health effect.

Groundwater

The ICR and HI values estimated for potential future residential receptors (children and adults) from ingestion and dermal contact of groundwater and inhalation of vapors are presented on Table 6-28. The total ICR value for future residential children (2E-04) and adults (3E-04) exceeds the USEPA's upper bound risk range (1E-04). Therefore, adverse health effects to future residents from ingestion, dermal contact, and inhalation are plausible. The total HI estimated for potential future residential children (8) and adults (3) exceeds unity (1), suggesting that adverse systemic health effects are likely. The ICR and HI values are driven by the presence of total metals arsenic, beryllium, and manganese.

6.6 Sources of Uncertainty

Uncertainties may be encountered throughout the process of performing a BRA. This section discusses the sources of uncertainty involved with the following:

- Analytical data
- Exposure Assessment
- Toxicity Assessment
- Compounds Not Qualitatively Evaluated

6.6.1 Analytical Data

The development of a BRA depends on the reliability of and uncertainties with the analytical data available to the risk assessor. Analytical data are limited by the precision and accuracy of the analytical method of analysis. For example, Contract Laboratory Program (CLP) methods have, in general, a precision of approximately plus or minus 50 percent depending on the sample media and the presence of interfering compounds. A value of 100 μg/kg could be as high as 150 μg/kg or as low as 50 μg/kg. In addition, the statistical methods used to compile and analyze the data (mean concentration, standard deviation, and detection frequencies) are subject to the uncertainty in the ability to acquire data.

Data validation serves to reduce some of the inherent uncertainty associated with the analytical data by establishing the usability of the data to the risk assessor who may or may not choose to include the data point in the estimation of risk. Data qualified as "J" (estimated) were retained for the estimation of risk at OU No. 4. Data can be qualified as estimated for many reasons including a slight exceedance of holding times, high or low surrogate recovery, or intra sample variability. Organic data qualified "B" (detected in blank) or "R" (unreliable) were not used in the estimation of risk due to the unusable nature of the data. Due to the comprehensive sampling and analytical program at OU No. 4, the loss of some data points qualified "B" or "R" did not significantly increase the uncertainty in the estimation of risk.

6.6.2 Exposure Assessment

In performing exposure assessments, uncertainties can arise from two main sources. First, the chemical concentration to which a receptor may be exposed must be estimated for every medium of interest. Second, uncertainties can arise in the estimation of contaminant intakes resulting from contact by a receptor with a particular medium.

Estimating the contaminant concentration in a given medium to which a human receptor could potentially be exposed can be as simple as deriving the 95th percent upper confidence limit of the mean for a data set. More complex methods of deriving the contaminant concentration are necessary when exposure to COPCs in a given medium occurs subsequent to release from another medium, or analytical data are not available to characterize the release. In this case, modeling is usually employed to estimate the potential human exposure.

The potential inhalation of fugitive dusts from affected soils was estimated in the BRA using USEPA's Rapid Assessment of Exposure to Particulate Emissions from Surface Contaminated Sites (Cowherd et al. 1985). The Cowherd model employs the use of a site-specific PEF for a wind erosion based on source area and vegetative cover. A conservative estimate of the PEF was derived for OU No. 4 by assuming that the entire area was not covered with vegetation and was unlimited in its erosion potential. Modeling results for fugitive dust emission exposure suggested that the potential risk associated with this pathway was not significant.

Groundwater samples were analyzed for total (unfiltered) and dissolved (filtered) inorganic contaminants. These samples were obtained from wells which were constructed using USEPA Region IV monitoring well design specifications. Groundwater taken from monitoring wells cannot be considered representative of potable groundwater or groundwater which is obtained from a domestic well "at the tap". The use of total inorganic analytical results overestimates the potential human health risks associated with potable use scenarios. However, for the sake of conservatism, total organic results were used to estimate the potential intake associated with groundwater use.

Currently, the shallow groundwater is not used as a potable source. Current receptors (military personnel, military dependents, and civilian base personnel) are exposed to groundwater drawn from the deep zone via ingestion, dermal contact, and inhalation. Therefore, assessing current risks to contaminants detected in the shallow aquifer for current receptors is unnecessary and if estimated may present an unlikely risk. Therefore, groundwater exposures to current receptors was not estimated for this investigation.

Current and/or future potential exposure via ingestion of surface water while swimming was not assessed. The surface water bodies included in this investigation are not sufficient in size or depth to support recreational swimming, therefore, the probability of exposure via this route is very small and estimation of risk, via this route, may unnecessarily produce an unacceptable risk.

To estimate an intake, certain assumptions must be made about exposure events, exposure durations, and the corresponding assimilation of contaminants by the receptor. Exposure factors, have been generated by the scientific community and have undergone review by the USEPA. Regardless of the validity of these exposure factors, they have been derived from a range of values generated by studies of limited number of individuals. In all instances, values used in the risk assessment, scientific judgments, and conservative assumptions agree with those of the USEPA. Conservative assumptions designed not to underestimate daily intakes were employed throughout the BRA and should error conservatively, thus adequately protecting human health and allowing the establishment of reasonable clean-up goals.

6.6.3 Sampling Strategy

Soil represents a medium of direct contact exposure and often is the main source of contaminants released into other media. The soil sampling depth should be applicable for the exposure pathways and contaminant transport routes of concern and should be chosen purposely within that depth interval. If a depth interval is chosen purposely, a random sample procedure to select a sampling point may be established. The assessment of surface exposure at all three sites is certain based on collection of samples from the shallowest depth, zero to one foot. Subsurface soil samples are important, however, if soil disturbance is likely or leaching of chemicals to groundwater is of concern.

Due to the nature of contaminants (i.e., chemical agents) at these sites, the soil investigation was limited to the surface soil. The surface soil samples at all sites were obtained directly or very near the suspected disposal areas. Therefore, these areas would be considered areas of very high concentration which would have a significant impact on exposures.

Due to the possible presence of buried chemical agents, the subsurface soil investigation did not consider potential hot spots through extensive sampling. The subsurface soil concentrations used in determining construction workers exposures were derived from subsurface soils which were considered around the site or off site. Consequently, the risk to future construction workers from ingestion and dermal contact with subsurface soils may be biased low. However, given the limited contaminants detected in the surface soil and groundwater, it does not appear as if this low bias creates a concern that needs to be addressed through additional subsurface soil sampling.

6.6.4 Toxicity Assessment

In making quantitative estimates of the toxicity of varying doses of a compound to human receptors, uncertainties arise from two sources. First, data on human exposure and the subsequent effects are usually insufficient, if they are available at all. Human exposure data usually lack adequate concentration estimations and suffer from inherent temporal variability. Therefore, animal studies are often used and therefore new uncertainties arise from the process of extrapolating animal results to humans. Second, to obtain observable effects with a manageable number of experimental animals, high doses of a compound are used over a relatively short time period. In this situation, a high dose means that experimental animal exposures are much greater than human environmental exposures.

Therefore, when applying the results of the animal experiment to the human condition, the effects at the high doses must be extrapolated to approximate effects at lower doses.

In extrapolating effects from animals to humans and high doses to low doses, scientific judgment and conservative assumptions are employed. In selecting animal studies for use in dose response calculations, the following factors are considered:

- Studies are preferred where the animal closely mimics human pharmacokinets

- Studies are preferred where dose intake most closely mimics the intake route and duration for humans

- Studies are preferred which demonstrate the most sensitive response to the compound in question

For compounds believed to cause threshold effects (i.e., noncarcinogens), safety factors are employed in the extrapolation of effects from animals to humans, and from high to low doses.

The use of conservative assumptions results in quantitative indices of toxicity that are not expected to underestimate potential toxic effects, but may overestimate these effects by an order of magnitude or more.

6.6.5 Compounds Not Quantitatively Evaluated

The following contaminants are not quantitatively evaluated in the BRA for OU No. 4 because toxicity information has not been promulgated by the USEPA:

- Copper
- Lead
- Vanadium
- Endosulfan II
- Endosulfan I
- Endrin Ketone
- 2-Methylnaphthalene

6.7 Conclusions of the BRA for OU No. 4

The BRA highlights the media of interest from the human health standpoint at OU No. 4 by identifying areas with elevated ICR and HI values. Current and future potential receptors at the site include current military personnel, future residents (i.e., children and adults), and future construction workers. The total risk from each site for the these receptors is estimated by logically summing the multiple pathways likely to affect the receptor during a given activity. The following algorithms defined the total site risk for the current and future potential receptor groups assessed in a quantitative manner. The risk associated with each site is derived using the estimated risk from multiple areas of interest.

1. Current Military Personnel

   a. Incidental ingestion of COPCs in surface soil + dermal contact with COPCs in surface soil + inhalation of airborne COPCs

2. Future Residents (Children and Adults)

   a. Incidental ingestion of COPCs in surface soil + dermal contact with COPCs in surface soil + inhalation of COPCs

   b. Ingestion of COPCs in groundwater + dermal contact with COPCs in groundwater + inhalation of volatile COPCs

3. Future Construction Worker

   a. Incidental ingestion of COPCs in on-site or off-site subsurface soil + dermal contact with COPCs in subsurface soil

6.7.1 Site 41

Presented on Table 6-29 are the total site ICR and HI values estimated for current and future receptors at this site. The total site ICR estimated for current military personnel (6E-07) is less than the USEPA's target risk range (1E-04 to 1E-06). Additionally, the total HI value estimated for this receptor is less than unity. The total site ICR estimated for future residential children (6E-04) and adults (1E-03) exceeds the USEPA's upper bound risk range (1E-04). The total site ICR estimated for future construction workers (9E-08) is less than the USEPA's target risk range of 1E-04 to 1E-06. Additionally, the total site HI for future residential children (16) and adults (8) exceeds unity. The total site HI estimated for the future construction worker (0.2) does not exceed unity. The total site risk receptors is driven by future potential exposure to shallow groundwater.

6.7.2 Site 74

Presented on Table 6-30 are the total site ICR and HI values estimated for current and future receptors at this site. The total site ICR estimated for current military personnel (8E-08) is less than the lower bound USEPA's target risk range (1E-06). Additionally, the total HI value estimated for this receptor is less than unity. The total site ICR estimated for future residential children (2E-04) and adults (3E-04) exceeds the USEPA's upper bound risk range (1E-04). The total site ICR estimated for future construction workers (2E-08) is less than the USEPA's target risk range of 1E-04 to 1E-06. Additionally, the total site HI for future residential children (8) and adults (3) exceeds unity. The total site HI estimated for the future construction worker (<0.01) does not exceed unity. The total site risk is driven by future potential exposure to shallow groundwater.

SECTION 6.0 TABLES

TABLE 6-1

ORGANIC DATA SUMMARY
DOWNSLOPE AND ON-SITE SURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
1,4-Dichlorobenzene	180J	1/46
2-Methylnaphthalene	55J	1/46
Acenaphthene	91J - 380J	2/46
Anthracene	41J - 510	3/46
Benzo(a)anthracene	130J - 2,400	4/46
Benzo(a)pyrene	40J - 2,000	5/46
Benzo(b)fluoranthene	38J - 2,500	6/46
Benzo(g,h,i)perylene	46J - 1,600	4/46
Benzo(k)fluoranthene	50J - 1,700	6/46
bis(2-chloroethyl)ether	57J - 220J	6/46
bis(2-ethylhexyl)phthalate	42J - 580J	12/46
Carbazole	44J - 330J	2/46
Chrysene	49J - 2,300	6/46
Dibenzofuran	130J	1/46
Dibenz(a,h)anthracene	57J	1/46
di-n-Butylphthalate	42J - 230J	13/46
Fluoranthene	40J - 200J	6/46
Fluorene	79J - 280J	2/46
Indeno(1,2,3-cd)pyrene	71J - 76J	2/46
Naphthalene	70J	1/46
Phenanthrene	72J - 2,600	6/46
Pyrene	50J - 2,300J	7/46
Methylene chloride	2J - 5J	13/46
Acetone	3J - 2,800	11/46
Toluene	1J - 4J	3/46
beta-BHC	4.72NJ	1/46

Note: Concentrations expressed in microgram per kilogram (μg/kg).
J - Estimated value
NJ - Estimated/tentative value

TABLE 6-1 (Continued)

ORGANIC DATA SUMMARY
DOWNSLOPE AND ON-SITE SURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
delta-BHC	0.03NJ	1/46
Lindane (gamma-BHC)	0.22NJ	1/46
Heptachlor	0.3NJ - 7.16J	5/46
Heptachlor epoxide	0.56NJ - 9.6NJ	5/46
Dieldrin	0.2NJ - 13.03NJ	17/46
4,4'-DDE	0.12J - 87.6J	34/46
Endrin	1.47NJ - 2.93J	5/46
Endosulfan II	0.45NJ - 5.01J	13/46
4,4'-DDD	0.37J - 92J	19/46
Endosulfan sulfate	0.32J	1/46
4,4'-DDT	0.37J - 277	29/46
Methoxychlor	1.41J - 3.28NJ	3/46
Endrin ketone	0.44NJ	1/46
Endrin aldehyde	0.61J - 1.37J	7/46
alpha-chlordane	0.08J - 42.7J	16/46
gamma-chlordane	0.06NJ - 93.5J	16/46
Aroclor 1242	82.9J	1/46
Aroclor 1260	58.4J	1/46
1,3-Dinitrobenzene	824NJ	1/46

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
NJ - Estimated/tentative value

TABLE 6-2

INORGANIC DATA SUMMARY
DOWNSLOPE AND ON-SITE SURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Inorganic	Surface Soil: Average Base-Specific Background[1] Concentration Range	Surface Soil: Twice the Average Base-Specific Maximum Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	No. of Times Exceeded Twice the Average Background Concentration
Aluminum	2,435.66	4,871.32	878 - 17,400J	46/46	13
Arsenic	0.38	0.76	0.671 - 4.42	19/46	16
Barium	8.79	17.58	3.14 - 82.2	46/46	11
Beryllium	0.114	0.228	0.187 - 0.344	12/46	4
Cadmium	0.325	0.655	0.854 - 7.44	5/46	5
Calcium	799	1,598	32.9 - 40,300	42/46	12
Chromium	2.49	4.97	2.19 - 41.4	41/46	24
Cobalt	1.728	3.455	6.46	1/46	1
Copper	7.04	14.08	4.17 - 132	15/46	4
Iron	1,583.12	3,166.24	397 - 91,600	46/46	20
Lead	18.55	37.09	2.57 - 341J	46/46	9
Magnesium	105.52	211.05	28.1 - 1,100	46/46	10
Manganese	8.42	16.84	1.67 - 6,000J	44/46	11
Mercury	0.043	0.087	0.074 - 0.768	22/46	13
Nickel	2.02	4.05	7.36 - 35.3	4/46	4
Potassium	99.26	198.52	184 - 547	14/46	11
Selenium	0.337	0.674	0.357 - 0.596	3/46	0
Silver	0.49	0.98	0.096 - 18.3J	3/46	1
Sodium	42.706	85.412	84.7 - 230	8/46	7
Vanadium	3.38	6.76	4.62 - 39.8	31/46	24
Zinc	6.676	13.353	3.77-14,600	46/46	19
Cyanide	NA	NA	1.09-1.57	46/46	NA

Notes: Concentrations expressed in milligram per kilogram (mg/kg).

(1) Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.

ND - Not Detected

NA - Not Applicable

J - Estimated value

TABLE 6-3

ORGANIC DATA SUMMARY
DOWNSLOPE AND ON-SITE SUBSURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Subsurface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
1,4-Dichlorobenzene	49J	1/66
2-Methylnapthalene	41J - 550	4/66
4-chloro-3-methylphenol	61J	1/66
4-Methylphenol	53J	1/66
Acenaphthene	52J - 130J	3/66
Benzo(a)anthracene	71J - 160J	2/66
Benzo(b)fluoranthene	75J - 150J	2/66
Benzo(a)pyrene	74J - 4,700J	6/66
bis(2-chloroethyl)phthalate	79J - 800	3/66
bi(2-ethylhexyl)phthalate	39J - 7,200J	33/66
Butylbenzyl phthalate	88J	1/66
Carbazole	66J	1/66
Chrysene	43J - 170J	4/66
Dibenzofuran	48J	1/66
Diethylphthalate	110J	1/66
di-n-Butylphthalate	40J - 230J	26/66
di-n-Octylphthalate	40J - 1,600	9/66
Fluoranthene	46J - 260J	5/66
Fluorene	44J - 120J	4/66
Indeno(1,2,3-cd)pyrene	105J	1/66
Naphthalene	45J - 130J	5/66
N-nitrosodiphenylamine	240J	1/66
Phenanthrene	39J - 260J	5/66
Pyrene	52J - 290J	6/66
Benzo(g,h,i)perylene	41J - 4,600J	5/66
Benzo(k)fluoranthene	80J - 109J	2/66
Methylene Chloride	2J-26J	18/60

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
NJ - Estimated/tentative value

TABLE 6-3 (Continued)

**ORGANIC DATA SUMMARY
DOWNSLOPE AND ON-SITE SUBSURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA**

Contaminant	Subsurface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
Chloromethane	2J - 3J	2/66
Acetone	4J - 6,000J	34/66
2-Butanone	1J - 15J	8/66
Trichloroethene	1J	1/66
Benzene	1J	2/66
Chlorobenzene	4J - 100	5/66
Ethylbenzene	7J - 58	2/66
delta-BHC	0.91J	2/66
Lindane (gamma-BHC)	11.9J	1/66
Heptachlor	0.68J - 18	9/66
Aldrin	0.7J - 12.8J	5/66
Heptachlor epoxide	0.4J - 11.5J	5/66
Endosulfan I	0.78NJ - 2.92NJ	5/66
4,4'-DDE	0.32NJ - 39.6J	27/66
Endrin	0.35J - 28.3J	11/66
Endosulfan II	0.5NJ - 25.2NJ	24/66
4,4'-DDD	0.34NJ - 1,060J	26/66
4,4'-DDT	0.68NJ - 302J	10/66
Methoxychlor	5.47NJ	1/66
Endrin ketone	0.86J	1/66
Endrin aldehyde	0.85NJ - 4.38J	9/66
alpha-Chlordane	0.28NJ - 160J	17/66
gamma-Chlordane	0.31J - 170J	13/66
Aroclor 1254	36.7J - 214J	5/66
Aroclor 1260	34.6J - 317J	5/66
Acetophenone	120J	1/66
Dieldrin	0.32J - 60NJ	17/66

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
NJ - Estimated/tentative value

TABLE 6-4

INORGANIC DATA SUMMARY
DOWNSLOPE AND ON-SITE SUBSURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Inorganic	Subsurface Soil				
	Average Base-Specific Background(1) Concentration Range	Twice the Average Base-Specific Maximum Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	No. of Times Exceeded Twice the Average Background Concentration
Aluminum	672 - 10,200	8,946.3	486 - 13,500J	66/66	6
Arsenic	0.03 - 0.47	0.6	0.518 - 3.02	33/66	29
Barium	2 - 11	11.9	3.15 - 186	63/66	37
Beryllium	0.03 - 0.23	0.2	0.187 - 0.31	10/66	8
Cadmium	0.17 - 1.2	1.0	1.32 - 4.73	3/66	3
Calcium	5 - 4,410	1,508.3	37.3 - 18,900	60/66	13
Chromium	2 - 9	8.7	2.1 - 40.5J	64/66	18
Cobalt	0.175 - 2	1.6	4.53	1/66	1
Copper	0.47 - 2	1.6	3.77 - 39.8	15/66	15
Iron	126 - 2,840	1,778.0	115J - 41,100	66/66	21
Lead	1 - 12	9.1	0.894J - 829	66/66	27
Magnesium	13 - 260	231.2	18.4 - 567	65/6	14
Manganese	0.40 - 8	6.2	1.63 - 244	60/66	30
Mercury	0.01 - 0.11	0.1	0.057-0.312	17/66	11
Nickel	0.70 - 5	4.0	7.56 - 12.9	2/66	2
Potassium	41 - 187	228.8	123 - 562	26/66	16
Selenium	0.12 - 0.55	0.8	0.373J - 0.948	11/66	3
Silver	0.18 - 1	1.1	0.202 - 9.71J	4/66	1
Sodium	7 - 45	40.6	59.3 - 486	10/66	10
Vanadium	0.75 - 13	10.1	4.79 - 25.7	44/66	20
Zinc	0.40 - 12	5.6	2.8J - 407	57/66	44

Notes: Concentrations expressed in milligram per kilogram (mg/kg).
(1) Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.
ND - Not Detected
NA - Not Applicable
J - Estimated

TABLE 6-5

GROUNDWATER DATA SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Groundwater Criteria				Frequency/Range		Comparison to Criteria			
	NCWQS(1)	MCL(2)	Federal Health Advisories(3)		No. of Positive Detects/ No. of Samples	Concentration Range	No. of Detects Above NCWQS	No. of Detects Above MCL	No. of Detects Above Health Advisories	
			10 kg Child	70 kg Adult					10 kg Child	70 kg Adult
Acetone	NE	NE	NE	NE	3-18	4J - 12J	NA	NA	NA	NA
Benzene	1.0	100(5)	NE	NC	1/18	2J	1	0	NA	NA
Bromoform	0.19	100	2,000	6,000	1/18	2J	3	0	0	0
Chlorobenzene	50	NE	NE	NE	1/18	1.4J	0	0	NA	NA
Arsenic	50	50	NE	NE	13/18	2.1 - 53.5	1	1	NA	NA
Barium	2,000	2,000	NE	NE	18/18	18.2 - 836	0	0	NA	NA
Beryllium	NE	4	30,000	20,000	11/18	0.954 - 37.4	NA	5	0	0
Cadmium	5	5	40	20	11/18	2.58 - 37.5	7	7	0	0
Chromium	50	100	1,000	800	12/18	12.1 - 166	8	4	0	0
Cobalt	NE	NE	NE	NE	6/18	15.6 - 106	NA	NA	NA	NA
Lead	15	15	NE	NE	13/18	2.3 - 145	10	10	NA	NA
Manganese	50	50(4)	NE	NE	18/18	24.5 - 766	15	15	NA	NA
Mercury	1.1	2	NE	NE	2/18	0.264 - 0.33	0	0	NA	NA
Nickel	100	100	1,000	50	9/18	22.8 - 177	1	1	0	3
Selenium	50	50	NE	NE	1/18	10.3J	0	0	NA	NA
Vanadium	NE	NE	NE	NE	14/18	10.6 - 179	NA	NA	NA	NA
Zinc	2,100	5,000(4)	3,000	1,200	13/18	41.6 - 675	1	1	1	1

Notes: Concentrations expressed in microgram per liter (µg/L).
(1) NCWQS = North Carolina Water Quality Standard for Groundwater
(2) MCL = Safe Drinking Water Act Maximum Contaminant Level
(3) Longer Term Health Advisories for a 10 kg Child and 70 kg Adult
(4) SMCL = Secondary Maximum Contaminant Level
(5) Total trihalomethanes ($TTHM_3$)
NE - Not Established
NA - Not Applicable
NJ - Estimated/tentative value
J - Estimated value

TABLE 6-6

SURFACE WATER DATA SUMMARY
UNNAMED TRIBUTARY AND TANK CREEK
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water Criteria			Contaminant Frequency/Range		Comparison to Criteria		
	NCWQS[1]	Federal Health AWQCs[2]				Positive Detects Above NCWQS	Positive Detects Above AWQC	
		Water & Organisms	Organisms Only	No. of Positive Detects/ No. of Samples	Contaminant Range		Water & Organisms	Organisms Only
Chlorobenzene	488	488	NE	2/14	1J - 4J	0	0	NA
Lindane (gamma-BHC)	NE	0.0186	0.0625	1/28	0.02J	NA	1	0
4,4'-DDT	0.000588	0.000024	0.000024	1/28	0.03J	NA	1	1
Barium	1,000	1,000	NE	28/28	17.9 - 442	0	0	0
Chromium	NE	50	NE	1/28	8.52	NA	0	NA
Lead	NE	50	NE	19/28	1.13J - 36.8	0	0	0
Manganese	50	50	100	28/28	12.3 - 1700	1	1	1
Mercury	NE	0.144	0.146	9/28	0.101 - 0.56	0	0	0
Zinc	NE	NE	NE	23/28	16.3 - 235	NA	NA	NA

Notes: Concentrations expressed in microgram per liter (μg/L).
(1) NCWQS = North Carolina Water Quality Standards for Surface Water
(2) AWQC = Ambient Water Quality Standard
NE - Not Established
NA - Not Applicable
J - Estimated value

TABLE 6-7

SEDIMENT DATA SUMMARY
UNNAMED TRIBUTARY AND TANK CREEK
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sediment Criteria		Range/Frequency		Comparison to Criteria: Positive Detects Above NOAA	
	NOAA ER-L[1] Concentration	NOAA ER-M[2] Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	ER-L	ER-M
Benzo(a)pyrene	430	1600	57J	1/28	NA	NA
Benzo(b)fluoranthene	NE	NE	69J	1/28	NA	NA
Benzo(k)fluoranthene	NE	NE	58J	1/28	NA	NA
di-n-Octylphthalate	NE	NE	49J - 310J	3/28	NA	NA
di-n-Butylphthalate	NE	NE	48J-370J	6/28	NA	NA
Methylene Chloride	NE	NE	2J-7J	8/28	NA	NA
Acetone	NE	NE	4J-190	11/28	NA	NA
Trichloroethene	NE	NE	2J	1/28	NA	NA
Toluene	NE	NE	2J	2/28	NA	NA
Dieldrin	0.02	8	0.46NJ - 6.39	10/41	10	0
4,4'-DDE	2	15	0.53J - 31.3J	9/41	11	2
Endosulfan II	NE	NE	0.64NJ - 8.22	9/41	NA	NA
4,4'-DDD	2	20	0.38NJ - 73.9J	22/41	13	3
4,4'-DDT	1	7	0.36NJ - 34.8J	17/41	11	2
Methoxychlor	NE	NE	0.91J - 3.2	6/41	NA	NA
Endrin ketone	NE	NE	0.66NJ	1/41	NA	NA
alpha-Chlordane	NE	NE	0.34J - 3.72	13/41	NA	NA
gamma-Chlordane	NE	NE	0.4J - 6.35J	11/41	NA	NA
Aroclor 1242	22.7	80[3]	63J - 140J	2/41	3	0
Aroclor 1254	22.7	80[3]	68J	1/41	1	0
1,3,5-Trinitrobenzene	NE	NE	1,390	1/28	NA	NA

TABLE 6-7 (Continued)

SEDIMENT DATA SUMMARY
UNNAMED TRIBUTARY AND TANK CREEK
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sediment Criteria		Range/Frequency		Comparison to Criteria: Positive Detects Above NOAA	
	NOAA ER-L[1] Concentration	NOAA ER-M[2] Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	ER-L	ER-M
Arsenic	8.2	70	0.617 - 9.3	13/42	0	0
Barium	NE	NE	1.4 - 161	36/42	NA	NA
Beryllium	NE	NE	0.235 - 1.02	5/42	NA	NA
Chromium	81	370	2.32J - 16.5J	16/42	0	0
Copper	34	270	6.13 - 19.9	4/42	0	0
Lead	46.7	218	1.1 - 59.4J	42/42	2	0
Manganese	NE	NE	1.3 - 3.6	37/42	NA	NA
Mercury	0.15	0.71	0.46-0.63	2/40	2	0
Nickel	20.9	51.6	3.79 - 6.12	6/42	0	0
Selenium	NE	NE	0.629J - 0.862J	4/42	NA	NA
Thallium	NE	NE	1.19J	1/42	NA	NA
Vanadium	NE	NE	3.5 - 30	12/42	NA	NA
Zinc	150	410	5.5 - 155	25/42	0	0

