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BASELINE LONG-TERM MONITORING STUDY
OPERABLE UNIT NO. 4 (SITES 41 AND 74)
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0352

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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 Fiscal Year 1996 Site Management Plan for MCB Camp Lejeune, a primary document identified in the FFA, identifies 33 sites requiring Remedial Investigation/Feasibility Study (RI/FS) activities. These 33 sites have been divided into 17 operable units to simplify proceeding with RI/FS activities. This report describes the Baseline Long-Term Monitoring Study (BLTMS) conducted at Operable Unit (OU) No. 4, which is comprised of Sites 74 and 41.

The purpose of this BLTMS 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 and to propose a baseline long-term monitoring plan for OU No. 4. This was accomplished by evaluating the sampled media (soil, groundwater, surface water, and sediment) at OU No. 4, the analytical data, and the human health Risk Assessment (RA) and ecological RA. This BLTMS report contains the results of all field investigations, and a summary of the results of the human health RA, and the ecological RA. Furthermore, the BLTMS provides information to support the Record of Decision (ROD) for a final remedial action.

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

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

1.1 Operable Unit Description

Operable units are formed as an incremental step towards addressing individual site problems. There are currently 33 Installation Restoration Program (IRP) sites on MCB Camp Lejeune which have been grouped into 17 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 74 and 41 which were grouped because both sites all had historic documentation of disposal of Chemical Weapons Material (CWM) and industrial wastes.

The sites included under OU No. 4 are one half hour in driving distance away from each other. 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 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 descriptions and histories of both of the sites are included under OU No. 4 are presented in section 1.2.

1.2 Site Descriptions and Histories

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

1.2.1 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. 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) identified excavated soils at Site 41. The occurrence of excavated soils at Site 41 would tend to confirm past disposal activities.

1.2.2 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.

1.2.3 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.

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.

1.2.4 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.

1.3 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.

1.3.1 Initial Assessment Study

An IAS was conducted by 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 BLTMS. 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.

1.3.2 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 1.3.2.1 and 1.3.2.2, respectively.

1.3.2.1 Site 41

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) and 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 FAWQC 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).

1.3.2.2 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 at 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. For 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.

1.3.3 Remedial Investigation Report

A remedial investigation report (RI) was conducted by Baker from January through March 4, 1994. The purpose of this investigation was to characterize potential disposal related impacts and threats to human health and the environmental resulting from previous operations and disposal activities at Sites 41 and 74. 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 investigation, and an aquatic and ecological survey.

1.3.3.1 Site 41 - Camp Geiger Dump Near Former Trailer Park

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.

1.3.3.1.1