Notes: Organic concentrations expressed in microgram per Kilogram (µg/Kg).
Inorganic concentrations expressed in milligram per Kilogram (mg/Kg).
(1) ER-L - Effective Range-Lower
(2) ER-M - Effective Range-Medium
(3) Total PCBs.
NE - Not Established
NA - Not Applicable
J - Estimated Value
NJ - Estimated/tentative value

TABLE 6-8

ORGANIC DATA SUMMARY
PESTICIDE DISPOSAL AREA SURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil: Range of Positive Detections	Surface Soil: No. of Positive Detects/ No. of Samples
4-chloro-3-methylphenol	54J - 240J	2/60
Acenaphthene	39J	1/60
Benzo(a)pyrene	130J	1/60
Benzo(g,h,i)pyrene	61J - 160J	2/60
bis(2-chloroethyl)ether	12J - 180J	5/60
Diethylphthalate	86J - 866	2/60
di-n-Butylphthalate	39J - 126J	13/60
Pyrene	38J	1/60
Methylene chloride	4J - 23J	20/60
Acetone	4J - 210J	22/60
Trichloroethene	2J - 8J	5/60
Toluene	1J - 3J	3/60
Styrene	1J	1/60
Xylenes (total)	3J - 6J	2/60
alpha-BHC	0.45	1/60
Heptachlor	0.2 NJ - 298J	8/60
Aldrin	0.41NJ	1/60
Heptachlor epoxide	0.21NJ - 1.43J	4/60
Dieldrin	0.32J - 706NJ	5/60
4,4'-DDE	0.31J - 1,730J	31/60
Endrin	0.42J - 1.06J	3/60
Endosulfan II	0.44NJ - 1.31NJ	3/60
4,4'-DDT	0.81J - 3,840J	22/60
Methoxychlor	166J	1/60
Endrin aldehyde	0.5NJ - 2.29NJ	5/60
alpha-chlordane	0.39J - 1,160J	8/60
gamma-chlordane	0.45J - 1,680J	8/60
Hydroxyacetophenone	190J	1/37
4,4'-DDD	0.37 - 3,700J	17/60
Bis(2-ethylhexyl)phthalate	240J	1/60

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
NJ - Estimated/tentative value

TABLE 6-9

INORGANIC DATA SUMMARY
PESTICIDE DISPOSAL AREA SURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Inorganic	Surface Soil				
	Average Base-Specific Background[1] Concentration Range	Twice the Average Base-Specific Maximum Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	No. of Times Exceeded Twice the Average Background Concentration
Aluminum	2,435.66	4,871.32	36.3 - 10,900	60/60	20
Arsenic	0.38	0.76	0.62J - 1.16	9/60	9
Barium	8.79	17.58	2.89 - 54.7	54/60	1
Beryllium	0.114	0.228	ND	0/60	NA
Cadmium	0.325	0.655	0.543 - 0.686	4/60	1
Calcium	799	1,598	34. 9 - 175,000	53/60	7
Chromium	2.49	4.97	1.89 - 10.6	50/60	17
Cobalt	1.728	3.455	ND	0/60	NA
Copper	7.04	14.08	5.07 - 22	4/60	1
Iron	1,583.12	3,166.24	31.21J - 34,200	60/60	6
Lead	18.55	37.09	0.878J - 15.4	60/60	0
Magnesium	105.52	211.05	16.3 - 2,790	52/60	5
Manganese	8.42	16.84	1.44 - 96.2	58/60	4
Mercury	0.043	0.087	0.015 - 0.092	8/60	2
Nickel	2.02	4.05	3.15 - 4.78	6/60	2
Potassium	99.26	198.52	80.7 - 351	16/60	3
Selenium	0.337	0.674	0.609 - 1.2	14/60	12
Silver	0.49	0.98	0.116J	1/60	1
Sodium	42.706	85.412	105J - 860	10/60	10
Vanadium	3.38	6.76	4.03 - 15.1	34/60	0
Zinc	6.676	13.353	2.27 - 33.9	33/60	2
Cyanide	NA	NA	1.05-1.37	60/60	NA

Notes: Concentrations expressed in milligram per kilogram (mg/kg).
(1) Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.
ND - Not Detected
NA - Not Applicable
J - Estimated value

TABLE 6-10

ORGANIC DATA SUMMARY
PESTICIDE DISPOSAL AREA SUBSURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Subsurface Soil	
	Range of Positive Detections	No. of Positive Detects/ No. of Samples
bis(2-ethylhexyl)phthalate	37J - 240J	8/47
Diethylphthalate	874	1/47
di-n-Butylphthalate	43J - 155J	10/47
Methylene chloride	190	1/47
Acetone	6J - 820	32/47
Heptachlor	0.24J - 1.59J	3/47
Aldrin	0.4J	1/47
Heptachlor epoxide	0.33J	1/47
4,4'-DDE	1.05NJ - 21.3J	5/47
4,4'-DDD	0.59J - 3.61J	5/47
4,4'-DDT	0.34NJ - 21.37J	9/47
Methoxychlor	7.06J	1/47
Endrin aldehyde	0.48NJ - 0.77NJ	2/47

Note: Concentrations expressed in microgram per kilogram (µg/kg).
J - Estimated value
NJ - Estimated/tentative value

TABLE 6-11

INORGANIC DATA SUMMARY
PESTICIDE DISPOSAL AREA SUBSURFACE SOIL
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Inorganic	Subsurface Soil				
	Average Base-Specific Background[1] Concentration Range	Twice the Average Base-Specific Maximum Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	No. of Times Exceeded Twice the Average Background Concentration
Aluminum	672 - 10,200	8,946.3	349 - 9,380	47/47	1
Arsenic	0.03 - 0.47	0.6	0.538J - 2.76	10/47	8
Barium	2 - 11	11.9	2.77 - 17.5	29/47	3
Beryllium	0.03 - 0.23	0.2	ND	0/47	NA
Cadmium	0.17 - 1.2	1.0	ND	0/47	NA
Calcium	5 - 4,410	1,508.3	34 - 2,250	23/47	1
Chromium	2 - 9	8.7	1.92 - 9.91	41/47	2
Cobalt	0.175 - 2	1.6	ND	0/47	NA
Copper	0.47 - 2	1.6	ND	0/47	NA
Iron	126 - 2,840	1,778.0	123 - 4,940	47/47	6
Lead	1 - 12	9.1	0.751 - 7.42	47/47	0
Magnesium	13 - 260	231.2	15.4 - 250	45/47	1
Manganese	0.40 - 8	6.2	1.55 - 21.7	32/47	2
Mercury	0.01 - 0.11	0.1	0.056	1/47	0
Nickel	0.70 - 5	4.0	ND	0/47	NA
Potassium	41 - 187	228.8	191 - 302	4/47	1
Selenium	0.12 - 0.55	0.8	0.818	1/47	1
Silver	0.18 - 1	1.1	ND	0/47	NA
Sodium	7 - 45	40	ND	0/47	NA
Vanadium	0.75 - 13	10.1	3.93 - 14.2	16/47	3
Zinc	0.40 - 12	5.6	2.51 - 11.9	18/47	2

Notes: Concentrations expressed in milligram per kilogram (mg/kg).
[1] Soil background concentrations are based on reference background soil samples collected from MCB Camp Lejeune investigations.
ND - Not Detected
NA - Not Applicable
J - Estimated value

TABLE 6-12

GROUNDWATER DATA SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Groundwater Criteria				Frequency/Range		Comparison to Criteria			
	NCWQS[1]	MCL[2]	Federal Health Advisories[3] 10 kg Child	Federal Health Advisories[3] 70 kg Adult	No. of Positive Detects/ No. of Samples	Concentration Range	No. of Detects Above NCWQS	No. of Detects Above MCL	No. of Detects Above Health Advisories 10 kg Child	No. of Detects Above Health Advisories 70 kg Adult
di-n-butylphthalate	700	NE	NE	NE	1/8	2J	0	NA	NA	NA
Acetone	700	NE	NE	NE	2/8	2J - 2.04J	0	NA	NA	NA
Lindane (gamma-BHC)	0.2	0.2	30	100	1/7	0.04J	0	0	0	0
Heptachlor	0.008	0.4	5	5	1/7	0.01NJ	1	0	0	0
Endosulfan II	NE	NE	NE	NE	1/7	0.02J	NA	NA	NA	NA
alpha-Chlordane	0.027	2	NE	NE	1/7	0.02NJ	0	0	NA	NA
Arsenic	50	50	NE	NE	5/8	2.86J - 18.1	0	0	NA	NA
Barium	2,000	2,000	NE	NE	8/8	28.2-117	0	0	NA	NA
Beryllium	NE	4	4,000	20,000	3/8	0.842 - 2.25	NA	0	0	0
Chromium	50	100	200	800	5/8	15.9-56.6	1	1	0	0
Lead	15	15	NE	NE	7/8	3.1J - 15.3	1	1	NA	NA
Manganese	50	50[4]	NE	NE	8/8	8.47 - 115	1	1	NA	NA
Mercury	1.1	2	NE	2	1/8	0.244	0	0	NA	0
Selenium	50	50	NE	NE	1/8	1.8J	0	0	NA	NA
Vanadium	NE	NE	NE	NE	4/8	4.3 - 301	NA	NA	NA	NA
Zinc	2,100	5,000[4]	3,000	12,000	5/5	19.1 - 417J	0	0	0	0

Notes: Concentrations expressed in microgram per liter (µg/L).

(1) NCWQS = North Carolina Water Quality Standards for Groundwater
(2) MCL = Safe Drinking Water Act Maximum Contaminant Level
(3) Longer Term Health Advisories for a 10 kg Child and 70 kg Adult
(4) SMCL = Secondary Maximum Contaminant Level

NE - Not Established
NA - Not Applicable
NJ - Estimated/tentative value
J - Estimated value

TABLE 6-13

SURFACE WATER DATA SUMMARY
PESTICIDE DISPOSAL AREA
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water Criteria			Contaminant Frequency/Range		Comparison to Criteria		
	NCWQS[(1)]	Federal Health AWQCs[(2)]				Positive Detects Above NCWQS	Positive Detects Above AWQC	
		Water & Organisms	Organisms Only	No. of Positive Detects/ No. of Samples	Contaminant Range		Water & Organisms	Organisms Only
Lead	NE	50	NE	3/3	1.62J - 6.04J	NA	0	NA

Notes: Concentrations expressed in microgram per liter (μg/L).
(1) NCWQS = North Carolina Water Quality Standards for Surface Water
(2) AWQC = Ambient Water Quality Standard
NE - Not Established
NA - Not Applicable
J - Estimated value

TABLE 6-14

SEDIMENT DATA SUMMARY
PESTICIDE DISPOSAL AREA
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Sediment Criteria		Range/Frequency		Comparison to Criteria: Positive Detects Above NOAA	
Contaminant	NOAA ER-L[1] Concentration	NOAA ER-M[2] Concentration	Range of Positive Detections	No. of Positive Detects/ No. of Samples	ER-L	ER-M
3,3'-Dichlorobenzidine	NE	NE	140J	1/3	NA	NA
Trichloroethene	NE	NE	8J	1/3	NA	NA
4,4'-DDE	2	15	0.9J - 1.85J	2/3	0	0
Endosulfan II	NE	NE	0.63J - 0.8JB	2/3	NA	NA
4,4'-DDT	1.58	46.1	0.82NJ	1/3	0	0
Methoxychlor	NE	NE	0.83J	1/3	NA	NA
Endrin aldehyde	NE	NE	1.35NJ	1/3	NA	NA
Barium	NE	NE	5.73 - 13	2/3	NA	NA
Chromium	5	9	1.8 - 3.13	2/3	0	0
Lead	46.7	218	2.67J - 6.06	3/3	0	0
Manganese	NE	NE	2.67 - 5.27	3/3	NA	NA
Vanadium	NE	NE	4.4	1/3	NA	NA
Zinc	150	410	12.6	1/3	0	0

Notes: Organic concentrations expressed in microgram per Kilogram (µg/Kg).
Inorganic concentrations expressed in milligram per Kilogram (mg/Kg).
(1) ER-L - Effective Range-Low
(2) ER-M - Effective Range-Medium
J - Estimated value
NJ - Estimated/tentative value
JB - Value estimated is greater than the Instrument Detection Limit (IDL).

TABLE 6-15

SUMMARY OF RISK-BASED AND CRITERIA-BASED COPCs
OPERABLE UNIT NO. 4 (SITES 41 AND 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Groundwater		Surface Water		Sediment	
	41	74	41	74	41	74	41	74	41	74
Total 1,2-Dichloroethene					●					
Trichloroethene		X							●	●
Toluene									●	
Chlorobenzene					●		●			
Anthracene	X									
Benzo(a)anthracene	X									
Benzo(a)pyrene	X		X						●	
Benzo(b)fluoranthene	X								●	
Benzo(g,h,i)perylene	X		X							
Benzo(k)fluoranthene	X								●	
Bis(2-chloroethyl)ether	X									
Chrysene	X									
Phenanthrene	X		X							
Pyrene	X		X						●	
Naphthalene			X							
2-Methylnaphthalene			X							
di-n-Octylphthalate									●	
di-n-Butylphthalate									●	
Methylene Chloride									●	
Acetone									●	
1,3,5-Trinitrobenzene									●	
3,3-Dichlorobenzidine										●
Heptachlor	X	X	X	X		●				
Heptachlor Epoxide	X	X	X							
Dieldrin	X	X	X						●	
4,4'-DDE	X	X	X	X					●	●
4,4'-DDT	X	X	X	X			●		●	●
4,4'-DDD	X	X	X	X					●	
Endrin Aldehyde	X	X	X							●
alpha-Chlordane	X	X	X			●			●	
gamma-Chlordane	X	X	X						●	
Endosulfan II	X		X			●			●	●

TABLE 6-15 (Continued)

SUMMARY OF RISK-BASED AND CRITERIA-BASED COPCs
OPERABLE UNIT NO. 4 (SITES 41 AND 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Groundwater		Surface Water		Sediment	
	41	74	41	74	41	74	41	74	41	74
Aldrin			X							
Endrin			X							
Endosulfan I			X							
PCB-1254			X						●	
PCB-1260			X							
alpha-BHC					●					
gamma-BHC							●			
Methoxychlor									●	●
PCB-1242									●	
Endrin Ketone									●	
Arsenic	X	X	X	X	X●	X●			●	
Barium	X	X	X	X	X●	X●	●		●	●
Beryllium	X		X		X●	X●			●	
Cadmium	X				X●					
Chromium	X	X	X	X	X●	X●	●		●	●
Cobalt					X					
Copper	X		X						●	
Lead	X		X		X●	X●	●	●	●	●
Nickel	X	X			X●				●	
Manganese	X	X	X	X	X●	X●	●		●	●
Mercury	X		X				●		●	
Selenium		X			●				●	
Thallium									●	
Vanadium	X	X	X	X	X●	X●			●	●
Zinc	X	X	X	X	X●	X●	●		●	●
Cyanide		X	X	X						

X - Selected as risk-based COPC
● - Selected as criteria-based COPC

TABLE 6-16

MATRIX OF POTENTIAL HUMAN EXPOSURE
SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Medium/ Exposure Route	Current Military Personnel	Future Construction Worker	Future Residential Population
Soil			
Incidental Ingestion	M	NE	A, C
Dermal Contact	M	NE	A, C
Subsurface Soil			
Incidental Ingestion	NE	W	NE
Dermal Contact	NE	W	NE
Groundwater			
Ingestion	NE	NE	A, C
Dermal Contact	NE	NE	A, C
Surface Water			
Ingestion	NE	NE	NE
Dermal Contact	NE	NE	NE
Sediment			
Incidental Ingestion	NE	NE	NE
Dermal Contact	NE	NE	NE
Air			
Inhalation of Vapor Phase Chemicals Indoor	NE	NE	A, C
Inhalation of Particulates Outdoor	M	NE	A, C

M = Military lifetime exposure
W = Construction duration exposure
NE = Not Exposed
A = Adult lifetime exposure
C = Exposure in children may be significantly greater than in adults

TABLE 6-17

MATRIX OF POTENTIAL HUMAN EXPOSURE
SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Medium/ Exposure Route	Current Military Personnel	Future Construction Worker	Future Residential Population
Soil			
Incidental Ingestion	M	NE	A, C
Dermal Contact	M	NE	A, C
Subsurface Soil			
Incidental Ingestion	NE	W	NE
Dermal Contact	NE	W	NE
Groundwater			
Ingestion	NE	NE	NE
Dermal Contact	NE	NE	NE
Surface Water			
Ingestion	NE	NE	NE
Dermal Contact	NE	NE	NE
Sediment			
Incidental Ingestion	NE	NE	NE
Dermal Contact	NE	NE	NE
Air			
Inhalation of Vapor Phase Chemicals Indoor	NE	NE	A, C
Inhalation of Particulates Outdoor	M	NE	A, C

M = Military lifetime exposure
W = Construction duration exposure
NE = Not Exposed
A = Adult lifetime exposure
C = Exposure in children may be significantly greater than in adults

TABLE 6-18

EXPOSURE ASSESSMENT SUMMARY
INCIDENTAL INGESTION OF SOIL CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult, Current Military Personnel, Future Construction Worker			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992
IR	Ingestion Rate	Child 200 mg/day Adult 100 mg/day Military Personnel 100 mg/day Construction Worker 480 mg/day	USEPA, December 1989 USEPA, March 1991
CF	Conversion Factor	1E-6 kg/mg	USEPA, December 1989
Fi	Fraction Ingested from Contaminated Source	100%	Conservative Professional Judgement
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr Military Personnel 350 days/yr Construction Worker 90 days/yr	USEPA, December 1989 USEPA, March 1991
ED	Exposure Duration	Child 6 years Adult 24 years Military Personnel 4 years Construction Worker 1 year	USEPA, March 1991 USEPA, December 1989
BW	Body Weight	Child 15 kg Adult 70 kg Military Personnel 70 kg Construction Worker 70 kg	USEPA, December 1989
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 8,760 days Military Personnel 1,460 days Construction Worker 365 days	USEPA, December 1989

TABLE 6-19

EXPOSURE ASSESSMENT SUMMARY
DERMAL CONTACT WITH SOIL CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult, Current Military Personnel, Future Construction Worker			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992
CF	Conversion Factor	1E-6 kg/mg	USEPA, December 1989
SA	Exposed Surface Area of Skin Available for Contact	Child 2,300 cm^2 Adult 5,800 cm^2 Military Personnel 5,800 cm^2 Construction Worker 4,300 cm^2	USEPA, January 1992 Reasonable worst case: individual skin area limited to head, hands, forearms, lower legs
AF	Soil-to-Skin Adherence Factor	1.0 mg/cm^2	USEPA, Region IV, 1992
ABS	Absorption Factor (dimensionless)	Organics 1.0 Inorganics 0.1	USEPA, Region IV, 1992
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr Military Personnel 350 days/yr Construction Worker 90 days/yr	USEPA, December 1989 USEPA, March 1991
ED	Exposure Duration	Child 6 years Adult 24 years Military Personnel 4 years Construction Worker 1 year	USEPA, March 1991 USEPA, December 1989
BW	Body Weight	Child 15 kg Adult 70 kg Military Personnel 70 kg Construction Worker 70 kg	USEPA, December 1989
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 8,760 days Military Personnel 1,460 days Construction Worker 365 days	USEPA, December 1989

TABLE 6-20

EXPOSURE ASSESSMENT SUMMARY
INHALATION OF FUGITIVE PARTICULATES
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult, Current Military Personnel			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/kg)	USEPA, May 1992
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr Military Personnel 350 days/yr	USEPA, December 1989
ED	Exposure Duration	Child 6 years Adult 24 years Military Personnel 4 years	USEPA, March 1991
IR	Inhalation Rate	Child 10 m^3 Adult 20 m^3 Military Personnel 20 m^3	USEPA, March 1991 USEPA, May 1989
BW	Body Weight	Child 15 kg Adult 70 kg Military Personnel 70 kg	USEPA, December 1989
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989
AT_{nc}	Averaging Time Noncarcinogens	Child 2,190 days Adult 8,760 days Military Personnel 1,460 days	USEPA, December 1989
PEF	Site-Specific Particulate Emission Factor	4.63×10^9 m^3/kg	USEPA, December 1989 Cowherd, 1985

TABLE 6-21

EXPOSURE ASSESSMENT SUMMARY
INGESTION OF GROUNDWATER CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/L)	USEPA, May 1992
IR	Ingestion Rate	Child 1 L/day Adult 2 L/day	USEPA, March 1991 USEPA, December 1989
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr	USEPA, December 1989
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, March 1991
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 10,950 days	USEPA, December 1989

TABLE 6-22

EXPOSURE ASSESSMENT SUMMARY
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/L)	USEPA, May 1992
SA	Exposed Surface Area of Skin Available for Contact	Child 10,000 cm^2 Adult 23,000 cm^2	USEPA, January 1992
PC	Permeability Constant	Chemical Specific	USEPA, January 1992
ET	Exposure Time	All 0.25 hr/day	USEPA, January 1992
EF	Exposure Frequency	Child 350 days/yr Adult 350 days/yr	USEPA, March 25, 1991
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, December 1989
CF	Conversion Factor	1 L/1000 cm^3	USEPA, December 1989
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989
AT_{nc}	Averaging Time Noncarcinogen	Child 2,190 days Adult 10,950 days	USEPA, December 1989

TABLE 6-23

EXPOSURE ASSESSMENT SUMMARY
INHALATION OF GROUNDWATER VOLATILE CONTAMINANTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Future Residential Child and Adult			
Input Parameter	Description	Value	Reference
C	Exposure Concentration	95% UCL (mg/m^3)	USEPA, May 1992
IR	Inhalation Rate	Child 0.6 m^3/hr Adult 0.6 m^3/hr	USEPA, December 1989
ET	Exposure Time	All 0.25 hr/day	USEPA, January 1992
EF	Exposure Frequency	All 350 day/yr	USEPA, December 1989
ED	Exposure Duration	Child 6 years Adult 30 years	USEPA, December 1989
BW	Body Weight	Child 15 kg Adult 70 kg	USEPA, December 1989
AT_c	Averaging Time Carcinogen	All 25,550 days	USEPA, December 1989
AT_{nc}	Averaging Time Noncarcinogens	Child 2,190 days Adult 10,950 days	USEPA, December 1989

TABLE 6-24

**TOXICITY FACTORS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA**

	RfD	RfC	CSF	CSFI	WOE	Reference
Volatiles:						
Benzene	PDG	PDG	2.9E-02	2.9E-02	A	IRIS, 1994
Chlorobenzene	2.0E-02	2.0E-02	--	--	D	IRIS, 1994; HEAST 1994
Toluene	2.0E-01	4.0E-01	--	--	D	IRIS, 1994
Trichloroethene	6E-03	PDG	1.1E-02	6.0E-03	B2	IRIS, 1994; USEPA 1992
Semivolatiles:						
1,4-Dichlorobenzene	--	8.0E-01	2.4E-02	--	B2	IRIS, 1994, HEAST, 1994
2-Methylnaphthalene	ND	ND	ND	ND	--	IRIS, 1995
Anthracene	3.0E-01	ND	ND	ND	D	IRIS, 1995
Benzo(a)anthracene	--	--	7.3E-01	--	B2	USEPA - Region IV, 1992
Benzo(a)pyrene	--	--	7.3E+00	--	B2	USEPA - Region IV, 1992
Benzo(b)fluoranehtne	--	--	7.3E-01	--	B2	USEPA - Region IV, 1992
Benzo(g,h,i)perylene	ND	ND	ND	ND	D	IRIS, 1995
Benzo(k)fluoranthene	--	--	7.3E-01	--	B2	USEPA - Region IV, 1992
Bis(2-chloroethyl)ether	ND	ND	1.1E+00	1.16E+00	--	IRIS, 1995
Chrysene	--	--	7.3E-02	--	B2	USEPA - Region IV, 1992
Fluoranthene	4.0E-02	ND	--	--	D	IRIS, 1994
Fluorene	4.0E-02	ND	ND	ND	D	IRIS, 1995
Indeno(1,2,3-cd)pyrene	--	--	7.3E-01	--	B2	USEPA - Region IV, 1992
Naphthalene	ND	ND	ND	ND	D	IRIS, 1995
Phenanthrene	3E-02[1]	ND	ND	ND	D	IRIS, 1994
Phenol	6.0E-01	--	--	--	D	IRIS, 1994
Pyrene	3.0E-02	ND	--	--	D	IRIS, 1994
Pesticides/PCBs:						
4,4'-DDD	ND	ND	2.4E-01	--	B2	IRIS, 1994
4,4'-DDE	ND	ND	3.4E-01	--	B2	IRIS, 1994
4,4'-DDT	5.0E-04	ND	3.4E-01	3.4E-01	B2	IRIS, 1994
Aldrin	3E-05	ND	1.70E+01	1.7E+01	B2	IRIS, 1995
alpha-BHC	ND	ND	6.3E+00	6.3E+00	B2	IRIS, 1995
beta-BHC	ND	ND	1.8E+00	1.8E+00	C	IRIS, 1995
Dieldrin	5.0E-05	--	1.6E+01	1.6E+01	B2	IRIS, 1994
Endosulfan I	6.0E-03	ND	ND	ND	--	IRIS, 1995
Endosulfan II	ND	ND	ND	ND	--	IRIS, 1995
Endrin	3.0E-04	ND	ND	ND	D	IRIS, 1995
Endrin Aldehyde	ND	ND	ND	ND	--	IRIS, 1995
Endrin Ketone	ND	ND	ND	ND	D	IRIS, 1995
Heptachlor	5.0E-04	ND	4.5E+00	4.5E+00	B2	IRIS, 1994
Heptachlor Epoxide	1.3E-05	ND	9.1E+00	9.1E+00	B2	IRIS, 1994
PCB	ND	ND	7.7E+00	ND	--	IRIS, 1995
Total Chlordane	6.0E-05	UR	1.3E+00	1.3E+00	B2	IRIS, 1994

TABLE 6-24 (Continued)

TOXICITY FACTORS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	RfD	RfC	CSF	CSFI	WOE	Reference
Inorganics:						
Arsenic	3.0E-04	ND	1.75+00	5.0E+01	A_I	IRIS, 1994
Antimony	4E-04	ND	ND	ND	--	IRIS, 1995
Barium	7.0E-02	--	--	--	--	IRIS, 1994
Beryllium	5.0E-03	ND	4.3E+00	8.4E+00	B2	IRIS, 1994
Cadmium	5.0E-04(2) 1.0E-03(3)	PDG	--	6.3E+00	B1	IRIS, 1994
Chromium VI	5.0E-03	PDG	--	4.2E+01	A_I	IRIS, 1994
Cobalt	6E-02	ND	ND	ND	--	USEPA-ECAO
Copper	3.71E-02	ND	ND	ND	D	HEAST, 1995
Cyanide	2.0E-02	ND	--	--	--	IRIS, 1994
Lead	ND	ND	ND	ND	B2	IRIS, 1995
Manganese	5.0E-03(2) 1.4E-01(3)	1.43E-05	--	--	D	IRIS, 1994
Mercury	3.0E-04	3.0E-04	--	--	D	HEAST, 1994
Nickel	2.0E-02	PDG	--	--	--	IRIS, 1994
Selenium	5.0E-03	ND	--	--	D	IRIS, 1994
Vanadium	7.0E-03	--	--	--	--	HEAST, 1994
Zinc	3.0E-01	--	--	--	D	IRIS, 1994

Notes:

RfD	Oral Reference Dose (mg/kg - day)
RfC	Inhalation Reference Concentration (mg/cu m)
CSF	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
CSFI	Inhalation Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
WOE	Weight of Evidence
IRIS	Integrated Risk Information System
HEAST	Health Effects Assessment Summary Tables
USEPA	United States Environmental Protection Agency
ECAO	Environmental Criteria Assessment Office
ND	Not Determined
PDG	Pending
WOE	Weight of Evidence
PDG	Pending
UR	Under Review by USEPA
A	Human Carcinogen
B1	Probable Human Carcinogen - Limited Evidence
B2	Probable Human Carcinogen - Sufficient Evidence
C	Possible Human Carcinogen
D	Not Classifiable as to Human Carcinogenicity
I	Ingestion

(1) Pyrene RfD used as a surrogate
(2) RfD for evaluation in water
(3) RfD for evaluation in soil/sediment

TABLE 6-25

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 4 (SITE 41)
SOIL
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group							
	Current Military Personnel		Future Residential Child		Future Residential Adult		Future Construction Worker	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Incidental Ingestion	4E-07	0.02	6E-06	0.2	3E-06	0.02	1E-07	0.2
Dermal Contact	2E-07	<0.01	5E-07	<0.01	9E-07	<0.01	5E-09	<0.01
Inhalation of Particulates	1E-09	<0.01	5E-09	<0.01	9E-09	<0.01	NA	NA
Total	6E-07	0.02	7E-06	0.2	4E-06	0.02	1E-07	0.2

NA - Not Applicable

TABLE 6-26

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group			
	Future Residential Child		Future Residential Adult	
	ICR	HI	ICR	HI
Ingestion	6E-04	16	1E-03	8
Dermal Contact	6E-06	0.03	4E-06	0.03
Inhalation of Vapors	NA	NA	NA	NA
Total	6E-04	16.03	1E-03	8.03

NA - Not Applicable

TABLE 6-27

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 4 (SITE 74)
SOIL
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group							
	Current Military Personnel		Future Residential Child		Future Residential Adult		Future Construction Worker	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Incidental Ingestion	7E-08	<0.01	9E-07	0.05	4E-07	<0.01	2E-08	<0.01
Dermal Contact	9E-09	<0.01	2E-08	<0.01	5E-08	<0.01	2E-10	<0.01
Inhalation of Particulates	7E-11	<0.01	3E-10	<0.01	4E-10	<0.01	NA	NA
Total	8E-08	<0.01	9E-07	0.05	5E-07	<0.01	2E-08	<0.01

NA - Not Applicable

TABLE 6-28

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HIs)
OPERABLE UNIT NO. 4 (SITE 74)
GROUNDWATER
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Route	Receptor Group			
	Future Residential Child		Future Residential Adult	
	ICR	HI	ICR	HI
Ingestion	2E-04	8	3E-04	3
Dermal Contact	7E-07	0.03	2E-07	0.02
Inhalation of Vapors	NA	NA	NA	NA
Total	2E-04	8.03	3E-04	3.02

NA - Not Applicable

TABLE 6-29

TOTAL SITE RISK
OPERABLE UNIT NO. 4 (SITE 41)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Receptors	Soil		Groundwater		Total	
	ICR	HI	ICR	HI	ICR	HI
Current Military Personnel	6E-07 (100)	0.02 (100)	NA	NA	6E-07	0.02
Future Child Resident	7E-06 (<1)	0.2 (<1)	6E-04 (100)	16 (99)	6E-04	16
Future Adult Resident	4E-06 (<1)	0.02 (<1)	1E-03 (100)	8 (99)	1E-03	8
Future Construction Worker	1E-07 (100)	0.2 (100)	NA	NA	1E-07	0.2

Notes: ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
( ) = Approximate percent contribution to the total ICR or HI values
Total = Soil + Groundwater
NA = Not Applicable

TABLE 6-30

TOTAL SITE RISK
OPERABLE UNIT NO. 4 (SITE 74)
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

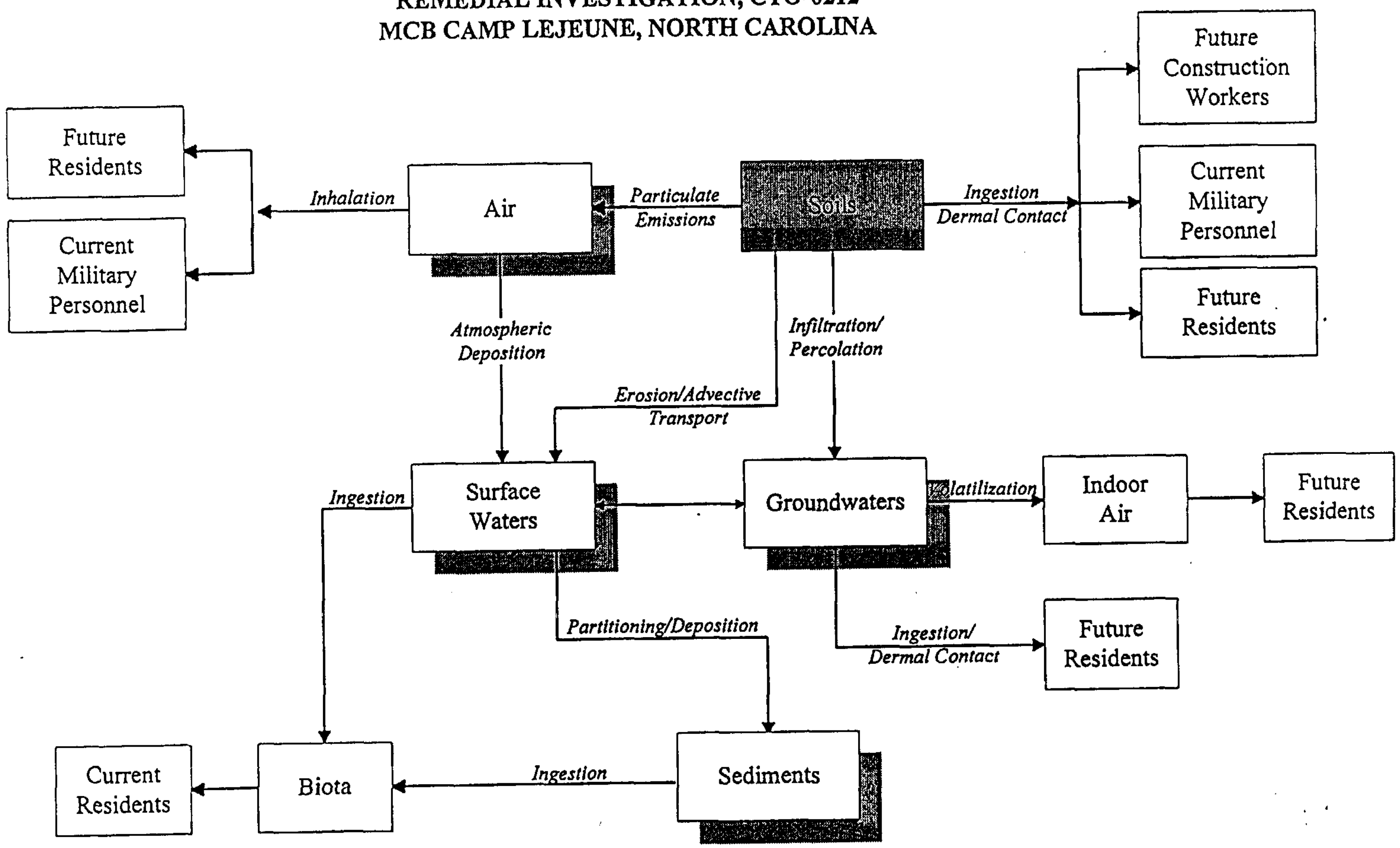
Receptors	Soil		Groundwater		Total	
	ICR	HI	ICR	HI	ICR	HI
Current Military Personnel	8E-08 (100)	<0.01 (100)	NA	NA	8E-08	<0.01
Future Child Resident	9E-07 (<1)	0.05 (<1)	2E-04 (99.7)	8.03 (99.7)	2E-04	8.08
Future Adult Resident	5E-07 (<1)	<0.01 (<1)	3E-04 (100)	3.02 (100)	3E-04	3.0
Future Construction Worker	2E-08 (100)	<0.01 (100)	NA	NA	2E-08	<0.01

Notes: ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
( ) = Approximate percent contribution to the total ICR or HI values
Total = Soil + Groundwater
NA = Not Applicable

SECTION 6.0 FIGURES

FIGURE 6-1

CONCEPTUAL SITE MODEL
OPERABLE UNIT NO. 4
SITES 69, 74, AND 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA



7.0 ECOLOGICAL RISK ASSESSMENT

7.1 Introduction

This section presents the ecological risk assessment (ERA) conducted at Operable Unit (OU) No. 4 that assesses the potential impacts to ecological receptors from contaminants detected at the site. The sites included at OU No. 4 include Site 41 and Site 74.

7.1.1 Objectives of the Ecological Risk Assessment

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 directs EPA to protect human health and the environment with respect to releases or potential releases of contaminants from abandoned hazardous waste sites (USEPA, 1989a). In addition, there are various Federal and State laws and regulations concerning environmental protection that are considered applicable or relevant and appropriate requirements or to be considered (ARARs/TBC) criteria. For example, these ARARs/TBCs include comparisons of contaminant concentrations in surface water to State Water Quality Standards.

The objective of this ERA was to evaluate if past disposal practices at OU No. 4 potentially are adversely impacting the ecological integrity of the terrestrial and aquatic habitats on, or adjacent to the sites. This assessment also evaluated the potential effects of contaminants at OU No. 4 on sensitive environments including wetlands and protected species. The conclusions of the ERA will be used in conjunction with the human health risk assessment to evaluate the appropriate remedial action for this site for the overall protection of public health and the environment.

7.1.2 Scope of the Ecological Risk Assessment

This ERA evaluated and analyzed the results from the RI and historical data collected during other studies. The RI included sampling and chemical analysis of the surface water, sediments, soil, and groundwater at the sites, as applicable. Information used to evaluate sensitive environments was obtained from historical data and previous studies conducted at Marine Corps Base (MCB) Camp Lejeune, North Carolina. In addition, a qualitative habitat evaluation was conducted at each of the two sites to identify potential terrestrial receptors (Figures 7-1 and 7-2, Biohabitat Maps). The media of concern for this ERA were the surface water, sediment, and surface soil.

This ERA focused on adverse impacts to aquatic and terrestrial receptors. If potential risks are characterized for the ecological receptors, further ecological evaluation of the site and surrounding areas may be warranted.

The risk assessment methodologies used in this evaluation were consistent with those outlined in the Framework for Ecological Risk Assessment (USEPA, 1992a). In addition, information found in the following documents was used to supplement the USEPA guidance document:

- U.S. EPA Supplemental Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (USEPA, 1989a)

- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (USEPA, 1989b)

- <u>Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters</u> (USEPA, 1990)

- <u>Fish Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters</u> (USEPA, 1993b)

7.1.3 Organization of The Ecological Risk Assessment

Based on the USEPA <u>Framework for Ecological Risk Assessment</u>, an ERA consists of three main components: (1) Problem Formulation, (2) Analysis, and (3) Risk Characterization (USEPA, 1992a). The Problem Formulation section includes a preliminary characterization of exposure and effects of the stressors to the ecological receptors. During the Analysis, the data are evaluated to determine the exposure and potential effects on the ecological receptors from the stressors. Finally, in the Risk Characterization, the likelihood of adverse effects occurring as a result of exposure to a stressor is evaluated. This section evaluates the potential impact on the ecological integrity at the site from the contaminants detected in the media.

7.2 <u>Problem Formulation</u>

Problem formulation is the first step of an ERA and includes a preliminary characterization of exposure and effects, as well as scientific data needs, policy and regulatory issues, and site-specific factors to define the feasibility, scope, and objectives for the ERA (USEPA, 1992a).

The results of the various site investigations indicated the presence of contaminants in the surface water, sediment and surface soil. As discussed above, CERCLA directs USEPA to protect the environment with respect to releases of contaminants. Due to the potential for ecological receptors to be exposed to the contaminants detected at OU No. 4, it was decided that an ERA should be performed.

Three types of information are needed to evaluate potential links between the contaminants of potential concern (COPCs) and the ecological endpoints. First, chemical analyses of the appropriate media are necessary to establish the presence, concentrations, and variabilities of the COPCs. Second, ecological surveys are necessary to establish if adverse ecological effects have occurred. Finally, toxicological information is necessary to evaluate the potential effects of the COPCs on the ecological receptors. The combination of all three types of data allows the assessment of the relative contribution of other potential causes of the observed effects (as measured by the ecological endpoints) that may be unrelated to the toxic effects of the contaminants of concern (e.g., habitat alterations and natural variability). Therefore, confidence in cleanup and monitoring decisions is greatly enhanced when based on a combination of chemical, ecological, and toxicological data.

Chemical analyses were performed on samples collected from the surface water, sediment, and surface soil to evaluate the presence, concentrations, and variabilities of the COPCs. Ecological surveys also were conducted as part of the Baker's field activities during the RI. Based on observations and available habitats, potential ecological receptors were identified. Finally, toxicological information for the COPCs detected in the media were obtained from available references and literature and used to evaluate the potential adverse ecological effects to the ecological receptors.

The components of the problem formulation include stressor characteristics, ecosystems potentially at risk, ecological effects, endpoint selection, and a conceptual model. The following sections discuss each of these components, and how they were evaluated in this ERA.

7.2.1 Stressor Characteristics

One of the initial steps in the problem formulation stage of an ERA is identifying the stressor characteristics. The term "stressor" is defined as any physical, chemical, or biological entity that can induce an adverse effect (USEPA, 1992a). For this ERA, the stressors that were evaluated include the contaminants detected in the surface water, sediment, biota, and surface soils. Contaminants in the subsurface soils and groundwater were not evaluated in this ERA.

The nature and extent of these contaminants were discussed in Section 4.0 of this report. Table 7-1 lists the contaminants that were detected in each media at Sites 41 and 74. The location of samples was based on historical information available for the site and a site visit to evaluate potential ecosystems and ecological receptors.

7.2.1.1 <u>Contaminants of Potential Concern (COPCs)</u>

The COPCs for the ERA were selected following the same procedures and criteria used for selecting the COPCs for the Baseline Human Health Risk Assessment (HHRA). However, some of the COPCs included in the ERA were different than those included in the HHRA. This is because some of the COPCs may have a greater or lesser adverse impact to ecological receptors than to human receptors. The frequency of detection and statistical summary tables are presented in Appendices O and P, respectively.

COPCs - Surface Water

Surface water samples were collected at OU No. 4 from Sites 41 and 74. The ERA addressed the surface water samples from Tank Creek and the associated tributary at Site 41 and the surface water at Site 74. Sample locations are illustrated on Figures 7-1, 7-2 and 7-4.

<u>Site 41</u>

The following organics and inorganics detected in the surface water samples were not addressed in the ERA because they are common naturally occurring chemicals and/or were not expected to be ecologically significant at the detected concentrations or were infrequently detected: gamma-BHC, heptachlor, 4,4'-DDT, chlorobenzene, cadmium, calcium, chromium, magnesium, nickel, potassium, and sodium.

There were no semivolatile organic compounds (SVOCs) or polychlorinated biphenyls (PCBs) detected in the surface water samples.

The following inorganics were detected in the surface water samples at Site 41 and were included in the ERA: aluminum, arsenic, barium, cobalt, copper, iron, lead, manganese, mercury, and zinc.

Site 74

The following inorganics detected in the surface water samples were not addressed in the ERA because they are common naturally occurring chemicals and were not expected to be ecologically significant at the detected concentration: calcium, magnesium, potassium and sodium.

There were no VOCs, SVOCs, pesticides, or PCBs detected in the surface water sample.

The following inorganics detected in the surface water samples at Site 74 were included in the ERA: aluminum, iron, and lead.

COPCs - Sediments

Sediment samples were collected at OU No. 4 from Sites 41 and Site 74. The ERA will address the sediment samples collected from Site 41 and Site 74. Sample locations are illustrated on Figures 7-1, 7-2 and 7-4.

Site 41

The following detected VOCs, SVOCs, pesticides, PCBs, and ordnance in the sediment samples were not addressed in the ERA because they are common laboratory and/or decontamination contaminants, or were detected infrequently: acetone, methylene chloride, trichloroethene, toluene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, di-n-octyl phthalate, fluoranthene, pyrene, endrin ketone, Aroclor - 1248, Aroclor - 1254 and 1,3,5-trinitrobenzene.

The following inorganics detected in the sediment samples were not addressed in the ERA because they are common naturally occurring chemicals, they were not expected to be ecologically significant at the detected concentrations, or they were infrequently detected: calcium, cobalt, magnesium, mercury, potassium, sodium, and thallium.

The following chemicals detected in the sediment samples were addressed in the ERA: dieldrin, endosulfan II, 4-4'-DDD, 4-4'-DDE, 4-4'-DDT, methoxychlor, alpha-chlordane, gamma-chlordane, aluminum, arsenic, barium, beryllium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, vanadium, and zinc.

Site 74

The following VOC, SVOC, and pesticides detected in the sediment samples were not addressed in the ERA because they are common laboratory and/or decontamination contaminants or were detected infrequently: trichloroethene, 3,3'-dichlorobenzidine, methoxychlor, and endrin aldehyde.

The following inorganics detected in the sediment samples were not addressed in the ERA because they are naturally occurring chemicals, they were not expected to be ecologically significant at the detected concentrations, or they were infrequently detected: calcium, magnesium, selenium, vanadium, and zinc.

The following chemicals detected in the sediment samples were addressed in the ERA: endosulfan II, 4-4'-DDE, 4-4'-DDT, aluminum, barium, chromium, iron, lead, and manganese.

COPCs - Surface Soils

Surface soil samples were collected at Sites 41 and 74. Sample locations are illustrated on Figures 2-2 and 2-11 found in Section 2 of this report.

<u>Site 41</u>

The following VOCs, SVOCs, pesticides, PCBs, and ordnance detected in the surface soil samples were not addressed in the ERA because they are common laboratory and/or decontamination contaminants; they were detected in and attributed to the laboratory or field blanks (the concentrations were compared to five or ten times the concentration of the maximum detect in blanks collected site-wide) or were infrequently detected: acetone, methylene chloride, bis(2-ethylhexyl)phthalate, 1,4-dichlorobenzene, 2-methylnaphthalene, acenaphthalene, carbazole, dibenzofuran, dibenz(a,h)anthracene, di-n-butyl phthalate, di-n-octyl phthalate, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, beta-BHC, delta-BHC, gamma-BHC, endrin, endosulfan sulfate, methoxychlor, endrin ketone, Aroclor-1242, Aroclor-1260, and 1,3-dinitrobenzene.

The following inorganics detected in the surface soil were not addressed in the ERA because they are common naturally occurring chemicals, they were not expected to be ecologically significant at the detected concentrations, they were infrequently detected or they were within typical background concentration found at the site: antimony, calcium, cobalt, magnesium, potassium, selenium, and sodium.

The following chemicals detected in the surface soil samples were addressed in the ERA: toluene, anthracene, bis(2-chloroethyl)ether, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(g,h,i)perylene, 4-4'-DDE, 4-4'-DDD, 4-4'-DDT, alpha-chlordane, gamma-chlordane, heptachlor, heptachlor epoxide, dieldrin, endosulfan II, endrin aldehyde, aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, vanadium, zinc, and total cyanide.

<u>Site 74</u>

The following VOCs, SVOCs, and pesticides detected in the surface soil samples were not addressed in the ERA because they are common laboratory and/or decontamination contaminants; they were detected infrequently; or were attributed to blank contamination: acetone, methylene chloride, styrene, xylenes (total), di-n-butyl phthalate and bis(2-ethylhexyl)phthalate, 4-chloro-3-methylphenol, acenaphthalene, benzo(a)pyrene, benzo(g,h,i)perylene, bis(2-chloroethyl)ether, diethylphthalate, pyrene, alpha-BHC, aldrin, endrin, endosulfan II, methoxychlor, and hydroxyacetophenone.

The following inorganics detected in the surface soil were not addressed in the ERA because they are common naturally occurring chemicals, they were not expected to be ecologically significant at the detected concentrations, they were infrequently detected, or were within typical background concentrations found at the site: antimony, cadmium, calcium, copper, magnesium, potassium, silver, and sodium.

The following chemicals detected in the surface soil samples were addressed in the ERA: trichloroethene, toluene, heptachlor, heptachlor epoxide, endrin aldehyde, dieldrin, 4-4'-DDE, 4-4'-

DDD, 4-4'-DDT, alpha-chlordane, gamma-chlordane, aluminum, arsenic, barium, chromium, iron, lead, manganese, mercury, nickel, selenium, vanadium, zinc, and total cyanide.

7.2.1.2 Physical/Chemical Characteristics of COPCs

Table 7-2 contains values for bioconcentration factors (BCFs, freshwater), water solubility, organic carbon partition coefficient, octanol water partition coefficient, and vapor pressure for the potential contaminants of concern identified in the sediments, surface water, surface soil, and biota samples for each site. Information from these tables were used in the risk characterization to assess the fate and transport of the constituents and the potential risks to the environmental receptors at each site. The following paragraphs discuss the significance of each parameter included in the table.

Bioconcentration factors measure the tendency for a chemical to partition from the water column or sediment and concentrate in aquatic organisms. Bioconcentration is important for ecological receptors because chemicals with high BCFs could accumulate in lower-order species and subsequently accumulate to toxic levels in species higher up the food chain. The BCF is the concentration of the chemical in the organism at equilibrium divided by the concentration of the chemical in the water. Therefore, the BCF is unitless. Bioconcentration factors among the metals range from 1 for chromium to 350,000 for manganese (SCDM, 1991). The bioconcentration factors among the organics range from 17 for trichloroethene to 180,000 for 4-4'-DDE (SCDM, 1991). The pesticides have the highest potential to concentrate in the tissue of organisms exposed to the contaminants. Published BCF data were not available for some of the COPCs at OU No. 4.

Water solubility is important in the ecological environment because it measures the tendency for a chemical to remain dissolved in the water column, partition to soil or sediment, or bioconcentrate in aquatic organisms. Chemicals with high water solubilities tend to be more bioavailable to aquatic organisms. However, they will not significantly bioconcentrate in the organisms. On the other hand, chemicals with a low water solubility will remain bound to the sediment and soils but may bioconcentrate in organisms to a significant degree. Water solubility for metals is negligible because they are practically insoluble in water. The water solubility of the organics ranged from less than 0.025 mg/L for 4,4' DDT to 17,000 mg/L for bis(2-chloroethyl ether) (SCDM, 1991).

The organic carbon partition coefficient (Koc) measures the tendency for a chemical to partition between soil or sediment particles containing organic carbon and water. This coefficient is important in the ecological environment because it determines how strongly an organic chemical will be bound to the organics in the sediments. The Koc is highest for benzo(a)pyrene at 5.5×10^6 mL/g and lowest for trichloroethene at 126 mL/g.

The octanol/water partition coefficient (Kow) is the ratio of a chemical concentration in octanol divided by the concentration in water. The octanol/water partition coefficient has been shown to correlate well with bioconcentration factors in aquatic organisms and adsorption to soil or sediment. The log Kow is presented in Table 7-2. The log Kow is highest for benzo(b)fluoranthene at 6.6 and lowest for bis(2-chloroethyl) ether at 1.3.

The vapor pressure measures the tendency for a chemical to partition into air. This parameter is important for the ecological environment because it can be used to determine the concentrations of the constituents in air. The vapor pressure is highest for cobalt, 1,300 mm Hg (SCDM, 1991). The vapor pressure for most of the other contaminants of concern are low or negligible.

7.2.2 Ecosystems Potentially at Risk

Based on the site-specific and regional ecology, several ecological receptors are potentially at risk from contaminants at the sites. Contaminants were identified in the surface water, sediment, soil, and groundwater samples at the sites. Potential receptors of contaminants in surface water and sediment include fish, oysters, blue crabs, benthic macroinvertebrates, other aquatic flora and fauna and some terrestrial faunal species. Potential receptors of contaminants in soils include: deer, rabbits, foxes, raccoons, birds and other terrestrial flora and fauna.

7.2.3 Ecological Effects

The ecological effects data that were used to assess potential risks to aquatic and/or terrestrial receptors in this ERA include: aquatic reference values including North Carolina Water Quality Standards (NCWQS), USEPA Region IV Water Quality Screening Values (WQSV), USEPA Ambient Water Quality Criteria Documents (AWQC), the Aquatic Information Retrieval Database, and Sediment Screening Values (SSVs), and terrestrial reference values. The following paragraphs discuss each of the above data sources.

The North Carolina Department of Environment, Health, and Natural Resources (NC DEHNR) has promulgated Water Quality Standards (WQS). These WQS meet the requirements of both federal and state law. These standards are regulatory values and are enforceable. They are used to evaluate the quality of waters in North Carolina.

The USEPA Region IV Waste Management Division (Region IV) has adopted Water Quality Screening Values (WQSV) for chemicals detected at hazardous waste sites (USEPA, 1992b). These values are intended as preliminary screening tools to review chemical data from hazardous waste sites. Exceedances of the screening level values indicate that there may be a need for further investigation of the site.

Section 304(a)(1) of the Clean Water Act of 1977 (P.L. 95-217) requires the Administrator of the USEPA to publish criteria for water quality accurately reflecting the latest scientific knowledge on the type and extent of all identifiable effects on health and welfare which may be expected from the presence of pollutants in any body of water, including groundwater. In accordance with the Clean Water Act, the USEPA Office of Water Regulations and Standards, Criteria and Standards Division have published Ambient Water Quality Criteria (AWQC) documents for several chemicals. These documents can be used to evaluate potential risks to aquatic organisms. In addition, potential risks to aquatic plants from contaminants also can be evaluated using these documents.

The Aquatic Information Retrieval Database (AQUIRE) database is an on-line system that contains information on acute, chronic, bioaccumulative, and sublethal effects data from tests performed on freshwater and saltwater organisms excluding bacteria, birds, and aquatic mammals. This database can be accessed to evaluate potential risks to aquatic organisms.

Currently, promulgated sediment quality criteria do not exist. Until these criteria are developed, USEPA Region IV is using Sediment Screening Values (SSV) compiled by National Oceanic and Atmospheric Administration for evaluating the potential for chemical constituents in sediments to cause adverse biological effects (USEPA, 1992b). The lower ten percentile (Effects Range-Low [ER-L]) and the median percentile (Effects Range-Median [ER-M]) of biological effects have been developed for several of the chemicals identified during the sediment investigations at OU No. 4.

If sediment contaminant concentrations are above the ER-M, adverse effects on the biota are considered probable. If contaminant concentrations are between the ER-M and ER-L, adverse effects on the biota are considered possible. Finally, if contaminant concentrations are below the ER-L, adverse effects on the biota are considered unlikely (USEPA, 1992b).

There are no standards, criteria, or other screening values for assessing potential impacts to terrestrial ecological receptors from contaminants in soils. A literature search was conducted to identify levels of contaminants in the soil that could cause adverse effects to terrestrial flora and invertebrates. However, these data cannot be used to evaluate potential risks to other terrestrial fauna (e.g., birds, deer, rabbits), since the exposure doses for these species are different than exposure doses for invertebrates and plants, which are in constant direct contact with the contaminants in the soil. In addition, the sensitivity of the organisms to the COPCs are not similar.

Terrestrial reference values (TRVs) for evaluating estimated chronic daily intakes (CDIs) were calculated from available toxicity data. TRVs were developed from No-Observed-Adverse-Effect-Levels (NOAELs) or Lowest-Observed-Adverse-Effect-Levels (LOAELs) obtained from the Integrated Risk Information System (IRIS), toxicological profiles for specific chemicals and information from other reference books. These values were used to assess the potential effects of contaminants on terrestrial fauna.

7.2.4 Ecological Endpoints

The information compiled during the first stage of problem formulation (stressor characteristics, ecosystems potentially at risk, and ecological effects) was used to select the ecological endpoints for this ERA. The following section of this report contains a description of the ecological endpoints selected for this ERA, and the reason they were selected.

There are two primary types of ecological endpoints: assessment endpoints and measurement endpoints. Assessment endpoints are environmental characteristics, which, if they were found to be significantly affected, would indicate a need for remediation (e.g., decrease in sports/fisheries). Measurement endpoints are quantitative expressions of an observed or measured effect of the contamination of concern. Measurement endpoints may be identical to assessment endpoints (e.g., measurement of abundance of fish), or they may be used as surrogates for assessment endpoints (e.g., toxicity test endpoints). Both types of endpoints were used in the ecological risk evaluation and are discussed in the following sections.

7.2.4.1 <u>Assessment Endpoints</u>

Assessment endpoints are the ultimate focus of risk characterization and link the measurement endpoints to the risk management process (USEPA, 1992a). There are five criteria that an assessment endpoint should satisfy (Suter, 1993):

- Societal relevance
- Biological relevance
- Unambiguous operational definition
- Accessibility to prediction and measurement
- Susceptibility to the hazardous agent

Societal relevance is important because risk to ecological receptors of little intrinsic interest to the public (e.g., nematodes, zooplankton) are unlikely to influence decisions unless they can be shown to indicate risks to biota of direct human interest (e.g., fish, wildlife) (Suter, 1993). The biological significance of a property is determined by its importance to a higher level of the biological hierarchy (Suter, 1993). The endpoint should be well defined and operational with a subject (e.g., benthic macroinvertebrates) and a characteristic of the subject (e.g., decrease in numbers of benthic macroinvertebrate) (USEPA, 1989b). The endpoint should be measurable (e.g., numbers of individuals) or predictable from measurements (e.g., toxicity tests). Finally, the endpoint must be susceptible to the contaminant being assessed. The assessment endpoints in this ERA were exceedances of Aquatic Reference Values (ARVs) and decreased integrity of populations of terrestrial floral and faunal species.

Aquatic organisms (e.g., fish, benthic macroinvertebrates) are socially relevant because humans enjoy the sport of fishing and they also are a food source for many people. The organisms are biologically relevant because they serve as food sources for other aquatic and terrestrial organisms. The endpoint is defined with a subject (aquatic organisms), and a characteristic of the subject (decreased integrity to aquatic organisms). The risk may be predicted by contaminant concentrations in media exceeding published aquatic reference values. Finally, aquatic organisms are susceptible to the COPCs at OU No. 4.

Terrestrial organisms (e.g., rabbits, deer, fox, raccoon, quail) are socially relevant because humans enjoy the sport of hunting and they also are a food source for many people. The organisms are biologically relevant because they serve as food sources for other terrestrial organisms and some also consume smaller mammals and plants which potentially have been contaminated. The endpoint is defined with a subject (rabbits, deer, fox, raccoon, and quail), and a characteristic of the subject (decreased integrity to rabbits, deer, fox, raccoon, and quail). The TRVs can be used to predict risks to terrestrial organisms. Finally, terrestrial organisms are susceptible to the COPCs at OU No. 4.

7.2.4.2 Measurement Endpoints

A measurement endpoint, or "ecological effects indicator" as it is sometimes referred, is used to evaluate the assessment endpoint. Therefore, measurement endpoints must correspond to, or be predictive of, assessment endpoints. In addition, they must be readily measurable, preferably quickly and inexpensively, using existing techniques. Measurement endpoints must take into consideration the magnitude of the contamination and the exposure pathway. The measurement endpoint should be an indicator of effects that are temporally distributed. Low natural variability in the endpoint is preferred to aid in attributing the variability in the endpoint to the contaminant. Measurement endpoints should be diagnostic of the pollutants of interest, as well as broadly applicable to allow comparison among sites and regions. Also, measurement endpoints should be standardized (e.g., standard procedures for toxicity tests). Finally, it is desirable to use endpoints that already are being measured (if they exist) to determine baseline conditions.

Endpoints are divided into four primary ecological groups: individual, population, community, and ecosystem endpoints. Individual endpoints (e.g., death, growth, tissue concentrations) are evaluated through toxicity tests, models, and other methods used to assess the effects on individual organisms. Population endpoints (e.g., occurrence, abundance, reproductive performance) are evaluated to determine presence and absence of species through field studies. Community endpoints (e.g., number of species, species diversity) are used to describe the complexity of the community. Finally, ecosystem endpoints (e.g., biomass, productivity, nutrient dynamics) are used to determine the effects between groups of organisms, and between organisms and the environment. Individual, population, and community endpoints were evaluated in this assessment.

The primary goal in deciding upon which ecological endpoints to evaluate was to determine the current effects that the contamination is having on the environment. The following sections discuss the measurement endpoints that were chosen for the ERA.

Aquatic Endpoints

Aquatic biota samples (e.g., fish, shellfish, and benthic macroinvertebrates) were not collected as part of the field activities at Sites 41 and 74. Aquatic species are expected to inhabit Sites 41 and 74 and be exposed to the COPCs. Potential effects from contaminants detected at Sites 41 and 74 on these species were evaluated by comparing exposure levels of COPCs in the surface water and sediments to aquatic reference values (i.e., NCWQS, WQSV, AWQC and SSVs).

Terrestrial Endpoints

As discussed earlier in this report, several terrestrial faunal species inhabit MCB Camp Lejeune including deer, birds, and small mammals, and potentially are exposed to the COPCs at OU No. 4. Potential effects from contaminants detected at OU No. 4 to these species were evaluated by comparing the CDIs to TRVs. In addition, comparisons of COPC concentrations in the soil to published plant and earthworm toxicity information was used to evaluate potential effects to some terrestrial species.

7.2.5 The Conceptional Model

This section of the report contains a list of hypotheses regarding how the stressors might affect ecological components of the natural environment:

- Aquatic receptors potentially may be adversely affected by exposure to contaminated water, sediment, and contaminated biota they ingest.
- Terrestrial receptors potentially may be adversely affected by exposure to contaminants in the surface water and surface soil.
- Terrestrial receptors potentially may be adversely affected by exposure to contaminated organisms and vegetation they ingest.

7.3 Analysis Phase

The next phase after the problem formulation is the analysis which consists of the technical evaluation of data on the potential effects and exposure of the stressor. This phase includes the ecological exposure characterization and the ecological effects characterization.

7.3.1 Characterization of Exposure

Characterization of exposure evaluates the interaction of the stressor with the ecological component. The following sections characterize the exposure in accordance with the stressors, ecosystem, exposure analysis, and exposure profile.

7.3.1.1 Stressor Characterization: Distribution or Pattern of Change

The remedial investigations involved collecting samples from four media; surface water, sediment, soil, and groundwater. The analytical results of these investigations are presented in Section 4.0 of this report. In addition, the source identification also is presented in Section 4.0 of the report, while the extent of contamination is discussed in Section 4.3 of this report.

7.3.1.2 Ecosystem Characterization

This section describes the regional ecology of the coastal plain and the habitats present at Sites 41 and 74. Information on sensitive environments and endangered species is also included.

Site Description

Site 41 is heavily wooded and vegetated. The areas along the eastern and southern boundaries are classified as wooded (Palustrine) wetlands (United State Fish and Wildlife Service, National Wetland Inventory, 1986). These areas are downslope of the former disposal area. No ecological surveys (i.e., biota sampling) were conducted at this site.

Site 74 is located in a stand of woods approximately one-half mile east of Holcomb Boulevard in the northeast portion of MCB Camp Lejeune. The general area is heavily overgrown with vegetation. The site is relatively flat. There are no significant surface water drainage features (i.e., ditches, streams, etc.) on site.

Deer, rabbits, and birds were the only terrestrial faunal species observed at OU No. 4. Based on the regional ecology, and due to the wooded areas around OU No. 4, there is the potential for other terrestrial fauna to periodically visit the site.

Regional Ecology

Camp Lejeune covers approximately 108,800 acres, 84 percent of which is forested (USMC, 1987). Approximately 45.1 percent of this is pine forest, 22 percent is mixed pine/hardwood forest, and 16.8 percent is hardwood forest. Nine percent of the base, a total of 3,587 acres, is wetland and includes pure pond pine stands, mixed pond pine/hardwood, marshes, pocosins, and wooded swamps. The base also contains 80 miles of tidal streams, 21 miles of marine shoreline, and 12 freshwater ponds.

The base drains primarily to the New River or its tributaries. These tributaries include Northeast Creek, Southwest Creek, Wallace Creek, French Creek, Bear Head Creek, and Duck Creek.

Because of the natural resources on the base, forested areas are actively managed for timber. Game species are also managed for hunting and ponds are maintained for fishing. Game species managed include wild turkey, white-tailed deer, black bear, grey and fox squirrels, bobwhite quail, eastern cottontail and marsh rabbits, raccoons, and wood ducks.

MCB Camp Lejeune is located in the Coastal Plain. The ecology of the region is influenced by climate, which is characterized by hot, humid summers and cool winters. Some subfreezing cold spells occur during the winters, and there are occasional accumulations of snow that rarely persist. The average precipitation is 55.96 inches and the mean temperature is 60.9°F. The area exhibits a long growing season, typically more than 230 days. Soils in the region range from very poorly drained muck to well-drained sandy loam.

A number of natural communities are present in the Coastal Plain. Subcommunities and variations of these major community types are also present and alterations of natural communities have occurred in response to disturbance and intervention (i.e., forest cleared to become pasture). The natural communities found in the area are summarized as follows:

- Mixed Hardwood Forest - Found generally on slopes of ravines. Beech is an indicator species with white oak, tulip, sweetgum, and holly.

- Southeastern Evergreen Forest - Dominated by pines, especially longleaf pine.

- Loblolly Pine/Hardwoods Community - Second growth forest that includes loblolly pine with a mix of hardwoods -- oak, hickory, sweetgum, sour gum, red maple, and holly.

- Southern Floodplain Forest - Occurs on the floodplains of rivers. Hardwoods dominate with a variety of species present. Composition of species varies with the amount of moisture present.

- Maritime Forest - Develop on the lee side stable sand dunes protected from the ocean. Live oak is an indicator species with pine, cedar, youpon, holly, and laurel oak. Deciduous hardwoods may be present where forest is mature.

- Pocosins - Lowland forest community that develop on highly organic soils that are seasonally flooded. Characterized by plants adapted to drought and acidic soils low in nutrients. Pond pine is dominant tree with dense layer of evergreen shrubs. Strongly influenced by fire.

- Cypress Tupelo Swamp Forest - Occurs in the lowest and wettest areas of floodplains. Dominated by bold cypress and tupelo.

- Freshwater Marsh - Occurs upstream from tidal marshes and downstream from non-tidal freshwater wetlands. Cattails, sedges, and rushes are present. On the coast of North Carolina swamps are more common than marshes.

- Salt Marsh - Regularly flooded, tidally influenced areas dominated by salt-tolerant grasses. Saltwater cordgrass is a characteristic species. Tidal mud flats may be present during low tide.

- Salt Shrub Thicket - High areas of salt marshes and beach areas behind dunes. Subjected to salt spray and periodic saltwater flooding. Dominated by salt resistant shrubs.

- Dunes/Beaches - Zones from the ocean shore to the maritime forest. Subjected to sand, salt, wind, and water.

- Ponds and Lakes - Low depressional areas where water table reaches the surface or where ground is impermeable. In ponds rooted plants can grow across the bottom. Fish populations managed in these ponds include redear, bluegill, largemouth bass, and channel catfish (USMC, 1987).

- Open Water - Marine and estuarine waters as well as all underlying bottoms below the intertidal zone.

Water Body Description

The unnamed tributary from the New River is classified by the NC DEHNR as SC HQW. The SC classifies the water body as tidal saltwater, which allows for aquatic life propagation and survival, fishing, wildlife and secondary recreation. The HQW means high quality waters, which are waters rated as excellent based on biological and physical/chemical characteristics obtained by monitoring, special studies or special designations made by the Wildlife Resources Commission, the Marine Fisheries Commission and/or the Department of Agriculture. These special designations include trout fishing areas, primary and functional nursing areas, and critical habitat areas (NC DEHNR, 1993).

Tank Creek and an unnamed tributary water body system is classified by NC DEHNR as C NSW, which indicates that it is a freshwater source available for aquatic life propagation and survival, fishing, wildlife, secondary recreation and agriculture. The NSW stands for Nutrient Sensitive Waters, which require limitations on nutrient inputs (NC DEHNR, 1993).

Site-Specific Ecology

During April 1993, Baker conducted a qualitative habitat evaluation of the terrestrial environment at Sites 41 and 74. Table 7-3 summarizes the habitats identified at each site and Appendix S includes data sheets that provide more detailed information.

Site 41

Site 41 and the surrounding area is primarily wooded with the age and composition of the forest varying with the amount of past disturbance in the area. The former landfill area is covered by a young pine forest dominated by loblolly pine (Pinus taeda). Secondary vegetation includes sweetgum (Liquidambar styraciflua). Saplings of sweetgum are mixed with red cedar (Juniperus virginiana) and wax myrtle (Myrica cerifera) in the understory. Vines are common in the understory and included poison ivy (Rhus radicans), trumpet creeper (Campsis radicans), Virginia creeper (Parthenocissus quinquefolia), and bullbriar (Smilax bona-nox). Grasses are the dominant groundcover in some areas and slender bush clover (Lespedeza virginica) is dominant in other areas. Forbs present on the forest floor also include the following species:

- Ebony spleenwort - Asplenium ebeneum
- Wood Sorrel - Oxalis europaea
- Barren False Strawberry - Duchesnea indica
- Lyre-leaved Sage - Salvia lyrata
- Bladder Sedge - Carex intermescens
- Bog Rush - Juncus effusus

- Corn Salad - Valerianella radiata
- Broom Sedge - Andropogon virginicus

Along a drainage swale to the north of the landfill a small freshwater wetland is present. Dominant vegetation varies within the wetland, depending on the amount of moisture present and the nature of the soil. Loblolly and longleaf pine (P. taeda and P. palustris), red cedar (Juniperus virginiana), sweetgum saplings (Liquidambar styraciflua), holly (Ilex opaca), and sweet myrtle (Myrica cerifera) are growing along the edges of the drainage swale. Several species of blueberries (Vaccinium spp.) are also present. Lichens and mosses are dominant on areas of open, sandy ground where they are interspersed with round-leaved sundew (Drosera rotundifolia), horned bladderwort (Utricularia cornuta), and rock spikemoss (Selaginella rupestris). Along the drainage way cattails (Typha latifolia), broom sedge (Andropogon virginicus), dwarf iris (Iris verna), and water pennywort (Hydrocotyle americana) are growing with grasses, sedges, and rushes. This drainage swale appears to lead to a large wetland identified on the NWI map as a palustrine, forested, deciduous wetland, which was also studied during the habitat evaluation.

South of the landfill, a loblolly pine\hardwood forest is present. Trees are the dominant vegetation in this habitat, although no species is clearly dominant. Tree species identified in the canopy include the following:

- Red Maple - Acer rubrum
- Tulip - Liriodendron tulipifera
- Loblolly Pine - Pinus taeda
- Sweetgum - Liquidambar styraciflua
- Beech - Fagus grandifolia
- Sugar Maple - Acer saccharum
- White Oak - Quercus alba
- Water Oak - Q. nigra
- Mockernut Hickory - Carya tomentosa
- Ironwood - Carpinus caroliniana
- River Birch - Betula nigra
- Sweetbay - Magnolia virginiana

Trees in the understory are also well mixed and no species is clearly dominant. Understory species identified include red cedar (Juniperus virginiana), wax myrtle (Myrica cerifera), dogwood (Cornus florida), holly (Ilex opaca), umbrella magnolia (Magnolia tripetala), and American snowbell (Styrax americana). Vines are common in the understory and seven different species were identified. They include poison ivy (Rhus radicans), Japanese honeysuckle (Lonicera japonica), wild grape (Vitis sp.), greenbriar (Smilax rotundifolia), Virginia creeper (Parthenocissus quinquefolia), trumpet creeper (Campsis radicans), and sand grape (Vitis rupestris).

Ferns are common on the forest floor; four species were identified including ebony spleenwort (Asplenium ebeneum), marsh fern (Aspidium thelypteris), royal fern (Osmunda regalis) and sensitive fern (Onoclea sensibilis). Cane (Arumdinaria tecta), grasses, and blue-eyed grass (Sisyrinchium sp.) are also found in the loblolly pine\hardwood forest.

Areas of mature hardwood forest were identified to the north, east, and west of the landfill, particularly in areas bordering the palustrine wetland. Again, trees are clearly dominant, although no individual species is dominant. Species present include tulip (Liriodendron tulipifera), red maple

(Acer rubrum), sweetgum (Liquidambar styraciflua), beech (Fagus grandifolia), white oak (Quercus alba), and mockernut hickory (Carya tomentosa). The understory is limited and consists of scattered dogwood (Cornus florida) and holly (Ilex opaca) trees. Vegetation is sparse on the forest floor and includes partridgeberry (Michella repens) and heartleaf (Hexastylis virginica).

To the south, east, and west of the site, a palustrine, forested, deciduous wetland is present along Tank and Southwest Creeks and along an unnamed tributary that flows roughly parallel to Tank Creek. This wetland area is often referred to as a swamp. (A swamp is defined as a forested wetland.) Trees are dominant in this area, but no species is clearly dominant. Some of the trees standing in deeper water are dead or dying and it appears that the water level may increased in the past. Trees identified in this wetland include black gum (Nyssa sylvatica), red maple (Acer rubrum), tulip (Liriodendron tulipifera), elm (Ulmus sp.), and swamp chestnut oak (Quercus michauxii). Ironwood (Carpinus caroliniana) and Leucothoe axillaris are present in the understory. Grasses, blue-eyed grass (Sisyrinchium sp.), and violets (Viola sp.) are present along the drier areas at the edge of the wetland and wetland vegetation, including sensitive fern (Onoclea sensibilis), marsh fern (Aspidium thelypteris), switch cane (Arundinaria tecta), sedges, and water pennywort (Hydrocotyle americana, is present in wetter areas, Lizards tail (Saururus cernus) is the dominant forb on the wetland floor in some areas.

A number of birds were observed at Site 41. Species identified include both resident birds and neotropical migrants. They are as follows:

- Downy Woodpecker - Picoides pubescens
- Red-eyed Vireo - Vireo oliveaceus
- Fish Crow - Corvus ossifragus
- Carolina Chickadee - Parus carolinensis
- Mourning Dove - Zenaida macroura
- Carolina Wren - Thryothorus ludovicianus
- Barn Swallow - Hirundo rustica
- Cardinal - Richmondena cardinalis
- Wood Thrush - Hylocichla mustelina
- Mockingbird - Mimus polyglottos
- Yellow Warbler - Dendroica petechia
- Blue-grey Gnatcatcher - Polioptila caerula
- Myrtle Warbler - Dendroica coronata
- Magnolia Warbler - Dendroica magnolia

Several species of reptiles and amphibians were observed at Site 41. Black racers (Coluber constrictor constrictor) were seen in the young pine forest and in the wooded wetland and a pair of box turtles (Terrepene carolina) were mating in the drainage swale. Several small pond-like areas are present along the access roads; these appeared to be large ruts that had collected surface water runoff. Tadpoles of at least two different species of frogs or toads were observed in the ponds. An adult southern toad (Bufo terrestris) was also found in this area of the site. Anoles (Anolis carolinensis carolinensis) were observed climbing trees in the pine\hardwood forest.

From direct observations and from signs found at Site 41 during the habitat evaluation, several species of mammals are present. These include white-tailed deer (Odocoileus virginianus), fox (Vulpes sp.), raccoon (Procylon lotor), and squirrel (Sciurus carolinensis). While beavers have dammed areas of the wooded wetland in the past, no current sign of beavers was observed.

Site 74

Site 74 and its environs are covered with pine forest. Loblolly pine (Pinus taeda) is dominant in the Former Mess Hall Grease Pit Area and longleaf pine (Pinus palustris) is dominant in the Former Pest Control Area. The understory of this pine forest is a shrub layer ranging in height from 1 to 15 feet. Scattered deciduous trees are also present and represent the following species:

- Sweetgum - Liquidambar styraciflua
- Post Oak - Quescus stellata
- Red Oak - Q. falcata
- White Oak- Q. alba
- Laurel Oak - Q. laurifolia
- Water Oak - Q. nigra
- Tulip - Liriodendron tulipifera
- Mockernut Hickory - Carya tomentosa

A variety of shrubs is present in the understory of the pine forest. In some areas of the site they formed dense thickets; in others they carpeted the ground. The following species were identified:

- Myrtle - Myrica cerifera
- Fetterbush - Lyonia lucida
- Slender Blueberry - Vaccinium tenellum
- Staggerbush - Lyonia mariana
- Sweet Pepperbush - Clethra alnifolia
- Winged Sumac- Rhus copallina
- Chinkapin - Castanea pumila
- Coastal Highbush Blueberry - Vaccinium caesariense
- Elliott's Blueberry - V. elliottii

In several areas of the Former Pesticide Control Area slender blueberry was dominant and carpeted the ground. Pine seedlings and deciduous tree seedlings were mixed with the shrubs throughout the site. Woody vines are also present and include greenbriar (Smilax rotundifolia), bullbriar (Smilax bona-nox), sand grape (Vitis rupestris), poison ivy (Rhus radicans), and Virginia creeper (Parthenocissus quinquefolia).

Ferns are also present. In the damper areas of the Former Mess Hall Grease Pit Area four species of ferns were identified -- cinnamon fern (Osmunda cinnamomea), royal fern (Osmunda regalis), sensitive fern (Onoclea sensibilis), and marsh fern (Aspidium thelypteris). These ferns are growing with switch cane (Arundinaria tecta). In other areas mosses, lichens, and various grasses are found with broom sedge (Andropogon virginicus), slender bush clover (Lespedeza virginica), bracken (Pteris aquilina), and partridgeberry (Mitchella repens).

A variety of birds were observed at Site 74. They include the following species:

- Mourning Dove - Zenaida macroura
- Wood Peewee - Contopus virens
- Carolina Chickadee - Parus
- Fish Crow - Corvus ossifragus
- Blue Jay - Cyanocitta cristata

- Whippoorwill - Caprimulgus vociferus
- Red-eyed Vireo - Vireo olivaceus
- Cardinal - Richmondena cardinalis
- Robin - Turdus migratorius
- Downy Woodpecker - Picoides pubescens
- White-eyed Towhee - Pipilo erythrophthalmus
- Blue-grey Gnatcatcher - Polioptila caerulea
- Carolina Wren - Thryothorus ludovicianus
- Great-crested Flycatcher - Myiarchus crinitus
- Red-bellied Woodpecker - Melanerpes carolinus
- Summer Tanager - Piranga rubra

No reptiles or amphibians were observed at Site 74. Tracks of mice and rabbits were noted, as were tracks of white-tailed deer. Regular deer trails through the forest were also observed and deer were apparently feeding on ferns in the Former Mess Hall Grease Pit Area.

Sensitive Environments

This section describes the sensitive environments that were evaluated at Sites 41 and 74. These sensitive environments include wetlands, threatened and endangered species, and other potentially sensitive environments.

Wetlands

The NC DEHNR's Division of Environmental Management (DEM) has developed guidance pertaining to activities that may impact wetlands (NC DEHNR, 1992a). In addition, certain activities affecting wetlands also are regulated by the U.S. Corps of Engineers.

The U.S. Fish and Wildlife Service (FWS) has prepared National Wetlands Inventory (NWI) maps for the Camp Lejeune, North Carolina area by stereoscopic analysis of high altitude aerial photographs (USDI, 1982). Sites 41 and 74 are included on these maps. The wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with Classification of Wetland and Deep-Water Habitats of the United States (Cowardin, et al, 1979). NWI maps are intended for an initial identification of wetland areas. They cannot be substituted for an actual wetland delineation that may be required by Federal, State and/or local regulatory agencies. Information from the wetlands maps was transferred to the site-specific biohabitat maps (Figures 7-1and 7-2).

Site-specific wetland delineations were not conducted at Sites 41 and 74, although potential wetland areas were noted during the habitat evaluation. These wetlands are illustrated on the biohabitat maps.

At Site 41, a drainage swale that supports wetland vegetation (sedges, rushes, cattails) is present, although it does not appear on NWI wetlands maps. This swale leads to a large palustrine, forested, deciduous wetland along the banks of Tank Creek, Southwest Creek, and an unnamed creek that is parallel to Tank Creek. Portions of this wetland were investigated during the habitat evaluation.

Two ponds, classified as palustrine open-water wetlands, are located within a half-mile radius of Site 74. Both of these ponds are managed for fish. South of the smaller pond a palustrine, forested, broad-leaved deciduous wetland is present. This wetland grades to a larger palustrine, forested, deciduous wetland. East of Piney Green Road, this wetland becomes a palustrine, forested, needle-leaved deciduous wetland.

Threatened and Endangered Species

Certain species have been granted protection by the FWS under the Federal Endangered Species Act (16 U. S. C. 1531-1543), and/or by the North Carolina Wildlife Resources Commission, under the North Carolina Endangered Species Act (G. S. 113-331 to 113-337). The protected species fall into one of the following status classifications: Federal or State endangered, threatened or candidate species; State special concern; State significantly rare; or State watch list. While only the Federal or State threatened or endangered and State special concern species are protected from certain actions, the other classified species have the potential for protection in the future.

Surveys have been conducted to identify threatened and endangered species at Camp Lejeune and several programs are underway to manage and protect them. Table 7-4 lists protected species present at the base and their protected classification. Of these species, the red-cockaded woodpecker, American alligator, and sea turtles are covered by specific protection programs.

The red-cockaded woodpecker requires a specific habitat in mature, living longleaf or loblolly pine trees. The birds live in family groups and young are raised cooperatively. At Camp Lejeune, 2,512 acres of habitat have been identified and marked for protection. Research on the bird at Camp Lejeune began in 1985 and information has been collected to determine home ranges, population size and composition, reproductive success, and habitat use. An annual roost survey is conducted and 36 colonies of birds have been located.

The American alligator is considered endangered in the northern-most part of its range, which includes North Carolina. It is found in freshwater, estuarine, and saltwater wetlands in Camp Lejeune and base wetlands are maintained and protected to protect alligators. Signs have been erected where alligators are known to live. Annual surveys of Wallace, Southwest, French, Duck, Mill, and Stone Creeks have been conducted since 1977 to identify alligators and their habitats on base.

Two protected sea turtles, the Atlantic loggerhead and Atlantic green turtle, nest on Onslow Beach at Camp Lejeune. The green turtle was found nesting in 1980; the sighting was the first time the species was observed nesting north of Georgia. The turtle returned to nest in 1985. Turtle nests on the beach are surveyed and protected, turtles are tagged, and annual turtle status reports are issued.

Four bird species, black skimmer, piping plover, Bachmans sparrow, and Peregrine falcon have also been identified during surveys at Camp Lejeune. The black skimmer and piping plover are sea and shore birds, respectively. Skimmers nest on low sandy islands and sand bars along the coast and piping plovers prefer beaches with broad open sandy flats above the high tide line. Skimmers feed above open water and piping plovers feed along the edge of incoming waves. Like the black skimmer and piping plover, Bachmans sparrows are very specific in their habitat requirements. They live in open stretches of pines with grasses and scattered shrubs for ground cover. Bachmans sparrows were observed at numerous locations throughout southern Camp Lejeune. A Peregrine falcon was observed approximately three miles east of OU No. 4 and may have been feeding in the area since the birds have a large foraging range.

In addition to the protected species that breed or forage at Camp Lejeune, several protected whales migrate through the coastal waters off the base during spring and fall. These include the Atlantic right whale, finback whale, sei whale, and sperm whale. Before artillery or bombing practice is conducted in the area, aerial surveys are made to assure that whales are not present in the impact areas.

No protected species were observed at Sites 41 and 74 during the habitat evaluation nor would they be expected to occur. Protected species at Camp Lejeune require specific habitats that do not correspond to the habitats identified at the sites. Previous survey results and maps of locations were protected species have been identified were consulted to produce biohabitat maps. No protected species have been identified within half-mile radii of Sites 41 or 74.

A natural heritage resources was conducted at Camp Lejeune (LeBlond, 1991) to identify threatened or endangered plants and areas of significant natural interest. From this list, the Rough-leaf loosestrife was the only Federally threatened or endangered plant species found on the Marine Corps Base. In addition, several State endangered or threatened and Federal and State candidate species were found on the MCB. The results of this survey are included in Appendix R.

Other Sensitive Environments

In addition to wetlands and protected species, other sensitive environments, including those listed in 40 CFR Part 300, were evaluated during Hazard Ranking System evaluations. These sensitive environments and their presence or absence at Sites 41 and 74 are discussed below.

- Marine Sanctuary - Sites 41 and 74 are not located within a Marine Sanctuary (NCMFC, 1992).

- National Park - Sites 41 and 74 are not located within a National Park (NPS, 1991).

- Designated Federal Wilderness Area - Sites 41 and 74 are not located within a Designated Federal Wilderness Area (WS, 1989).

- Areas Identified under the Coastal Zone Management Act - The North Carolina Coastal Area Management Act (CAMA) regulates various types of Areas of Environmental Concern including estuarine waters, coastal wetlands, public trust areas, and estuarine shoreline through the establishment of unified policies, criteria, standards, methods, and processes (CAMA, 1974).

- Sensitive Areas Identified under the National Estuary Program (NEP) or Near Coastal Waters Program (NCWP) - Sites 41 and 74 are not located within a Sensitive Area identified under the NEP or NCWP (NCMFC, 1992).

- Critical Areas Identified under the Clean Lakes Program - Sites 41 and 74 are not located within a Critical Area identified under the Clean Lakes Program (NPS, 1991).

- National Monument - Sites 41 and 74 are not located near a National Monument (NPS, 1991).

- National Seashore Recreational Area - Sites 41 and 74 are not located within a National Seashore Recreational Area (NPS, 1991).

- National Lakeshore Recreational Area - Sites 41 and 74 are not located within a National Lakeshore Recreational Area (NPS, 1991).

- National Preserve - Sites 41 and 74 are not located within a National Preserve (NPS, 1991).

- National or State Wildlife Refuge - Sites 41 and 74 are not located within a National or State Wildlife Refuge (NCWRC, 1992).

- Unit of the Coastal Barrier Resource Program - Sites 41 and 74 are not located within a unit of the Coastal Barrier Resource Program (USDI, 1993).

- Administratively Proposed Federal Wilderness Area - Sites 41 and 74 are not located within an Administratively Proposed Federal Wilderness Area (WS, 1989, 1993).

- Spawning Areas Critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters - Due to size restrictions, no critical spawning areas have been identified within Tank Creek (USMC, 1993). No specific spawning areas critical for the maintenance of fish/shellfish species in Tank Creek have been designated as such by state agencies (NC DEHNR, 1992).

- Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time - Surface waters associated with Sites 41 and 74 are not migratory pathways or feeding areas critical for the maintenance of an anadromous fish species because there is not a significant population of anadromous fish in Tank Creek (USMC, 1993).

- National river reach designated as Recreational - Tank Creek is not designated as a National Recreational River (NPS, 1990, 1993).

- Federal designated Scenic or Wild River - Tank Creek is not a Federally designated Scenic or Wild River (NPS, 1990, 1993).

- State land designated for wildlife or game management - Sites 41 and 74 are not located within a State game land (NCWRC, 1992).

- State designated Scenic or Wild River - Tank Creek is not a State designated Scenic or Wild River (NCMFC, 1992).

- State designated Natural Area - Sites 41 and 74 are not located within a State designated Natural Area or Area of Significant Value (LeBlond, 1991).

- State designated areas for protection or maintenance of aquatic life - No areas within the boundaries of Sites 41 and 74 are designated as primary nursery areas or are unique or special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses (NC DEHNR, 1992).

- Areas of Significant Value - Sites 41 and 74 are not located within a State Area of Significant Value (LeBlond, 1991).

- State Registered Natural Resource Area - Sites 41 and 74 are not located within a State Registered Natural Resource Area (LeBlond, 1991).

7.3.1.3 <u>Exposure Analysis/Profile</u>

The next step in the characterization of exposure is to combine the spatial and temporal distributions of both the ecological component and the stressor to evaluate exposure. This section of the ERA addresses and quantifies each exposure pathway via surface water, sediment, air, soil, and groundwater.

To determine if ecological exposure via these pathways may occur in the absence of remedial actions, an analysis was conducted including the identification and characterization of the exposure pathways. The following four elements were examined to determine if a complete exposure pathway was present:

- A source and mechanism of chemical release
- An environmental transport medium
- A feasible receptor exposure route
- A receptor exposure point

<u>Potential Exposure Scenarios</u>

This section discusses the potential exposure scenarios at OU No. 4 including surface water, sediments, soil, groundwater and air. The location of samples was based on historical information available for the site and a site visit to evaluate potential ecosystems and ecological receptors (see Figures 7-1 and 7-2, Biohabitat Maps).

Surface Water Exposure Pathway

Potential release sources to be considered in evaluating the surface water pathway are contaminated surface soils and groundwater. The release mechanisms to be considered are groundwater seepage and surface runoff. The potential routes to be considered for ecological exposure to the contaminated surface waters are ingestion and dermal contact. Potential exposure points for ecological receptors include species living in, or coming in contact with, the surface water on site or off site and downgradient relative to tidal influence.

COPCs were detected in the surface water demonstrating a release from a source to the surface water transport medium. Potential receptors that may be exposed to contaminants in surface waters in/or around surface water include: fish, benthic macroinvertebrates, deer, birds, and other aquatic and terrestrial life.

Aquatic organisms (i.e., fish, benthic macroinvertebrates) are exposed to contaminants in the surface water by ingesting water while feeding and by direct contact. In addition, aquatic organisms may ingest other aquatic flora and fauna that have bioconcentrated chemicals from the surface water. Overall, aquatic organisms have a high exposure to contaminants in the surface water. Potential decreased integrity of aquatic receptors from contaminants in the surface water were evaluated in this ERA by direct comparisons of contaminant concentrations in the surface water to published water quality standards and criteria.

Terrestrial faunal receptors potentially are exposed to contaminants in the surface water through ingestion and dermal contact. The magnitude of the exposure depends on their feeding habits and the amount of time they reside in the contaminated waters. In addition, terrestrial species may ingest organisms (e.g., fish, insects, plants) that have bioconcentrated contaminates from the surface water. Potential decreased integrity of terrestrial receptors from contaminants in the surface water was evaluated in this ERA by comparing CDI to TRVs. Total exposure of the terrestrial receptors to the COPCs in the surface waters was determined by estimating the CDI dose and comparing this dose to TRVs representing acceptable daily doses in mg/kg/day.

Sediment Exposure Pathway

The potential release sources to be considered in evaluating the sediment pathway are contaminated surface soils and groundwater. The release mechanisms to be considered are groundwater seepage and surface runoff. The potential routes to be considered for ecological exposure to the contaminated sediments are ingestion and dermal contact. Potential exposure points for ecological receptors include species living in, or coming in contact with, the sediments.

COPCs were detected in the sediment demonstrating a release from a source to the sediment transport medium. Potential receptors that may be exposed to contaminants in sediments include benthic macroinvertebrates, bottom feeding fish, aquatic vegetation and other aquatic life.

Aquatic organisms (i.e. fish, benthic macroinvertebrates) are exposed to contaminants in the sediments by ingesting sediments while feeding and by direct contact. In addition, aquatic organisms may ingest other aquatic flora and fauna that have bioconcentrated chemicals from the sediments. Overall, aquatic organisms have a high exposure to contaminants in the sediment. Potential decreased integrity of aquatic receptors from contaminants in the sediment were evaluated in this ERA by direct comparisons of contaminant concentrations in the sediments to SSVs.

Terrestrial faunal receptors potentially are exposed to contaminants in the sediments through ingestion and dermal contact. The magnitude of the exposure depends on their feeding habits and the amount of time they reside in the contaminated sediments. In addition, terrestrial species may ingest organisms (e.g., fish, insects, small mammals, plants) that have bioconcentrated contaminates from the sediments. Potential decreased integrity of terrestrial receptors from contaminants in the sediments was qualitatively evaluated in this ERA.

Soil Exposure Pathway

Potential release sources to be considered in evaluating the soil pathway are surface or buried wastes and contaminated soil. The release mechanisms to be considered are fugitive dust, leaching, tracking, and surface runoff. The transport medium is the soil. The potential routes to be considered for ecological exposure to the contaminated soils are ingestion and dermal contact. Potential exposure points for ecological receptors include species living in, or coming in contact with, the soils.

COPCs were detected in the surface soil demonstrating a release from a source to the surface soil transport medium. Potential receptors that may be exposed to contaminants in surface soil at/or around surface soil in the areas of detected COPCs including: deer, fox, raccoon, rabbits, birds, plants, and other terrestrial life.

Terrestrial receptors potentially are exposed to contaminants in the soils through ingestion, dermal contact, and/or direct uptake (for flora). The magnitude of the exposure depends on their feeding habits and the amount of time they reside in the contaminated soils. In addition, terrestrial species may ingest organisms (e.g., insects, small mammals, plants) that have bioconcentrated contaminates from the soils. Potential decreased integrity of terrestrial receptors from contaminants in the surface soils was evaluated in this ERA by comparison of CDIs to TRVs, and direct comparisons of soil concentrations to literature toxicity value for plants and invertebrates.

Groundwater Exposure Pathway

The potential release source to be considered in evaluating the groundwater pathway is contaminated soils. The release mechanism to be considered is leaching. The routes to be considered for ecological exposure to the contaminated groundwater are ingestion and dermal contact. Groundwater discharge to area surface waters may represent a pathway for contaminant migration. Since organisms are not directly exposed to groundwater at OU No. 4, the groundwater to surface water exposure is accounted for in the surface water section of the ERA.

Air Exposure Pathway

There are two potential release mechanisms to be considered in evaluating the atmospheric pathway: release of contaminated particulates and volatilization from surface soil, groundwater and surface water. The potential exposure points for receptors are areas on or adjacent to the site.

No data have been collected to document exposure to receptors via the air pathway. However, based on the low concentrations of VOCs detected in the soil, sediments, and surface water, and the negligible vapor pressure of pesticides and metals, the air concentration of the COPCs is not expected to cause a decrease in integrity of the terrestrial receptors. Therefore, this pathway was not evaluated as part of the ERA.

7.3.2 Ecological Effects Characterization

The potential ecological effects to aquatic receptors were evaluated by direct comparisons of contaminant concentrations in surface water and sediment to ARVs and other available criteria or TBCs. Potential ecological effects to terrestrial receptors were evaluated by comparison to literature values and by comparing the CDIs to TRVs. The following sections further discuss the Aquatic Reference Values (ARV) comparisons and the CDI to TRV comparisons to evaluate the potential ecological effects to aquatic and terrestrial receptors from the COPCs.

Contaminant concentrations detected in the surface water at OU No. 4 were compared to the NC DEHNR WQS, USEPA WQSV, USEPA AWQC and other toxicity values obtained from the USEPA AWQC documents and AQUIRE to determine if there were any exceedances of the published values. In addition, the log normal upper 95 percent confidence limit or the maximum value detected were compared to the WQS, the acute and chronic WQSVs, and the acute and chronic AWQC using the quotient ratio method. If the variability in measured concentration values is great and the log normal upper 95 percent confidence limit was greater than the maximum detected value, the maximum detected value was used in the quotient ratio. This yields a value termed the Quotient Index (QI). A QI greater than unity indicates a potential for adverse effects to aquatic life. The log normal upper 95 percent confidence limit were used to represent a conservative estimate of exposure at the site. The ratio of the upper 95 percent confidence limit (or maximum detected value) and the ARVs were calculated for each COPC.

Contaminant concentrations detected in the sediments at Site OU No. 4 were compared to the SSVs to determine if there were any exceedances in the established values. In addition, the upper 95 percent confidence limit or the maximum value detected was compared to the Region IV lower 10 percentile (ER-L) and median percentile (ER-M) using the quotient ratio method. Because the screening values are set to be protective of the aquatic environment, any exceedances of these values indicate a potentially toxic environment for the aquatic organisms inhabitating the water body.

7.3.2.1 Surface Water Quality

Tables 7-5 and 7-6 contain the freshwater North Carolina WQS, the Region IV USEPA WQSV, and the USEPA AWQC for the COPCs detected at Site 41and Site 74, respectively.

The freshwater water quality values for the following metals are water hardness dependent: cadmium, chromium III, copper, lead, nickel, silver, and zinc. In general, the higher the water hardness (in mg/L of $CaCO_3$) the higher the water quality value. A hardness concentration of 50 mg/L $CaCO_3$ was used to calculate these values since actual hardness data was not available.

The following COPCs detected in the surface water samples do not have WQS, WQSV, or AWQC values: aluminum, barium, cobalt, manganese, and vanadium. The potential impact to aquatic species from these chemicals in the surface water was evaluated using the results of acute and chronic tests obtained from the AQUIRE database (AQUIRE, 1993). The maximum detected concentration of these chemicals in the surface water were below the adverse effects levels obtained from the database. Therefore, no decrease in integrity of ecological receptors from these chemicals is expected.

7.3.2.2 Sediment Quality

Tables 7-7 and 7-8 contain the sediment SSVs for hazardous waste sites for the COPCs detected in Site 41 and Site 74. Sediment samples were collected from zero to six inches, and six to twelve inches at most of the sediment stations. Some sediment stations were sampled at a depth of zero to six inches only, due to sampler refusal or other difficulties in collecting the 6 to 12-inch sample.

The following COPCs detected in the sediments do not have SSVs for them: aluminum, barium, beryllium, iron, manganese, selenium, vanadium, endosulfan II and methoxychlor. There is limited, if any, data assessing the effects on aquatic organism exposed to these chemicals in sediment samples. Therefore, the effects of these chemicals on aquatic organisms were not determined.

7.3.2.3 Surface Soil Quality

There are no standards, criteria, or other screening values for assessing potential impacts to terrestrial ecological receptors from contaminants in soils. In addition, the amount of literature data evaluating adverse ecological effects on terrestrial species exposed to contaminants in surface soils is limited. However, toxicological effects on plants and/or invertebrates inhabiting soils contaminated by the following chemicals were obtained from various studies in the literature: arsenic, barium, beryllium, chromium, copper, lead, manganese, mercury, silver, vanadium, and zinc. This data was used to evaluate decreased integrity of terrestrial flora and invertebrates from COPCs in the soil.

No toxicological effects of plants and/or invertebrates inhabiting soils contaminated by the following chemicals were obtained from various studies in the literature: aluminum, cobalt, iron, nickel, selenium, and thallium. Therefore, these contaminants were not evaluated in the ERA.

No information was found which evaluate the toxicological affects on plants and/or invertebrates inhabiting soils contaminated with TCL organics, therefore, the evaluation was limited to TAL inorganics.

7.3.2.4 Terrestrial Chronic Daily Intake

As discussed above, there are no standards, criteria, or other screening values for assessing potential impacts to terrestrial receptors from contaminants in soils. However, there are some models that exist to estimate the exposure to terrestrial receptors. The following describes the procedures used to evaluate the potential soil exposure to terrestrial fauna at OU No. 4 by both direct and indirect exposure to COPCs via water (surface water), soil, and foodchain transfer.

Contaminants of concern at OU No. 4 are identified in Section 7.2.1.1 for each media. Based on the regional ecology and potential habitat at the site, the indicator species used in this analysis are the white-tailed deer, cottontail rabbit, red fox, raccoon, and the bobwhite quail. The exposure points for these receptors are the surface soils, surface water, and vegetation. The routes for terrestrial exposure to the COPCs in the soil and water are incidental soil ingestion, drinking water, vegetation (leafy plants, seeds and berries) ingestion, fish ingestion, and ingestion of small mammal ingestion.

Total exposure of the terrestrial receptors to the COPCs in the soil and surface waters was determined by estimating the Chronic Daily Intake (CDI) dose and comparing this dose to TRVs representing acceptable daily doses in mg/kg/day. For this analysis, TRVs were developed from NOAELs or LOAELs obtained from the Integrated Risk Information System (IRIS, 1993), or other toxicological data in the literature (Table 7-9).

7.4 Risk Characterization

The risk characterization is the final phase of a risk assessment. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor are evaluated. This section evaluates the potential adverse effects on the ecological integrity at Sites 41 and 74 from contaminants identified at the site.

A Quotient Index (QI) approach was used to characterize the risk to aquatic receptors from exposure to surface water and sediments. This approach characterizes the potential effects by comparing exposure levels of COPCs in the surface water and sediments to the aquatic reference values presented in Section 7.2.3, Ecological Effects. The QI is calculated as follows:

$$QI = \frac{EL}{ARV}$$

Where: QI = Quotient Index
EL = Exposure Level, mg/L or mg/kg
ARV = Aquatic Reference Value, mg/L or mg/kg

7.4.1 Surface Water Quality

Table 7-10 contains a comparison of the COPCs identified in the surface water at Sites 41 and 74 to the ARVs to determine if they exceeded the published values. A QI ratio of the detected value at each sampling station, and WQS, WQSVs, and AWQC were calculated for each COPC. A QI ratio greater than unity indicates a potential for decreased integrity of aquatic life. Table 7-10 presents only the ratios that are greater than unity for the COPCs at each site. Figures 7-3, 7-4 and 7-5 presents the QI exceedances per sampling station.

The following sections discuss the surface water quality results at Sites 41 and 74. These sections contain comparisons of the contaminants detected in the surface water and sediments at the sites to their ARVs and comparisons to base-wide background (inorganics only) concentrations (see Section 4.4 for base-wide concentration tables).

7.4.1.1 Site 41

Twenty-eight surface water samples collected at Site 41 in the unnamed tributary and Tank Creek were analyzed for TCL organics, TCL pesticides and PCBs, and TAL inorganics. Aluminum had QI ratios greater than unity when compared to the acute AWQC in six samples and the chronic AWQC in twenty-five samples. Aluminum was detected at concentrations greater than the base-wide background average concentration in six samples. Copper had QI ratios greater than unity when compared to NCWQS in four samples, the acute WQSV and AWQC in three samples, and the chronic WQSV and AWQC in four samples. Copper was detected at concentrations greater than the base-wide background average concentration in four samples. Iron had QI ratios greater than unity when compared to the NCWQS and the chronic AWQC in nineteen samples. Iron was detected at concentrations above the base-wide background average concentration in twenty samples. Lead had QI ratios greater than unity when compared to the NCWQS in three samples and the chronic WQSV and AWQC in eleven samples. Lead was detected in twelve samples at concentrations above the base-wide background average concentration. Mercury also had QIs greater than one when compared to the NCWQS, chronic WQSV and the chronic AWQC in nine samples. Mercury was detected at concentrations above the base-wide background average concentration in nine samples. Zinc had QI ratios greater than unity when compared to the NCWQS in six samples, and the acute and chronic WQSVs and AWQC in three samples. Zinc was detected at concentrations greater than the base-wide background average in twenty samples. The locations of these exceedances also are present in Table 7-10 and Figures 7-3 and 7-4. No other inorganics detected at Site 41 exceeded any of the surface water ARVs.

No organics or pesticides detected at Site 41 had QI ratios greater than unity.

7.4.1.2 Site 74

Three surface water samples collected at Site 74 were analyzed for TCL organics, TCL pesticides and PCBs, and TAL inorganics. Aluminum had QI ratios greater than unity when compared to the chronic AWQC in three samples; however, all three samples were detected at concentrations below both the base-wide background average concentration. Lead had QIs greater than unity when compared to the chronic WQSV and the chronic AWQC in three samples. Lead was detected at concentration above both the base-wide background average concentration in two samples. The locations of these exceedances are presented in Table 7-18 and Figure 7-5.

No TCL organics or TCL pesticides and PCBs detected at Site 74 had QIs greater than unity when compared to the surface water ARVs.

7.4.2 Sediment Quality

Table 7-11 contains a comparison of the COPCs identified in the sediment to the ARVs to determine if exceedances of published values occurred. The QI ratio of the detected values at each sampling station and the ER-L and ER-M were calculated for each COPC. A ratio greater than unity indicates a possibility for adverse effects to aquatic life. Table 7-19 presents only the ratios that are greater than unity for the COPCs. Figures 7-3 and 7-4 presents the ratios that are greater than unity per sampling location.

The following sections discuss the sediment quality results at the sites. These sections contain a comparison of the contaminants detected in the sediments to their ARVs and base-wide background concentrations (see Section 4.4 for base-wide inorganic concentration tables).

7.4.2.1 Site 41

Forty-two sediment samples collected from twenty-eight stations were analyzed for TCL organics, TCL pesticides and PCBs, and TAL inorganics. Lead exceeded the ER-L in two samples and silver exceeded the ER-L in three samples and the ER-M in one sample. Lead was detected at concentrations above the base-wide average background in five samples. Silver was detected at concentration above the base-wide average background in these three samples. Zinc exceeded the ER-L in one sample and was detected at concentrations above the base-wide average background concentration in twenty samples. No other inorganics detected in the sediments exceeded the ER-L or ER-M values.

Among the pesticides and PCBs, 4-4'-DDD exceeded the ER-L in seventeen samples and the ER-M in five samples; 4-4'-DDT exceeded the ER-L in fourteen samples and the ER-M in three samples; 4,4'-DDE exceeded the ER-L in fifteen samples and the ER-M in four samples; dieldrin exceeded the ER-L in ten samples; alpha-chlordane exceeded the ER-L in eleven samples; and gamma-chlordane exceeded the ER-L in nine samples and the ER-M in one sample. No other organics, pesticides or PCBs exceeded the ER-L or ER-M values in any of the sediment samples.

The following COPCs in the sediments had QIs greater than unity when compared to the ER-L: lead, silver, zinc, 4-4'-DDD, 4-4'-DDT, 4,4'-DDE, dieldrin, and alpha and gamma-chlordane. The following COPCs had QIs greater than unity when compared with the ER-Ms: silver, 4,4'-DDD, 4,4'-DDE, 4-4'-DDT, and gamma-chlordane.

7.4.2.2 Site 74

Three sediment samples collected from three stations at Site 74 were analyzed for TCL organics, TCL pesticides and PCBs, and TAL inorganics.

No TCL organics, TCL pesticides, TCL PCBs, or TAL inorganics were detected in Site 74 sediments exceeded the ER-L or ER-M values.

7.4.3 Surface Soil Quality

The following sections discuss the results of the risk characterization of surface soils at OU No. 4. These sections contain a comparison of the contaminants detected in the surface soils to the concentrations of the contaminants in soil that caused adverse effects to plants, terrestrial invertebrates, and terrestrial vertebrates. This data was obtained from various sources in the literature.

7.4.3.1 Site 41

Arsenic concentrations ranged from 0.617 to 3.67 mg/kg in the surface soils at Site 41, which are below the 25 mg/kg that depressed crop yields (USDI, 1988). Barium concentrations ranged from 3.14 to 82.2 mg/kg, which are below the 2,000 mg/kg that induced plant toxicity (Adriano, 1986). Beryllium concentrations of 0.187 to 0.344 mg/kg were found in the surface soils which were below the 0.500 mg/kg limit for neutral to alkaline fine-textured soils (Adriano, 1986). Some of the chromium concentrations found in the surface soils (2.42J to 41.4 mg/kg) are greater than the 10 kg/mg in surface soils that caused mortality in the earthworm species Pheretima pesthuma, (Hopkin, 1989).

Copper concentrations ranged from 4.17 to 132 mg/kg, some of which are above the 50 mg/kg level that interfered with the reproduction activity of the earthworm species Allolobuphora caliginosa (Hopkin, 1989). The phytotoxicity of lead was reported to be lower than that of copper (which would be greater than 50 mg/kg). Lead concentrations ranged from 2.57 to 341 mg/kg, which are less than the 670 mg/kg, which is considered hazardous to earthworms (Beyer, 1993). Manganese concentrations ranged from 1.67 to 6,000 mg/kg some of which were greater than the mean U.S. soil concentration of 560 mg/kg and vanadium concentrations ranged from 4.62 to 39.8 mg/kg which are lower than the mean U.S. soil concentration of 58 mg/kg (Adriano, 1986). Mercury concentrations ranged from 0.073 to 0.768 mg/kg, which are less than the 3 mg/kg which has been shown to interfere with reproduction in mallard ducks and produce brain lesions in their ducklings (Beyer, 1993). Zinc concentrations ranged from 3.77 to 14,600 mg/kg, which are greater than the 450 to 1400 mg/kg that caused plant toxicity (Adriano, 1986).

7.4.3.2 Site 74

Arsenic concentrations ranged from 0.621J to 1.16 mg/kg in the surface soils, which are below the 25 mg/kg that depressed crop yields (USDI, 1988). Barium concentrations ranged from 2.89 to 54.7 mg/kg, which are below the 2,000 mg/kg that induced plant toxicity (Adriano, 1986). Chromium concentrations of 1.89 to 10.6 mg/kg were found in the surface soils, which are greater than the 10 kg/mg in surface soils that caused mortality in the earthworm species Pheretima pesthuma, (Hopkin, 1989). Copper concentrations ranged from 5.07 to 22 mg/kg, which are below the 50 mg/kg level that interfered with the reproduction activity of the earthworm species Allolobuphora caliginosa (Hopkin, 1989).

Lead concentrations ranged from 0.878J to 15.4 mg/kg, which are less than the 670 mg/kg which is considered hazardous to earthworms (Beyer, 1993). Manganese concentrations ranged from 1.44 to 96.2 mg/kg, which are lower than the mean U.S. soil concentration of 560 mg/kg (Adriano, 1986). Mercury concentrations ranged from 0.015 to 0.092 mg/kg, which are less than the 3 mg/kg which has been shown to interfere with reproduction in mallard ducks and produce brain lesions in their ducklings (Beyer, 1993). Vanadium concentrations ranged from 4.03 to 15.1 mg/kg, which are below the mean U.S. soil concentrations of 58 mg/kg (Adriano, 1986). Zinc concentrations ranged from 2.27 to 33.9 mg/kg which are below the 450 to 1400 mg/kg that caused plant toxicity (Adriano, 1986). Selenium concentrations ranged from 0.609 to 1.2 mg/kg, which were below the 5 to 15 mg/kg range that is highly toxic to animals (Arthur, 1992).

7.4.4 Terrestrial Chronic Daily Intake Model

The following sections discuss the CDIs and QIs calculated for the terrestrial receptors.

7.4.4.1 CDI Calculations

Total exposure of the terrestrial receptors at Sites 41 and 74 to the COPCs in the soil and surface waters was determined by estimating the CDI dose and comparing this dose to TRVs representing acceptable daily doses in mg/kg/day. CDIs were estimated for the white-tailed deer, cottontail rabbit, bobwhite quail, and red fox at Sites 41 and 74. The CDI for the raccoon was only estimated at Site 41. There were no streams or rivers that traverse Site 74, therefore it was assumed that there were no fish, and therefore no raccoons feeding on site. The estimated CDI dose of the receptors (bobwhite quail, cottontail rabbit, and white-tailed deer) to soils, surface water, and vegetation was determined using the following equation:

$$E = \frac{(Cw)(Iw)+[(Cs)(Bv\ or\ Br)(Iv)+(Cs)(Is)][H]}{BW}$$

where:

E	=	Total Exposure, mg/kg/d
Cw	=	Constituent concentration in the surface water, mg/L
Iw	=	Rate of drinking water ingestion, L/d
Cs	=	Constituent concentration in soil, mg/kg
Bv	=	Soil to plant transfer coefficient (leaves, stems, straw, etc.), unitless
Br	=	Soil to plant transfer coefficient (fruits, seeds, tubers, etc.), unitless
Iv	=	Rate of vegetation ingestion, kg/d
Is	=	Incidental soil ingestion, kg/d
H	=	Contaminated area/Home area range area ratio, unitless
BW	=	Body weight, kg

The estimated CDI dose of the raccoon was determined using the following equation.

$$E = \frac{(Cw)(Iw) + [(Cs)(Br)(Iv) + (Cs)(Is) + (Cf)(If)][H]}{BW}$$

where:

E	=	Total Exposure, mg/kg/d
Cw	=	Constituent concentration in the surface water, mg/L
Iw	=	Rate of drinking water ingestion, L/d
Cs	=	Constituent concentration in soil, mg/kg
Br	=	Soil to plant transfer coefficient (fruit, seeds, tubers, etc.), unitless
Iv	=	Rate of vegetation ingestion, kg/d
Is	=	Incidental soil ingestion, kg/d
If	=	Rate of fish ingestion, kg/d
Cf	=	Constituent concentration in the fish, mg/kg (whole body concentrations)
H	=	Contaminated area/Home area range area ratio, unitless
BW	=	Body weight, kg

The estimated CDI dose of the red fox was determined using the following equation:

$$E = \frac{(Cw)(Iw) + [(Cs)(Br)(Iv) + (Cs)(Is) + (Cm)(Im)][H]}{BW}$$

where:

E	=	Total Exposure, mg/kg/d
Cw	=	Constituent concentration in the surface water, mg/L
Iw	=	Rate of drinking water ingestion, L/d
Br	=	Soil to plant transfer coefficient (fruit, seeds, tubers, etc.), unitless
Iv	=	Rate of vegetation ingestion, kg/d
Cs	=	Constituent concentration in soil, mg/kg
Is	=	Incidental soil ingestion, kg/d
Im	=	Rate of small mammal ingestion, kg/d
Cm	=	Constituent concentrations in small mammals, mg/kg
		where: Cm = (Cs)(Bv) + (Cs)(Is)
Bv	=	Soil to plant transfer coefficient (leaves, stems, straw, etc.), unitless
H	=	Contaminated area/Home area range area ratio, unitless
BW	=	Body weight, kg

Bioconcentration of the COPCs to plants was calculated using the soil to plant transfer coefficient (Bv or Br) for organics (Travis, 1988) and metals (Baes, 1984). Concentrations of COPCs in the fish were calculated for Site 41. This was accomplished by multiplying the freshwater BCF by the surface water concentration of a specific chemical. Freshwater BCFs could not be located in the literature for aluminum, barium, cobalt, iron, and manganese. These concentrations were assumed to be zero. If a chemical was not detected in the surface water, it was also assumed to be a nondetect in the fish. The concentrations of the COPCs in the soil (Cs) used in the model were the log normal upper 95 percent confidence limit or the maximum concentration detected of each COPC at each site. The log normal upper 95 percent confidence limit or the maximum concentration detected for each constituent was also used as the concentration of each COPC in the surface water. The exposure parameters used in the CDI calculations are presented in Table 7-12 and are summarized for each receptor below.

For the white-tailed deer, the feeding rate is 1.6 kg/d (Dee, 1991). The incidental soil ingestion rate is 0.019 kg/d (Scarano, 1993). The rate of drinking water ingestion is 1.1 L/d (Dee, 1991). The rate of vegetation ingestion is 1.6 kg/d. The body weight is 45.4 kg (Dee, 1991), and the home range is 454 acres (Dee, 1991). The deer's diet was assumed to be 100 percent vegetation (leaves, stems, straw).

For the eastern cottontail rabbit, the feeding rate is 0.1 kg/d (Newell, 1987). The incidental soil ingestion rate is 0.002 kg/d (Newell, 1987). The rate of drinking water ingestion is 0.119 L/d (USEPA, 1993). The rate of vegetation ingestion is 0.1 kg/d. The body weight is 1.229 kg (USEPA, 1993), and the home range is 9.29 acres (USEPA, 1993). The rabbit's diet was assumed to be 100 percent vegetation (leaves, stems, straw).

For the bobwhite quail, the feeding rate is 0.014 kg/d (USEPA, 1993). The quail's diet was assumed to be 100 percent vegetation (leaves, stems, straw). The incidental soil ingestion rate is 0.001 kg/d (Newell, 1987). The rate of drinking water ingestion is 0.019 L/d (USEPA, 1993). The rate of vegetation ingestion is 0.014 kg/d. The body weight is 0.177 kg (USEPA, 1993), and the home range is 8.89 acres (USEPA, 1993).

For the red fox, the feeding rate is 0.446 kg/d (USEPA, 1993). The fox's diet was assumed to be 20 percent vegetation (seed, berries) and 80 percent small mammals. The incidental soil ingestion rate is 0.012 kg/d (USEPA, 1993). The rate of drinking water ingestion is 0.399 L/d (USEPA, 1993). The rate of vegetation ingestion is 0.089 kg/d, the rate of small mammal ingestion is 0.356 kg/d. The body weight is 4.69 kg (USEPA, 1993), and the home range is 1,771 acres (USEPA, 1993).

For the raccoon, the feeding rate is 0.319 kg/d (USEPA, 1993). The raccoon's diet was assumed to be 40 percent vegetation (nuts, seeds, berries) and 60 percent fish. The incidental soil ingestion rate is 0.030 kg/d (USEPA, 1993). The rate of drinking water ingestion is 0.331 L/d (USEPA, 1993). The rate of vegetation ingestion is 0.128 Kg/d and the rate of fish ingestion is 0.192 kg/d. The body weight is 3.99 kg (USEPA, 1993), and the home range is 385 acres (USEPA, 1993).

7.4.4.2 QI Calculations

As was used to characterize the risk to aquatic receptors, the QI approach was used to characterize the risk to terrestrial receptors. In this use of the QI, the risk are characterized by comparing the CDIs for each COPCs to the TRVs and is calculated as follows:

$$QI = \frac{CDI}{TRV}$$

Where: QI	=	Quotient Index
CDI	=	Total Exposure, mg/kg/day (chronic daily intake)
TRV	=	Terrestrial Reference Value, mg/kg/day

Tables 7-13 and 7-14 contain the QI for the COPCs in each of the areas. A QI of greater than "unity" is considered to be indicative of potential risk. Such values do not necessarily indicate that an effect will occur but only that a lower threshold has been exceeded. The evaluation of the significance of the QI has been judged as follows: (Menzie, 1993)

- QI exceeds "1" but less than "10": some small potential for environmental effects;
- QI exceeds "10": significant potential that greater exposures could result in effects based on experimental evidence;
- QI exceeds "100": effects may be expected since this represents an exposure level at which effects have been observed in other species.

The risks characterized above provide insight into general effects upon animals in the local population. However, depending on the endpoint selected, they may not indicate if population-level effects will occur.

There are some differences of opinion found in the literature as to the effectiveness of using models to predict concentrations of contaminants found in terrestrial species. According to one source, the food chain models currently used incorporate simplistic assumption that may not represent conditions at the site, bioavailability of contaminants, or site-specific behavior of the receptors. Simple food chain models can provide an effective means of initial characterization of risk, however, residue analyses, toxicity tests, and the use of biomarkers provide a better approach for assessing exposure (Menzie, 1993).

The following sections discuss the results of the terrestrial CDI compared to the TRVs, the COPCs in the soils compared to published soil toxicity data, and an evaluation of the potential impacts to threatened and endangered species, wetlands, and other sensitive environments. TRVs could not be located for bis(2-chloroethyl)ether, 4-methyl-2-pentanone, aluminum, cobalt, and iron. Therefore, these COPCs could not be included in this comparison.

The CDI model was used to assess decreased integrity in terrestrial species from exposure to contaminants in surface water and surface soils. The surface soil data were grouped into two areas, Site 41 and Site 74 for the statistics. Therefore, a QI was calculated for each area (Note: the surface water samples were included in the calculations for each area).

At Site 41, the QIs of the CDI to the TRVs were less than unity for all COPCs except manganese. The QIs for manganese were calculated to be 10.6 for the quail, 9.0 for the rabbit, 1.2 for the fox, and 1.3 for the raccoon. Therefore, the total QI for the quail, rabbit fox, and raccoon were greater than unity. The QIs were greater than unity, but less than ten for all the contaminants except manganese in the quail, indicating only a small potential that the animals are being adversely affected by the contaminants at Site 41. The QI for manganese for the quail was greater than 10 (10.6) but much less than 100 indicating a significant potential that greater exposures could result in adverse affects.

At Site 74, the QIs of the CDI to the TRVs were less than unity for all the COPCs except manganese. The QIs for manganese were calculated to be 1.19 for the quail and 1.04 for the rabbit. Therefore, the total QIs for the quail (1.26) and the rabbit (1.09) were greater than unity. The QIs were greater than unity, but less than 10 for all contaminants indicating only a small potential that the animals are being adversely affected.

7.4.5 Threatened and/or Endangered Species

Several threatened and/or endangered species inhabit MCB Camp Lejeune. However, these threatened and/or endangered species are not known to regularly frequent or breed at OU No. 4 (USMC, 1993). In addition, no protected species were observed at Sites 41 and 74 during the habitat evaluation nor would they be expected to occur. Protected species at Camp Lejeune require specific habitats that do not correspond to the habitats identified at the sites. Previous survey results and maps of locations where protected species have been identified were consulted to produce biohabitat maps. No protected species have been identified within half-mile radii of Sites 41 or 74. Therefore, potential adverse impacts to these protected species from contaminants at OU No. 4 appear to be low.

7.4.6 Flora/Wetlands

Site-specific wetland delineations were not conducted at Sites 41 and 74, although potential wetland areas were noted during the habitat evaluation. Generally, wetlands were not identified on each of the sites, although wetlands were present within a half mile radius of each site. These wetlands are illustrated on the biohabitat maps (Figures 7-1 and 7-2) potential impacts to wetlands are addressed in the surface water and sediment sections.

7.4.7 Other Sensitive Environments

No areas within the boundaries of OU No. 4 are designated as unique or special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses. There are no known spawning and nursery areas for resident fish species within Site 41 or 74. There is no potential for decreased integrity of fish spawning or nursing in those areas.

Several threatened and/or endangered species are known to inhabit Camp Lejeune as discussed in Section 7.3. No known threatened and/or endangered species are known to inhabit Sites 41 or 74.

The potential impact to terrestrial organisms that are present at OU No. 4 is discussed in earlier sections of this report. The terrestrial organisms that may be breeding in contaminated areas at OU No. 4 may be more susceptible to chemical stresses due to the higher sensitivity of the reproductive life stages of organisms to these types of stresses.

7.5 Ecological Significance

This section essentially summarizes the overall risks to the ecology at the site. It addresses impacts to the ecological integrity at the Operable Unit from the COPCs detected in the media, and to determine which COPCs are impacting the site to the greatest degree. This information, to be used in conjunction with the human health RA, supports the selection of remedial action(s) for the Operable Unit that are protective of public health and the environment.

7.5.1 Aquatic Endpoints

The measurement endpoint used to assess the aquatic environment is decreased integrity of aquatic organisms.

7.5.1.1 Surface Water and Sediments

Overall, metals and pesticides appear to be the most significant site related COPCs that have the potential for decreasing the integrity of aquatic organisms at OU No. 4. Pesticides are not only potentially toxic to aquatic life through a direct exposure pathway, but as indicated by their high BCF value, they have a high potential to bioconcentrate pesticides in organisms. Therefore, other fauna that feed upon these organisms will be exposed to pesticides via this indirect exposure pathway. Following is a summary of other findings within OU No. 4.

Based on the potential habitat, and other physical characteristics, the most significant populations of aquatic organisms at the site, including fish, bentho macroinvertebrates, and some terrestrial vertebrates, potentially are in or surrounding Site 41. Aluminum, copper, iron, lead, mercury, silver, and zinc were the only inorganic COPCs detected in the surface water at concentrations that exceeded any of the ARVs. Copper, iron, lead, mercury, silver, and zinc exceeded the ARVs at Site 41; and, lead and aluminum exceeded the ARVs at Site 74.

Lead, silver, zinc, 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, dieldrin, alpha-chlordane, and gamma-chlordane were the only COPCs detected in sediment samples at Site 41 that exceeded the sediment ARVs. There were no COPCs detected at Site 74 that exceeded any sediment ARVs.

7.5.2 Terrestrial Endpoints

During the habitat evaluation, no areas of vegetation stress or gross impacts from site contaminants were noted. Habitats surrounding all three sites appeared to be diverse and the community and ecosystem structure appeared to be intact.

The measurement endpoints used to assess the terrestrial environment is decreased integrity of terrestrial organisms. Overall, metals appear to be the most significant site-related COPCs that have the potential for decreasing the integrity of terrestrial organisms at OU No. 4. Other site-specific comments follow.

Based on the soil toxicity data for plants and terrestrial invertebrates (earthworms), beryllium, chromium, copper, iron, lead, manganese, and zinc were detected in concentrations that potentially may decrease the integrity of terrestrial invertebrates and floral species at Site 41.

At Site 74, chromium was detected at concentrations that potentially may decrease the integrity of terrestrial invertebrates and floral species.

Other terrestrial organisms (e.g., rabbits, birds, deer) may be exposed to contaminants in the surface soils and surface water by ingestion. Based on the comparison of the CDI to the TRVs, there is a small potential that terrestrial receptors are being adversely affected.

7.5.3 Threatened and Endangered Species

Potential adverse impacts to these threatened or endangered species from contaminants at OU No. 4 appear to be low. There are no areas where protected, threatened, or endangered species have been observed on OU No. 4.

7.5.4 Wetlands

Site-specific wetland delineations were not conducted at Sites 41 and 74, although potential wetland areas were noted during the habitat evaluation. Generally, wetlands were not identified on each of the sites, although wetlands were present within a half mile radius of each site. These wetlands are illustrated on the biohabitat maps (Figures 7-1 and 7-2) potential impacts to wetlands are addressed in the surface water and sediment sections.

7.5.5 Other Sensitive Environments

There are no known spawning and nursery areas for resident fish species within Sites 41 or 74. Therefore, there is no potential for decreased integrity of fish spawning or nursing at Sites 41 or 74.

7.6 Uncertainty Analysis

The procedures used in this evaluation to assess risks to ecological receptors, as in all such assessments, are subject to uncertainties. The following discusses the uncertainty in the ERA.

The chemical sampling program at OU No. 4 consisted of surface water, sediments, soil, and groundwater. The concentrations of chemicals in the surface water will vary with the tides; the concentrations are expected to be lower at higher tides (more dilution) and higher at low tides (less dilution).

The ecological investigation consisted of one sampling effort. The results of this sampling will only provide a "snapshot in time" of the ecological environment. Because the biotic community can have a high amount of natural variability, the "snapshot in time" may not be an accurate representation of actual site conditions.

There also is uncertainty in the use of toxicological data in ecological risk assessments. The surface water and sediment values established by North Carolina and Region IV are set to be protective of a majority of the potential receptors. There will be some species, however, that will not be protected by the values because of their increased sensitivity to the chemicals. Also, the toxicity of chemicals mixtures is not well understood. All the toxicity information used in the ERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals.

There is uncertainty in the ecological endpoint comparison. The values used in the ecological endpoint comparison (either the WQS of the SSV) are set to be protective of a majority of the potential receptors. There will be some species, however, that will not be protected by the values because of their increased sensitivity to the chemicals. Also, the toxicity of chemical mixtures is not well understood. All the toxicity information used in the ecological risk assessment for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals. In addition, there were several contaminants that did not have WQS or SSVs. Therefore, potential effects to ecological receptors from these chemicals cannot be determined.

The SSVs were developed using data obtained from freshwater, estuarine and marine environments. Therefore, their applicability for use to evaluate potential effects to aquatic organisms from contaminants in estuarine habitats must be evaluated on a chemical specific basis because of differences in both the toxicity of individual contaminants to freshwater and saltwater organisms, and the bioavailability of contaminants in the two aquatic systems. In addition, the toxicity of several of the metals (cadmium, chromium, copper, lead, nickel, and zinc) to aquatic organisms increases or decreases based on water hardness. Because water hardness was not available, a default value of 50 mg/L of $CaCO_3$ was used.

Several contaminants in the surface water and sediment exceeded applicable ARVs values. Although the ARVs may have been exceeded in these samples, the potential for them to impact aquatic life may not be significant.

Finally, there is also uncertainty in the chronic daily intake models used to evaluate decreased integrity to terrestrial receptors. Many of the input parameters are based on default values (i.e., ingestion rate) that may or may not adequately represent the actual values of the parameters. In addition, there is uncertainty in the amount that the indicator species will represent other species potentially exposed to COPCs at the site. Finally, terrestrial species will also be exposed to contaminants by ingesting fauna that have accumulated contaminants. This additional exposure route was not evaluated in this ERA because the high uncertainty associated with this exposure route.

7.7 Conclusions

Overall, metals and pesticides appear to be the most significant site related COPCs that have the potential to affect the integrity of the aquatic ecosystems at OU No. 4. For the terrestrial ecosystems, metals appear to be the most significant site related COPCs that have the potential to affect terrestrial receptors at OU No. 4.

Potential adverse impacts to threatened or endangered species are low due to the absence of critical habitats or noted observations at the three sites. Biohabitats maps did not indicate a significant impact to ecological resources on or near the three sites.

7.7.1 Site 41

Aluminum, copper, iron, lead, mercury, and zinc exceeded surface water ARVs and lead, silver, zinc, 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, dieldrin, alpha-chlordane, and gamma-chlordane exceeded the sediment ARVs. The surface water and sediments with the greatest potential impact to aquatic receptors are associated with the two seeps and their drainage channels to the unnamed tributary to Tank Creek. The surface waters of the unnamed tributary and Tank Creek do not show significant potential for impact to aquatic receptors from COPC concentrations except for aluminum and iron. However, these COPCs lacked an upstream to downstream concentration gradient in the tributary and the creek. The sediments of the unnamed tributary and Tank Creek do not show a significant potential for impact to aquatic receptors from COPC concentrations due to the lack of upstream to downstream concentration gradients that would indicate a source area for COPCs on site.

The seeps and drainage channels to the unnamed tributary do not represent a significant habitat for aquatic receptors. Although the seeps were flowing during various site visits, extended drought conditions could result in more ephermal conditions. While it is recognized that these systems will support some tolerant species, the natural conditions that exist in both the seeps and the drainage channel are not conducive to attainment of a diverse and stable aquatic community. The populations that would occur in both the seeps and the drainage channel at the site would exhibit high temporal and spatial variability in both diversity and densities due to the natural conditions that exist. This type of natural variability has been recognized as one of the most significant components of the uncertainty associated with ecological risk assessments. Because there is no point of departure (e.g., 1 x 10^{-6} for human health carcinogenic risk) for determining when a ecosystem has been impacted by site conditions verses when a ecosystem is exhibiting natural temporal and spatial fluctuations, the high natural variability of ecosystems that exist in drainage channels and seeps makes it difficult to quantify site impacts to the ecological integrity of these systems.

However, the potential for impacts to the integrity of aquatic receptors in the seeps and drainage channels warranted additional investigation of these ecosystems. Subsequently, additional surface water and sediment analysis for metals in the seeps was initiated and were reported and discussed in this version of the report. In addition to total metal analyses, dissolved metal analyses were conducted on surface water samples. It has been established that the dissolved fraction of the sample represents the most bioavailable form of the metal and is a more accurate indication of potential risks. Mercury and aluminum were not detected in the dissolved analysis, and dissolved lead was detected only once at a concentration below the surface water ARV. Based on the additional investigations, these results support the conclusion that the seeps are not adversely impacting the aquatic ecosystems of the unnamed tributary and Tank Creek and potential impacts from sediments are limited to the seeps and drainage channels to the unnamed tributary to Tank Creek.

Comparison of surface soils and soil toxicity studies indicate that beryllium, chromium, copper, iron, lead, manganese, and zinc were detected in concentrations that potentially may decrease the integrity of terrestrial invertebrates and floral species at Site 41. However, based on the comparison of chronic daily intakes and terrestrial reference values, there does not appear to be an impact to terrestrial organisms including rabbits, deer, quail, fox, and raccoon from the site. This analysis included exposure to surface waters of the seeps, unnamed tributary, and Tank Creek, which supports the conclusion that any potential impacts from the seeps are limited to only aquatic receptors in the seeps itself.

7.7.2 Site 74

Aluminum and lead exceeded the ARVs in surface water. There were no COPCs detected that exceeded any sediment ARVs. Aluminum was detected at concentrations below both the median and average base-wide concentrations, while lead was detected at concentrations above both the base-wide average and median concentrations, but the quotient ratio was not indicative of a significant potential for impact to surface water aquatic receptors. For surface soils, chromium at the site exceeded soil toxicity reference levels. Based on the comparison of chronic daily intakes and terrestrial reference values, there appears to be a small potential for adverse affect to terrestrial organisms due to manganese for the quail and rabbit. There does not appear to be an impact to terrestrial organisms based on the comparison of chronic daily intakes and terrestrial reference values for the fox and deer receptors.

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SECTION 7.0 TABLES

TABLE 7-1

LIST OF CONTAMINANTS DETECTED IN THE SURFACE WATER, SEDIMENT, SURFACE SOIL AND BIOTA SAMPLES
OPERABLE UNIT NO. 4
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Site 41				Site 74		
	Surface Water		Sediment	Surface Soil	Surface Water	Sediment	Surface Soil
	Unnamed Tributary and Tank Creek		Unnamed Tributary and Tank Creek	Unnamed Tributary and Tank Creek	Pesticide Disposal Area	Pesticide Disposal Area	Former Disposal Potential Disposal Former Pest Control Area
	Total	Dissolved					
Volatiles							
Acetone			X	X			X
Chlorobenzene	X						
Methylene Chloride			X	X			X
Toluene			X	X			X
Trichloroethene			X			X	X
Styrene							X
Xylenes (total)							X
Semivolatiles							
Acenaphthene				X			X
Anthracene				X			
Diethyl phthalate							X
Di-n-butyl phthalate			X	X			X
1,4-Dichlorobenzene				X			
Bis(2-chloroethyl)ether				X			X
Bis(2-ethylhexyl)phthalate			X	X			X
Benzo(a)anthracene				X			
Dibenz(a,h)anthracene				X			
Benzo(a)pyrene			X	X			X
Benzo(b)fluoranthene			X	X			
Benzo(k)fluoranthene			X	X			
Benzo(g,h,i)perylene				X			X
Indeno(1,2,3-cd)pyrene				X			
Carbazole				X			
Chrysene				X			
Dibenzofuran				X			
Di-n-octyl phthalate			X	X			
3,3-Dichlorobenzidine						X	
Fluoranthene			X	X			

TABLE 7-1 (Continued)

LIST OF CONTAMINANTS DETECTED IN THE SURFACE WATER, SEDIMENT, SURFACE SOIL AND BIOTA SAMPLES OPERABLE UNIT NO. 4 REMEDIAL INVESTIGATION, CTO-0212 MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Site 41				Site 74		
	Surface Water		Sediment	Surface Soil	Surface Water	Sediment	Surface Soil
	Unnamed Tributary and Tank Creek		Unnamed Tributary and Tank Creek	Unnamed Tributary and Tank Creek	Pesticide Disposal Area	Pesticide Disposal Area	Former Disposal Potential Disposal Former Pest Control Area
	Total	Dissolved					
Fluorene				X			
4-Chloro-3-methylphenol							X
2-Methylnaphthalene				X			
Naphthalene				X			
Phenanthrene				X			
Pyrene			X	X			X
Pesticides							
4,4-DDE			X	X		X	X
4,4-DDD			X	X			X
4,4-DDT	X		X	X		X	X
alpha-Chlordane			X	X			X
gamma-Chlordane			X	X			X
Aldrin							X
Dieldrin			X	X			X
Endrin				X			X
Endrin aldehyde				X		X	X
Endrin ketone			X	X			
Endosulfan II			X	X		X	X
Endosulfan sulfate				X			
alpha-BHC							X
beta-BHC				X			
delta-BHC				X			
gamma-BHC (Lindane)	X			X			
Heptachlor	X			X			X
Heptachlor epoxide				X			X
Methoxychlor			X	X		X	X

TABLE 7-1 (Continued)

**LIST OF CONTAMINANTS DETECTED IN THE SURFACE WATER, SEDIMENT, SURFACE SOIL AND BIOTA SAMPLES
OPERABLE UNIT NO. 4
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA**

Analyte	Site 41				Site 74		
	Surface Water		Sediment	Surface Soil	Surface Water	Sediment	Surface Soil
	Unnamed Tributary and Tank Creek		Unnamed Tributary and Tank Creek	Unnamed Tributary and Tank Creek	Pesticide Disposal Area	Pesticide Disposal Area	Former Disposal Potential Disposal Former Pest Control Area
	Total	Dissolved					
PCBs							
PCB-1242				X			
PCB-1248			X				
PCB-1254			X				
PCB-1260				X			
Ordanance							
1,3,5-Trinitrobenzene			X				
1,3-Dinitrobenzene				X			
Chemical Surety							
Thiodiglycol							X
Hydroxyacetophone							X
Inorganics							
Aluminum	X		X	X	X	X	X
Antimony				X			X
Arsenic	X	X	X	X			X
Barium	X	X	X	X		X	X
Beryllium			X	X			
Cadmium	X			X			X
Calcium	X	X	X	X	X	X	X
Chromium	X		X	X		X	X
Cobalt	X	X	X	X			
Copper	X	X	X	X			X
Iron	X	X	X	X	X	X	X
Lead	X	X	X	X	X	X	X
Magnesium	X	X	X	X	X	X	X
Manganese	X	X	X	X		X	X
Mercury	X		X	X			X
Nickel	X		X	X			X
Potassium	X	X	X	X	X		X

TABLE 7-1 (Continued)

LIST OF CONTAMINANTS DETECTED IN THE SURFACE WATER, SEDIMENT, SURFACE SOIL AND BIOTA SAMPLES
OPERABLE UNIT NO. 4
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 41				Site 74		
	Surface Water		Sediment	Surface Soil	Surface Water	Sediment	Surface Soil
	Unnamed Tributary and Tank Creek		Unnamed Tributary and Tank Creek	Unnamed Tributary and Tank Creek	Pesticide Disposal Area	Pesticide Disposal Area	Former Disposal Potential Disposal Former Pest Control Area
Analyte	Total	Dissolved					
Selenium			X	X		X	X
Silver			X	X			X
Sodium	X	X	X	X	X		X
Thallium			X				
Vanadium	X		X	X		X	X
Zinc	X	X	X	X		X	X
Total Cyanide				X			X

TABLE 7-2

PHYSICAL/CHEMICAL CHARACTERISTICS OF THE COPCs
OPERABLE UNIT NO. 4
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	BCF	Water Solubility (mg/L)	Organic Carbon Partition Coefficient (mL/g)	Vapor Pressure (mm Hg)	Log Octanol/ Water Coefficient
Inorganics					
Aluminum	ND[1,3]	ND[1,3]	ND[1]	ND[1,3]	ND[1,3,4]
Arsenic	4[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Barium	ND[1,3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Beryllium	19[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Cadmium	3,800[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Chromium	1[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Cobalt	ND[3]	ND[1,3]	ND[1]	1,300[3]	ND[1,3,4]
Copper	23,000[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Cyanide, total	ND	Miscible	ND	264.3[3]	0.66[3]
Iron	ND[3]	ND[1,3]	ND[1]	ND[1,3]	ND[1,3,4]
Lead	45[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Manganese	350,000[3]	ND[1,3]	ND[1]	ND[1,3]	ND[1,3,4]
Mercury	52,175[8]	ND[1,3]	ND[1]	0.002[3]	ND[1,3,4]
Nickel	8[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Selenium	5,700[3]	ND[1,2]	ND[1]	ND[1,2,3]	ND[1,3,4]
Silver	28[3]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
Vanadium	ND[3]	ND[1,3]	ND[1]	ND[3]	ND[1,3,4]
Zinc	4.4[8]	ND[1,3]	ND[1]	ND[1,2,3]	ND[1,3,4]
VOCs					
Toluene	90[5]	530[5]	300	28	2.73
Trichloroethene	17[3]	1,100[3]	126[1]	69[3]	2.4[3]
SVOCs					
Anthracene	9,200[3]	0.043[3]	14,000[1]	ND[1,2,3]	4.5[3]
Benzo(a)anthracene	ND[3]	ND[1,2,3]	1,380,000[1]	ND[1,2,3]	5.7[3]
Benzo(a)pyrene	83,000[3]	ND[1,2,3]	5,500,000[1]	ND[1,2,3]	6.0[3]
Benzo(b)fluoranthene	ND	ND[1,2]	550,000[1]	ND[2,3]	6.6[3]
Benzo(k)fluoranthene	ND[3]	ND[1,2,3]	550,000	ND[1,2,3]	6.1[1]
Benzo(g,h,i)perylene	ND	ND[1,2]	1,600,000[1]	ND[1,2]	6.5[1]
Chrysene	ND[3]	ND[1,2,3]	200,000[1]	ND[1,2,3]	5.7[3]
Bis(2-chloroethyl)ether	1.1×10^{1}[3]	1.7×10^{4}[3]	ND	1.6[3]	1.3[3]
Fluoranthene	1,150[1] (L/kg)	0.206[1]	38,000[1]	ND[1,2]	4.9[1]
Phenanthrene	2,630[1] (L/kg)	1.2[3]	14,000[1]	ND[1,2,3]	4.5[1]
Pyrene	69[3]	ND[1,2,3]	38,000[1]	ND[1,2,3]	4.88[1]

TABLE 7-2 (Continued)

PHYSICAL/CHEMICAL CHARACTERISTICS OF THE COPCs
OPERABLE UNIT NO. 4
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	BCF	Water Solubility (mg/L)	Organic Carbon Partition Coefficient (mL/g)	Vapor Pressure (mm Hg)	Log Octanol/ Water Coefficient
Pesticides/PCBs					
Chlordane, total	11,500[6]	0.056[3]	140,000[1]	ND[1,2,3]	5.5[6]
Dieldrin	6,800[3]	0.2[3]	1,700[1]	ND[1,2,3]	4.3[6]
Methyoxychlor	ND	ND	ND	ND	ND
Endrin Aldehyde**	7,000[7]	2.5×10^{-7}	ND[1,3,4,5,6,7]	3.0×10^{-6}	4.56[7]
4,4-DDE	180,000[3]	0.12[3]	4,400,000[1]	ND[1,2,3]	5.7[3]
4,4-DDD	ND[3]	0.09[3]	770,000[1]	ND[1,2,3]	6.0[3]
4,4-DDT	31,477[7]	0.025[3]	243,000[1]	ND[1,2,3]	6.4[3]
Endosulfan II*	ND	0.51	2,042	1×10^{-5}	3.83
Heptachlor	ND	0.18	ND	4×10^{-4}	5.27
Heptachlor Epoxide	ND	0.2	ND	1.95×10^{-5}	5.40

(1) USEPA, 1986.
(2) Negligible (less than 0.1).
(3) SCDM, 1991.
(4) USEPA, 1985.
(5) Howard, 1990.
(6) Howard, 1991.
(7) USEPA, 1993a.
ND = No data
BCF = Bioconcentration Factor
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
* Values for Endosulfan
** Values for Endrin

TABLE 7-3

SUMMARY OF HABITAT TYPES
SITES 41, 69, AND 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Area Designation	Habitat Type	Dominant Vegetation	Secondary Vegetation	Fauna Present
41A	Young Pine Forest	Loblolly Pine	Sweetgum, red cedar, wax myrtle, vines (poison ivy, trumpet creeper, virginia creeper, bullbriar) grasses, bush clover, ebony spleenwort, sedges, rushes, corn salad	Mourning dove, resident and migratory songbirds including neotropical migrants, black racer, southern toad, frog and toad tadpoles
41B	Freshwater Wetland	No vegetation clearly dominant vegetation types (trees, shrubs, forbs) varied in dominance depending on area (saplings, grasses, lichens)	Loblolly pine, longleaf pine, red cedar, sweetgum, wax myrtle, holly, blueberry, lichens/mosses, round-leaved sundew, horned bladderwort, rock spikemoss, broom sedge, cattail, dwarf iris, grasses, sedges, rushes	Mourning dove, resident and migratory songbirds including neotropical migrants, fox, white-tailed deer, box turtles
41C	Loblolly Pine/ Hardwood Forest	Trees are dominant but no species clearly dominant	Loblolly pine, tulip, red maple, beech, sweetgum oak (white, water), hickory, red cedar, wax myrtle, dogwood, holly, umbrella magnolia vines (Japanese honeysuckle, poison ivy, greenbriars, Virginia creeper, grapes), ferns (marsh, royal, sensitive, ebony spleenwort), grasses, cane	Mourning dove, resident and migratory songbirds including neotropical migrants, white-tailed deer, raccoon, squirrel, anole
41D	Wooded Wetland (Swamp)	Trees dominant but no species clearly dominant. Species include tulip, black gum, red maple, elm, swamp chestnut oak	Ironwood, Leucothoe axillaris, lizards tail, cane, grasses, sedges, water pennywort, violet, ferns (marsh, sensitive)	Mourning dove, resident and migratory songbirds including neotropical migrants, white-tailed deer, raccoon, black racer, crayfish

TABLE 7-3 (Continued)

SUMMARY OF HABITAT TYPES
SITES 41, 69, AND 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Area Designation	Habitat Type	Dominant Vegetation	Secondary Vegetation	Fauna Present
41E	Hardwood Forest	Tress dominant but no species clearly dominant. Species include tulip, red maple, sweetgum, beech, white oak, mockernut hickory	Dogwood, holly, partridgeberry, wild ginger	Mourning dove, resident and migratory songbirds including neotropical migrants, white-tailed deer
74	Pine Forest with Shrub Understory	Loblolly pine, longleaf pine	Scattered deciduous trees, wax myrtle, fetterbush, staggerbush, sweet pepperbush blueberries (slender, coastal highbush, Elliott's) greenbriars, broom sedge and other grasses, ferns (cinnamon, marsh, royal, sensitive, braken)	White-tailed deer, rabbit, small rodents, mourning dove, whippoorwill, resident and migratory songbirds

TABLE 7-4

OPERABLE UNIT NO. 4
PROTECTED SPECIES WITHIN MCB CAMP LEJEUNE
REMEDIAL INVESTIGATION CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Species	Protected Classification
American alligator (Alligator mississippienis) [2]	T(f), T(s)
Bachmans sparrow (Aimophilia aestivalis)[1]	SC
Black skimmer (Rhynochops niger)[1]	SC
Green (Atlantic) turtle (Chelonia m. mydas) [2]	T(f), T(s)
Loggerhead turtle (Caretta caretta) [2]	T(f), T(s)
Peregrine falcon (*)[1]	(*)
Piping plover (Charadrius melodus)[1]	T(f), T(s)
Red-cockaded woodpecker (Picoides borealis)[3]	E(f), E(s)
Rough-leaf loosestrife (Lysimachia asperulifolia)[4]	E(f), E(s)

Legend: SC= State Special Concern
E(f) = Federal Endangered
E(s) = State Endangered
T(f) = Federal Threatened
T(s) = State Threatened

* The observer did not differentiate between the American eastern peregrine falcon [E(f), E(s)] or the Arctic peregrine falcon [T(f), T(s)].

Source: (1) Fussell, 1991
(2) USMC, 1991
(3) Walters, 1991
(4) LeBlond, 1991

TABLE 7-5

SITE 41 - UNNAMED TRIBUTARY AND TANK CREEK
FREQUENCY AND RANGE OF DETECTION COMPARED TO FRESHWATER NORTH CAROLINA WQSs, AND USEPA WQSVs
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Surface Water					Contaminant Frequency/Range		No. of Positive Detects Above NCWQS	No. of Positive Detects Above Screening Values		No. of Positive Detects Above USEPA AWQC	
	North Carolina (NCWQS)	Region IV Screening Values (USEPA WQSVs)		USEPA Water Quality Criteria (USEPA AWQC)		No. of Positive Detects/No. of Samples	Range of Positive Detections		Acute	Chronic	Acute	Chronic
		Acute	Chronic	Acute	Chronic							
Inorganics (μg/L)												
Aluminum	NE	NE	NE	750	87	24/28	76.6 - 17,800	NA	NA	NA	6/28	25/28
Arsenic	50	360	190	360	190	9/28	2.2 - 30.2	0/9	0/9	0/9	0/9	0/9
Barium	NE	NE	NE	NE	NE	28/28	17.9 - 442	NA	NA	NA	NA	NA
Cobalt	NE	NE	NE	NE	NE	3/28	19.6 - 43.9	NA	NA	NA	NA	NA
Copper	7	18*	12*	18*	12*	4/28	13.3 - 41.2	4/4	3/4	4/4	3/4	4/4
Iron	1000	NE	NE	NE	1000	28/28	469 - 278,000	19/28	NA	NA	NA	19/28
Lead	25	82*	3.2*	82*	3.2*	19/28	1.13 - 36.8	3/19	0/19	11/9	0/19	11/19
Manganese	NE	NE	NE	NE	NE	28/28	12.3 - 1,700	NA	NA	NA	NA	NA
Mercury	0.012	2.4	0.012	2.4	0.012	9/28	0.101 - 0.56	9/9	0/9	9/9	0/9	9/9
Vanadium	NE	NE	NE	NE	NE	3/28	35.4 - 51.5	NA	NA	NA	NA	NA
Zinc	50	120*	110*	120*	110*	23/28	16.3 - 235	6/23	3/23	3/23	3/23	3/23

* = Criteria are hardness dependent (calculated using a hardness of 100 mg/L CaCO3)
NE = Not established
NA = Not applicable

TABLE 7-6

SITE 74 - PESTICIDE DISPOSAL AREA
FREQUENCY AND RANGE OF DETECTION COMPARED TO FRESHWATER NORTH CAROLINA WQSs, USEPA WQSVs, AND USEPA AWQC
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Surface Water ARARs					Contaminant Frequency/Range		Comparison to ARARs				
	North Carolina (NCWQS)	Region IV Screening Values (USEPA WQSVs)		USEPA Water Quality Criteria (USEPA AWQC)		No. of Positive Detects/ No. of Samples	Range of Positive Detections	No. of Positive Detects Above NCWQS	No. of Positive Detects Above Screening Values		No. of Positive Detects Above USEPA AWQC	
		Acute	Chronic	Acute	Chronic				Acute	Chronic	Acute	Chronic
Inorganics (µg/L)												
Aluminum	NE	NE	NE	750	87	3/3	12J - 492J	NA	NA	NA	0/3	3/3
Iron	1000	NE	NE	NE	1,000	3/3	138 - 274	0/3	NA	NA	NA	0/3
Lead	25	82[1]	3.2[1]	82[1]	3.2[1]	3/3	1.62J - 6.04J	0/3	0/3	2/3	0/3	2/3

NE = Not Established
NA = Not Applicable
[1] Criteria are hardness dependent

TABLE 7-7

SITE 41 - UNNAMED TRIBUTARY AND TANK CREEK
FREQUENCY AND RANGE OF DETECTION COMPARED TO SEDIMENT SCREENING VALUES
REMEDIAL INVESTIGATION CTO - 0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Sediment Screening Values (SSVs)		Contaminant Frequency/Range		Comparison to Screening Values	
	ER-L	ER-M	No. of Positive Detects/No. of Samples	Range of Positive Detections	No. of Positive Detects Above ER-L	No. of Positive Detects Above ER-M
Inorganics (mg/kg)						
Aluminum	NE	NE	42/42	276 - 18,800	NA	NA
Arsenic	33	85	13/42	0.617 - 9.3	0/13	0/13
Barium	NE	NE	36/42	1.4 - 161	NA	NA
Beryllium	NE	NE	5/42	0.235 - 1.02	NA	NA
Chromium	80	145	16/42	2.3 - 16.5	0/16	0/16
Copper	70	390	4/42	6.3 - 19.9	0/4	0/4
Iron	NE	NE	42/42	262 - 104,000	NA	NA
Lead	35	110	42/42	1.1 - 59.4	2/42	0/42
Manganese	NE	NE	37/42	1.3 - 306	NA	NA
Nickel	30	50	6/42	3.79 - 6.12	0/6	0/6
Selenium	NE	NE	4/42	0.629 - 08.862	NA	NA
Silver	1	2.2	3/42	1.14 - 29.7	3/3	1/3
Vanadium	NE	NE	12/42	3.5 - 3.0	NA	NA
Zinc	120	270	25/42	5.5 - 155	1/25	0/25

TABLE 7-7 (Continued)

SITE 41 - UNNAMED TRIBUTARY AND TANK CREEK
FREQUENCY AND RANGE OF DETECTION COMPARED TO SEDIMENT SCREENING VALUES
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Sediment Screening Values (SSVs)		Contaminant Frequency/Range		Comparison to Screening Values	
	ER-L	ER-M	No. of Positive Detects/No. of Samples	Range of Positive Detections	No. of Positive Detects Above ER-L	No. of Positive Detects Above ER-M
Pesticides/PCBs ($\mu g/k$)						
Endosulfan II	NE	NE	9/41	0.64 - 8.22	NA	NA
4,4-DDD	2	20	22/41	0.38 - 73.9	17/22	5/22
4,4-DDT	1	7	17/41	0.36 - 210	14/17	3/17
4,4-DDE	2	15	19/41	0.53 - 31.3	15/19	4/19
Dieldrin	0.02	8	10/41	0.46 - 6.39	10/10	0/10
Methoxychlor	NE	NE	6/41	0.91 - 21.7	NA	NA
alpha-Chlordane	0.5*	6*	13/41	0.34 - 3.72	11/13	0/13
gamma-Chlordane	0.5*	6*	11/41	0.4 - 6.35	9/11	9/11

NE = Not Established
NA = Not Applicable
(1) Values for Total PCBs.

TABLE 7-8

SITE 74 - PESTICIDE DISPOSAL AREA
FREQUENCY AND RANGE OF DETECTION COMPARED TO SEDIMENT SCREENING VALUES
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Sediment Screening Values (SSVs)		Contaminant Frequency/Range		Comparison to Screening Values	
	ER-L	ER-M	No. of Positive Detects/No. of Samples	Range of Positive Detections	No. of Positive Detects Above ER-L	No. of Positive Detects Above ER-M
Inorganics (mg/kg)						
Aluminum	NE	NE	3/3	584-3,320	NA	NA
Barium	NE	NE	2/3	5.73-13	NA	NA
Chromium	80	145	2/3	1.8-3.13	0/2	0/2
Iron	NE	NE	3/3	199-1,530	NA	NA
Lead	35	110	3/3	2.67J-6.06J	0/3	0/3
Manganese	NE	NE	3/3	2.76-5.27	NA	NA
Pesticides (μg/kg)						
Endosulfan II	NE	NE	2/3	0.63J-0.8JP	NA	NA
4,4-DDE	2	15	2/3	0.9J-1.85J	0/2	0/2
4,4-DDT	1	7	1/3	0.82NJ	0/1	0/1

NE = Not Established
NA = Not Applicable

TABLE 7-9

TERRESTRIAL REFERENCE VALUES AND SOIL TO PLANT TRANSFER COEFFICIENTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Soil to Plant Transfer Coefficient	Soil-to-Plant Coefficient	Terrestrial Reference Value (TRV) mg/kg/day
	(Bv)	(Br)*	
Phenanthrene	0.097 (1,2)	0.097	150 (7)+++
Anthracene	0.097 (1,2)	0.097	150 (7)+++
Fluoranthene	0.057 (1,2)	0.057	125 (8)
Pyrene	0.059 (1,2)	0.059	75 (8)
Benzo(a)anthracene	0.020 (1,2)	0.020	150 (7)+++
Chrysene	0.020 (1,2)	0.020	150 (7)+++
Benzo(b)fluoranthene	0.006 (1,2)	0.006	150 (7)+++
Benzo(k)fluoranthene	0.012 (1,2)	0.012	150 (7)+++
Benzo(a)pryene	0.013 (1,2)	0.013	150 (7)+++
Benzo(g,h,i)perylene	0.007 (1,2)	0.007	150 (7)+++
Bis(2-chloroethyl)ether	6.86 (1,3)	6.86	NA
Trichloroethene	1.58 (1,4)	1.58	750 (9)
Toluene	1.02 (1,2)	1.02	223 (10)
Dieldrin	0.126 (1,4)	0.126	0.005 (10)
4,4-DDE	0.019 (1,4)	0.019	0.05 (10)
4,4-DDD	0.013 (1,4)	0.013	0.05 (10)
4,4-DDT	0.008 (1,4)	0.008	0.05 (10)
Chlordane, alpha	0.026 (1,4)	0.026	0.055 (10)
Chlordane, gamma	0.026 (1,4)	0.026	0.055 (10)
Heptachlor	0.035 (1,3)	0.035	0.15 (10)
Heptachlor Epoxide	0.029 (1,3)	0.029	0.15 (10)++++
Endosulfan II	0.237 +(1,5)	0.237	0.15 (8)+
gamma-BHC	0.331 (1,5)	0.331	0.33 (8)
Endrin aldehyde ++	0.0896++(1,3)	0.090	0.065 (10)++
Aluminum	0.004 (6)	0.007 (6)	NA
Arsenic	0.040 (6)	0.006 (6)	16 (11)
Barium	0.150 (6)	0.015 (6)	30 (10)
Chromium	0.008 (6)	0.005 (6)	2.7 (12)
Cobalt	NA	NA	NA
Copper	0.400 (6)	0.250 (6)	300 (10)
Iron	0.004 (6)	0.001 (6)	NA

TABLE 7-9 (Continued)

TERRESTRIAL REFERENCE VALUES AND SOIL TO PLANT TRANSFER COEFFICIENTS
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Soil to Plant Transfer Coefficient (Bv)	Soil-to-Plant Coefficient (Br)*	Terrestrial Reference Value (TRV) mg/kg/day
Lead	0.045 (6)	0.009 (6)	27.4 (10)
Manganese	0.250 (6)	0.050 (6)	0.14 (13)
Mercury	0.900 (6)	0.200 (6)	7.4 (14)
Nickel	0.060 (6)	0.060 (6)	5 (10)
Selenium	0.025 (6)	0.853 (6)	0.025 (8)
Vanadium	0.006 (6)	0.003 (6)	5 (8)
Zinc	1.500 (6)	0.900 (6)	38 (15)
Cyanide, total	NA	NA	10.8 (10)

NA - Information not available
* - Br is assumed to be the same as Bv for organics
+ Value is for Endosulfan
++ Value is for Endrin
+++ Value is for total PAHs
++++ Value is for Heptachlor

(1) Travis, 1988
(2) Montgomery, 1990
(3) SCDM, 1991
(4) USEPA, 1986
(5) Howard, 1991
(6) Baes, 1984
(7) ATSDR, 1990
(8) HEAST, 1993
(9) ATSDR, 1991
(10) IRIS, 1993
(11) USDH, 1992
(12) USDH, 1991
(13) IRIS, 1990
(14) ATSDR, 1988
(15) ATSDR, 1989

TABLE 7-10

SURFACE WATER QUOTIENT INDEX FOR SITES 41 AND 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample Number	Sample Concentration ($\mu g/L$)[3]	North Carolina (NCWQS)[1] Quotient Ratio	Region IV Screening Values (USEPA WQSV)[2] Quotient Ratio		USEPA Ambient Water Quality Criteria (USEPA AWQC) Quotient Ratio	
				Acute	Chronic	Acute	Chronic
Site 41 - Tank Creek and Unnamed Tributary							
Aluminum							
	41-TC-SW06	390	NA	NA	NA	0.52	4.5
	41-TC-SW07	395	NA	NA	NA	0.53	4.5
	41-TC-SW08	411	NA	NA	NA	0.55	4.7
	41-TC-SW09	397	NA	NA	NA	0.53	4.6
	41-NE-SW05	178	NA	NA	NA	0.24	2.0
	41-UN-SW01	447	NA	NA	NA	0.60	5.7
	41-UN-SW02	303	NA	NA	NA	0.40	3.5
	41-UN-SW03	437	NA	NA	NA	0.58	5.0
	41-UN-SW04	442	NA	NA	NA	0.59	5.1
	41-UN-SW10	460	NA	NA	NA	0.61	5.3
	41-UN-SW11	3,380	NA	NA	NA	4.5	388.5
	41-UN-SW12	139	NA	NA	NA	0.19	1.6
	41-UN-SW13	3,390	NA	NA	NA	4.5	39.0
	41-UN-SW14	139	NA	NA	NA	0.19	1.6
	41-UN-SW15	260	NA	NA	NA	0.35	3.0
	41-UN-SW16	183	NA	NA	NA	0.24	2.1
	41-UN-SW17	988	NA	NA	NA	1.3	11.4
	41-UN-SW18	356	NA	NA	NA	0.47	4.1
	41-UN-SW19	245	NA	NA	NA	0.33	2.8
	41-UN-SW20	110	NA	NA	NA	0.15	1.3
	41-UN-SW23	11,000	NA	NA	NA	14.7	126.4
	41-UN-SW24	17,800	NA	NA	NA	23.7	204.6

TABLE 7-10 (Continued)

SURFACE WATER QUOTIENT INDEX FOR SITES 41 AND 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample Number	Sample Concentration (μg/L)[3]	North Carolina (NCWQS)[1] Quotient Ratio	Region IV Screening Values (USEPA WQSV)[2] Quotient Ratio		USEPA Ambient Water Quality Criteria (USEPA AWQC) Quotient Ratio	
				Acute	Chronic	Acute	Chronic
Aluminum (Continued)	41-UN-SW25	7,060	NA	NA	NA	9.4	81.1
	41-UN-SW26	102	NA	NA	NA	0.14	1.2
	41-UN-SW28	585	NA	NA	NA	0.78	6.7
Copper	41-UN-SW23	34.1	4.9	1.9	2.8	1.9	2.8
	41-UN-SW24	41.2	5.9	2.3	3.4	2.3	3.4
	41-UN-SW25	20.1	2.9	1.1	1.7	1.1	1.7
	41-UN-SW26	13.3	1.9	0.74	1.1	0.74	1.1
Iron							
	41-TC-SW01	1,300	1.3	NA	NA	NA	1.3
	41-TC-SW06	1,460	1.5	NA	NA	NA	1.5
	41-TC-SW07	1,540	1.5	NA	NA	NA	1.5
	41-TC-SW08	1,490	1.5	NA	NA	NA	1.5
	41-TC-SW09	1,510	1.5	NA	NA	NA	1.5
	41-TC-SW011	2,690	2.7	NA	NA	NA	2.7
	41-TC-SW012	6,260	6.3	NA	NA	NA	6.3
	41-TC-SW013	14,100	14.1	NA	NA	NA	14.1
	41-TC-SW014	2,810	2.8	NA	NA	NA	2.8
	41-UN-SW15	39,600	39.6	NA	NA	NA	39.6
	41-UN-SW16	33,400	33.4	NA	NA	NA	33.4
	41-UN-SW17	17,600	17.6	NA	NA	NA	17.6
	41-UN-SW18	10,600	10.6	NA	NA	NA	10.6
	41-UN-SW22	15,700	15.7	NA	NA	NA	15.7
	41-UN-SW23	245,000	245.0	NA	NA	NA	245.0
	41-UN-SW24	278,000	278.0	NA	NA	NA	278.0

TABLE 7-10 (Continued)

SURFACE WATER QUOTIENT INDEX FOR SITES 41 AND 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample Number	Sample Concentration (μg/L)[3]	North Carolina (NCWQS)[1] Quotient Ratio	Region IV Screening Values (USEPA WQSV)[2] Quotient Ratio		USEPA Ambient Water Quality Criteria (USEPA AWQC) Quotient Ratio	
				Acute	Chronic	Acute	Chronic
Iron (Continued)	41-UN-SW25	238,000	238.0	NA	NA	NA	238.0
	41-UN-SW27	1,340	1.3	NA	NA	NA	1.3
	41-UN-SW28	2,940	2.9	NA	NA	NA	2.9
Lead	41-TC-SW011	8.1	0.32	0.1	2.6	0.1	2.6
	41-TC-SW013	12.1	0.48	0.15	3.8	0.15	3.8
	41-UN-SW16	7.7	0.31	0.09	2.4	0.09	2.4
	41-UN-SW17	3.6	0.14	0.04	1.1	0.04	1.1
	41-UN-SW18	4.3	0.17	0.05	1.3	0.05	1.3
	41-UN-SW23	36.2	1.4	0.44	11.3	0.44	11.3
	41-UN-SW24	36	1.4	0.44	11.3	0.44	11.3
	41-UN-SW25	36.8	1.5	0.45	11.5	0.45	11.5
	41-UN-SW26	7.2	0.29	0.09	2.3	0.09	2.3
	41-UN-SW27	17	0.68	0.21	5.3	0.21	5.3
	41-UN-SW28	4.8	0.19	0.06	1.5	0.06	1.5
Mercury	41-TC-SW013	0.101	8.4	0.04	8.4	0.04	8.4
	41-UN-SW15	0.28	23.3	0.12	23.3	0.12	23.3
	41-UN-SW17	0.36	30.0	0.15	30.0	0.15	30.0
	41-UN-SW18	0.28	23.3	0.12	23.3	0.12	23.3
	41-UN-SW19	0.21	17.5	0.09	17.5	0.09	17.5
	41-UN-SW23	0.56	46.7	0.23	46.7	0.23	46.7
	41-UN-SW24	0.46	38.3	0.19	38.3	0.19	38.3
	41-UN-SW25	0.26	21.7	0.11	21.7	0.11	21.7
	41-UN-SW26	0.23	19.2	0.10	19.2	0.10	19.2

TABLE 7-10 (Continued)

SURFACE WATER QUOTIENT INDEX FOR SITES 41 AND 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample Number	Sample Concentration ($\mu g/L$)[3]	North Carolina (NCWQS)[1] Quotient Ratio	Region IV Screening Values (USEPA WQSV)[2] Quotient Ratio		USEPA Ambient Water Quality Criteria (USEPA AWQC) Quotient Ratio	
				Acute	Chronic	Acute	Chronic
Zinc	41-UN-SW15	59.2	1.2	0.49	0.54	0.49	0.54
	41-UN-SW16	68.7	1.4	0.57	0.62	0.57	0.62
	41-UN-SW17	80.7	1.6	0.67	0.73	0.67	0.73
	41-UN-SW23	231	4.6	1.9	2.1	1.9	2.1
	41-UN-SW24	235	4.7	2.0	2.1	2.0	2.1
	41-UN-SW25	133	2.7	1.1	1.2	1.1	1.2
Site 74							
Aluminum	74-PDA-SW01	492	NA	NA	NA	0.66	5.7
	74-PDA-SW02	309	NA	NA	NA	0.41	3.6
	74-PDA-SW03	127	NA	NA	NA	0.17	1.6
Lead	74-PDA-SW01	5.84	0.23	0.07	1.8	0.07	1.8
	74-PDA-SW02	6.04	0.24	0.07	1.9	0.07	1.9

(1) NCWQS = North Carolina Water Quality Standards
(2) USEPA WQSV = U.S. Environmental Protection Agency Water Quality Screening Values
(3) µg/L = micrograms per liter
NA = Not Available
NOTE: Shaded areas are for Quotient Ratios that exceed one.

TABLE 7-11

**SEDIMENT SCREENING VALUES QUOTIENT INDEX FOR SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Sample Number	Sample Concentration (μg/kg)[2]	SSV[1] QUOTIENT RATIO ER-L[3]	SSV[1] QUOTIENT RATIO ER-M[4]
SITE 41 - Tank Creek and Unnamed Tributary				
Lead	41-UN-SD13-06	59,400	1.7	0.5
	41-UN-SD13-612	58,900	1.7	0.5
Silver	41-UN-SD04-612	1,140	1.1	0.5
	41-UN-SD11-612	1,200	1.2	0.5
	41-UN-SD13-06	29,700	29.7	13.5
Zinc	41-UN-SD25	155	1.3	0.57
4,4-DDD	41-UN-SD01-06	2.77	1.4	0.14
	41-UN-SD01-612	12.7	6.4	0.64
	41-UN-SD03-06	3.73	1.9	0.19
	41-UN-SD03-612	15.3	7.7	0.77
	41-UN-SD04-06	3.95	2	0.19
	41-TC-SD06-612	12.6	6.3	0.63
	41-TC-SD09-06	63.3	31.7	3.1
	41-UN-SD10-06	23.1	11.6	1.16
	41-UN-SD10-612	73.9	37	3.7
	41-UN-SD13-06	7.69	3.8	0.38
	41-UN-SD13-612	10.5	5.3	0.53
4,4-DDD	41-UN-SD14-06	5.9	3	0.3
	41-UN-SD14-612	6.68	3.34	0.33
	41-UN-SD20	27	13.5	1.35
	41-UN-SD23	17	8.5	0.85
	41-UN-SD26	4.2	2.1	0.21
	41-UN-SD28	42	21	2.1

TABLE 7-11 (Continued)

SCREENING VALUES QUOTIENT INDEX FOR SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample Number	Sample Concentration ($\mu g/kg$)[2]	SSV[1] QUOTIENT RATIO	
			ER-L[3]	ER-M[4]
4,4-DDT	41-UN-SD02-06	1.36	1.4	0.19
	41-UN-SD02-612	2.58	2.6	0.37
	41-UN-SD03-06	1.26	1.3	0.18
	41-UN-SD03-612	1.25	1.3	0.18
	41-TC-SD06-06	2	2	0.29
	41-TC-SD06-612	34.8	34.8	5
	41-UN-SD10-06	4.51	4.5	0.64
	41-UN-SD10-612	5.96	6	0.85
	41-UN-SD13-06	4.78	4.8	0.68
	41-UN-SD13-612	9.64	9.6	1.4
	41-UN-SD14-06	2.29	2.3	0.33
	41-UN-SD14-612	1.58	1.6	0.23
	41-UN-SD20	210	210	30
	41-UN-SD26	5.8	5.8	0.83
4,4-DDE	41-UN-SD01-06	4.66	2.3	0.31
	41-UN-SD01-612	4.9	2.5	0.33
	41-UN-SD03-06	3.05	1.5	0.2
	41-UN-SD03-612	3.98	2	0.27
	41-UN-SD04-06	2.07	1.03	0.14
	41-UN-SD10-06	29	14.5	1.93
	41-UN-SD10-612	31.3	15.7	2.09
	41-UN-SD13-06	14.3	7.2	0.95
	41-UN-SD13-612	14.9	7.5	0.99
	41-UN-SD14-06	4.04	2.02	0.27
	41-UN-SD14-612	2.91	1.46	0.19
	41-TC-SD09-06	11.2	5.6	0.75
	41-UN-SD20	18	9	1.2
	41-UN-SD25	19	9.5	1.3
	41-UN-SD28	7.8	3.9	0.52

TABLE 7-11 (Continued)

SCREENING VALUES QUOTIENT INDEX FOR SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample Number	Sample Concentration (µg/kg)[2]	SSV[1] QUOTIENT RATIO ER-L[3]	SSV[1] QUOTIENT RATIO ER-M[4]
Dieldrin	41-UN-SD01-06	1.35	67.5	0.17
	41-UN-SD01-612	1.08	54	0.14
	41-UN-SD02-06	1.21	60.5	0.15
	41-UN-SD03-06	0.83	41.5	0.1
	41-UN-SD04-06	0.46	23	0.06
	41-UN-SD13-06	6.39	319.5	0.79
	41-UN-SD13-612	5.19	259.5	0.65
	41-UN-SD14-06	2.07	103.5	0.26
	41-UN-SD14-612	1.57	78.5	0.19
	41-TC-SD06-06	2.5	125	0.31
alpha-Chlordane	41-UN-SD01-06	1.38	2.8	0.23
	41-UN-SD01-612	1.15	2.3	0.19
	41-UN-SD03-06	0.82	1.6	0.14
	41-UN-SD10-06	3.72	7.4	0.62
	41-UN-SD10-612	1.81	3.6	0.3
	41-UN-SD13-06	2.56	5.1	0.43
	41-UN-SD13-612	3.09	6.2	0.52
	41-UN-SD14-06	1.39	2.8	0.23
	41-UN-SD14-612	0.98	2	0.16
	41-TC-SD06-612	2.01	1	0.34
	41-TC-SD09-06	3.48	1.7	0.58
gamma-Chlordane	41-UN-SD01-06	1.43	2.9	0.24
	41-UN-SD01-612	1.35	2.7	0.23
	41-UN-SD03-06	0.92	1.8	0.15
	41-UN-SD10-06	6.35	12.7	1.1
	41-UN-SD10-612	1.45	2.9	0.24
	41-UN-SD13-06	2	4	0.67
	41-UN-SD13-612	2.44	4.9	0.41
	41-UN-SD14-06	1	2	0.17
	41-TC-SD06-612	0.99	2	0.17

(1) Sediment Screening Values
(2) µg/kg = micrograms per kilogram
(3) ER-L = Effects Range-Low
(4) ER-M = Effects Range-Median

Notes: Shaded areas are for Quotient Ratios that exceed one.
There were no QI ratios greater than one at Site 74.

TABLE 7-12

TERRESTRIAL CHRONIC DAILY INTAKE MODEL EXPOSURE PARAMETERS[1]
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Parameter	Units	White-Tailed Deer	Eastern Cottontail Rabbit	Bobwhite Quail	Red Fox	Raccoon
Food Source Ingestion	NA	Vegetation 100%	Vegetation 100%	Vegetation 100%	Small Mammals 80% Vegetation 20%	Vegetation 40% Fish 60%
Feeding Rate	kg/d	1.6[2]	0.1[3]	0.014[4]	0.446[4]	0.319[4]
Incident Soil Ingestion	kg/d	0.019[1]	0.002[3]	0.001[3]	0.012[4]	0.030[4]
Rate of Drinking Water Ingestion	L/d	1.1[2]	0.119[4]	0.019[4]	0.399[4]	0.331[4]
Rate of Vegetation Ingestion	kg/d	1.6	0.1	0.014	0.089	0.128
Body Weight	kg	45.4[2]	1.229[4]	0.177[4]	4.69[4]	3.99[4]
Rate of Small Mammal Ingestion	kg/d	NA	NA	NA	0.356	NA
Rate of Fish Ingestion	kg/d	NA	NA	NA	NA	0.192
Home Range Size	acres	454[2]	9.29[4]	8.89[4]	1,771[4]	385[4]

NA - Not Applicable
[1] Scarano, 1993
[2] Dee, 1991
[3] Newell, 1987
[4] USEPA, 1993

TABLE 7-13

QUOTIENT INDEX RATIO - SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Bobwhite Quail	Eastern Cottontail	Red Fox	Whitetailed Deer	Raccoon
Phenanthrene	2.61e-05	1.82e-05	3.97e-07	1.50e-07	1.63e-06
Anthracene	2.69e-05	1.88e-05	4.10e-07	1.55e-07	1.69e-06
Fluoranthene	2.21e-05	1.33e-05	3.00e-07	1.05e-07	1.59e-06
Pyrene	3.60e-05	2.18e-05	4.91e-07	1.73e-07	2.58e-06
Benzo(a)anthracene	1.65e-05	7.18e-06	1.76e-07	5.01e-08	1.46e-06
Chrysene	1.70e-05	7.38e-06	1.81e-07	5.15e-08	1.50e-06
Benzo(b)fluoranthene	1.45e-05	4.84e-06	1.29e-07	2.89e-08	1.42e-06
Benzo(k)fluoranthene	1.48e-05	5.61e-06	1.44e-07	3.64e-08	1.39e-06
Benzo(a)pryene	1.53e-05	5.99e-06	1.52e-07	3.96e-08	1.42e-06
Benzo(g,h,i)perylene	1.37e-05	4.67e-06	1.24e-07	2.83e-08	1.34e-06
Bis(2-chloroethyl)ether	NA	NA	NA	NA	NA
Toluene	1.53e-06	1.47e-06	3.03e-08	1.29e-08	5.61e-08
Dieldrin	9.59e-03	7.13e-03	1.54e-04	5.96e-05	5.57e-04
4,4'-DDE	2.97e-03	1.28e-03	3.15e-05	8.88e-06	2.63e-04
4,4'-DDD	1.44e-03	5.62e-04	1.42e-05	3.71e-06	1.33e-04
4,4'-DDT	1.74e-03	6.43e-04	6.64e-05	1.81e-05	7.08e-02
Chlordane, alpha	3.48e-04	1.63e-04	3.92e-06	1.18e-06	3.24e-05
Chlordane, gamma	3.34e-04	1.57e-04	3.76e-06	1.13e-06	3.12e-05
Heptachlor	1.24e-04	7.89e-05	3.22e-05	9.21e-06	3.71e-05
Heptachlor Epoxide	7.91e-05	3.86e-05	9.17e-07	2.83e-07	6.57e-06
Endosulfan II	4.83e-04	4.05e-04	8.53e-06	3.47e-06	2.35e-05
gamma-BHC (lindane)	1.31e-04	1.15e-04	7.43e-06	2.41e-06	8.61e-05
Endrin aldehyde	4.86e-04	3.32e-04	7.28e-06	2.72e-06	3.11e-05
Aluminum	NA	NA	NA	NA	NA
Arsenic	7.83e-04	4.93e-04	1.67e-04	4.81e-05	1.95e-04
Barium	1.20e-02	9.42e-03	1.40e-03	4.24e-04	1.59e-03
Cobalt	NA	NA	NA	NA	NA
Copper	1.14e-03	1.03e-03	3.13e-05	1.21e-05	4.84e-05
Iron	NA	NA	NA	NA	NA
Lead	1.63e-02	9.16e-03	3.01e-04	1.02e-04	1.22e-03
Manganese	1.06e+01	9.03e+00	1.17e+00	3.62e-01	1.27e+00

TABLE 7-13 (Continued)

QUOTIENT INDEX RATIO - SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Bobwhite Quail	Eastern Cottontail	Red Fox	Whitetailed Deer	Raccoon
Mercury	1.14e-03	1.09e-03	2.53e-05	1.13e-05	7.17e-04
Vanadium	1.49e-02	5.54e-03	9.96e-04	2.77e-04	2.19e-03
Zinc	4.12e-01	4.03e-01	8.13e-03	3.69e-03	1.00e-02
Total	1.11e+01	9.46e+00	1.19e+00	3.66e-01	1.36e+00

NA - Terrestrial reference value not available, therefore a quotient index ration could not be calculated.

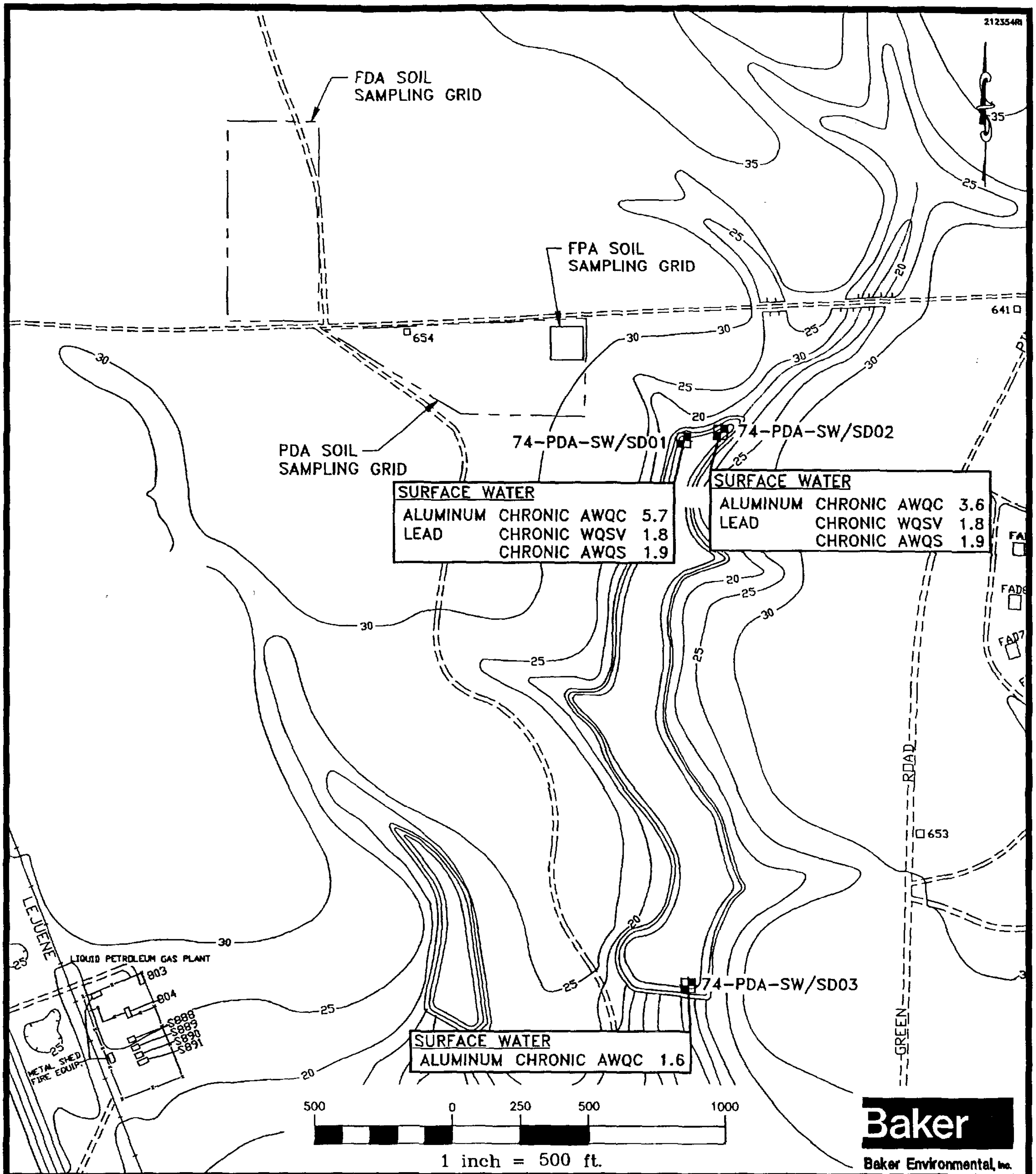
TABLE 7-14

QUOTIENT INDEX RATIOS - SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Bobwhite Quail	Eastern Cottontail	Red Fox	Whitetailed Deer
Trichloroethene	1.01E-06	1.02E-06	6.11E-09	1.36E-08
Toluene	1.15E-06	1.14E-06	6.81E-09	1.51E-08
Dieldrin	1.24E-02	9.50E-03	5.95E-05	1.20E-04
4,4'-DDE	3.02E-03	1.35E-03	9.62E-06	1.41E-05
4,4'-DDD	1.56E-03	6.28E-04	4.63E-06	6.25E-06
4,4'-DDT	3.81E-03	1.37E-03	1.05E-05	1.28E-05
Chlordane, alpha	4.31E-04	2.09E-04	1.46E-06	2.28E-06
Chlordane, gamma	4.45E-04	2.16E-04	1.51E-06	2.35E-06
Heptachlor	1.95E-04	1.04E-04	7.10E-07	1.18E-06
Hepachlor Epoxide	7.54E-05	3.80E-05	2.62E-07	4.20E-07
Endrin Aldehyde	4.45E-04	3.14E-04	2.00E-06	3.87E-06
Aluminum	NA	NA	NA	NA
Arsenic	2.30E-04	1.28E-04	7.76E-07	1.47E-06
Barium	4.86E-03	3.87E-03	2.04E-05	4.92E-05
Chromium	1.22E-02	4.39E-03	3.31E-05	4.07E-05
Iron	NA	NA	NA	NA
Lead	1.76E-03	1.03E-03	2.48E-05	1.70E-05
Manganese	1.19E+00	1.04E+00	5.42E-03	1.34E-02
Mercury	5.12E-04	5.06E-04	2.57E-06	6.69E-06
Nickel	5.16E-03	3.25E-03	2.12E-05	3.89E-05
Selenium	4.01E-03	1.93E-03	1.35E-05	2.10E-05
Vanadium	7.54E-03	2.57E-03	1.97E-05	2.30E-05
Zinc	2.00E-02	2.02E-02	1.11E-04	2.68E-04
Cyanide, total	6.28E-04	1.81E-04	1.50E-06	1.40E-06
Total	1.26E+00	1.09E+00	5.76E-03	1.40E-02

NA - Terrestrial reference value not available, therefore, a quotient index ratio could not be calculated.

SECTION 7.0 FIGURES



LEGEND

74-PDA-SW/SD01 — SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, FEB. 1994

FIGURE 7-5
QUOTIENT INDEX RATIOS EXCEEDANCES IN SURFACE WATER AND SEDIMENT - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
REMEDIAL INVESTIGATION CTO-0212
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

8.0 CONCLUSIONS

The following conclusions for Sites 41 and 74 are based on the results of the RI, and the human health and ecological risk assessments.

8.1 Site 41

1. Polynuclear aromatic hydrocarbons (PAHs) detected in soil may be the result of reported burning operations during disposal activities. The extent of this contamination is within the central portion of the former disposal area. PAHs were not detected in groundwater.

2. Pesticides were detected in most soil samples; however, the pesticide levels are within base-wide concentrations which are indicative of historical pest control spraying. Low levels of pesticides were detected at isolated areas within the shallow aquifer and the upper portion of the Castle Hayne aquifer, indicating that pesticides have migrated to a limited extent from the soil matrix to shallow groundwater.

3. Although there were many background exceedances associated with the metals results, the data do not suggest a gross metals contamination problem in either the surface or subsurface soils at the site. The majority of elevated metals concentrations exceeded the twice background levels by less than an order of magnitude.

4. Total lead, iron, and manganese were detected above State and Federal groundwater standards in most of the wells during the RI field investigation. Monitoring well 41GW11, which is located in the central portion of the former disposal area, exhibited the highest levels of lead, iron, and manganese. However, the elevated concentrations of total metals may be due to turbidity in the well or sampling techniques rather than from leaching of these metals from soil to groundwater. Resampling of selected shallow monitoring wells using the low-flow sampling technique resulted in significantly lower metal concentrations. Only metals concentrations in well 41GW11 exceeded drinking water standards during this round.

5. Shallow groundwater is apparently discharging from the landfill via two seeps. Surface water samples collected from the seeps have exhibited elevated levels of iron, lead, and manganese. However, the unnamed tributary and Tank Creek do not appear to be significantly impacted by the site or seep discharges. Downstream surface water samples exhibited slightly higher iron and lead levels than upstream samples. Sediment samples along the seep pathway primarily exhibited pesticides above EPA Region IV screening values. High iron concentrations were detected in the seep sediments, suggesting that much of the iron in the seep surface water is being deposited in the sediments through oxidation and precipitation.

6. Under current exposure pathways, there are no adverse human health risks mainly because the site is in a remote area, and there is no exposure pathway associated with the groundwater (i.e., no water supply wells are currently located near the site).

7. Under future potential exposure pathways involving residential use, adverse human health risks would result due to groundwater usage. However, future residential use of the area is unlikely since the site is suspected of containing buried CWM.

8. No adverse human health risks were calculated for the future construction worker. However, buried CWM, if present, would still pose a risk to a construction worker at the site.

9. The risk analysis for environmental media concentrations and terrestrial intake models did not indicate that there are significant ecological risks associated with Site 41 to terrestrial receptors and aquatic receptors in the unnamed tributary and Tank Creek.

10. Based on the results of the human health and ecological risk assessments, there are no areas of concern associated with soils or sediment that require remediation. However, institutional controls should be considered in the FS to restrict site access and land use because of the unacceptable risk calculated for the residential use scenario as well as the suspected buried CWM.

11. Remediation of the groundwater and seep discharges should be considered in the FS because there were some exceedances of State and Federal ARARs. In addition, the seep discharge may pose a future potential threat to the environment and habitat along the unnamed tributary.

8.2 Site 74

1. Soil at the former pest control area exhibited pesticides above base background levels, indicating that former pest control activities have resulted in soil contamination. The extent of soil contamination at the former pest control area is limited.

2. Low levels of pesticides were detected in shallow groundwater at the pest control area; however, the levels are below State and Federal drinking water standards.

3. Soil and groundwater at the former grease pit disposal area have not been significantly impacted by former disposal activities. Although organic and inorganic contaminants were detected in soil, the low concentrations and infrequent distribution of the contaminants do not suggest that there is a source area associated with former disposal areas.

4. The subsurface conditions at the former grease pit disposal area are unknown since no intrusive investigations (e.g., trenching) could be conducted due to suspected buried CWM. Therefore, the background information, which indicated that PCBs and other wastes were disposed at the site, cannot be verified.

5. No chemical agents were detected during borehole monitoring by the U.S. Army TEU. In addition, no chemical surety degradation compounds were detected in soil samples.

6. Elevated total metals in groundwater are not believed to be indicative of former disposal activities. Dissolved metal concentrations were below State and Federal drinking water standards.

7. Under current exposure pathways, there are no adverse human health risks associated with the site (i.e., the shallow groundwater is not currently being used for any purpose).

8. Under future potential exposure pathways involving residential use, adverse human health risks would result due to groundwater usage. However, future residential use of the area is unlikely since the site is suspected of containing buried CWM.

9. No adverse human health risks were calculated for the future construction worker. However, buried CWM, if present, would still pose a risk to a construction worker at the site.

10. The risk analysis for environmental media concentrations and terrestrial intake models indicated that there are no significant ecological risks associated with Site 74 to aquatic and terrestrial receptors.

11. Based on the results of the human health and ecological risk assessments, there are no areas of concern associated with the soils that require remediation. However, institutional controls should be considered in the FS to restrict site access and land use because of the unacceptable risk calculated for the residential use scenario as well as the suspected buried CWM.

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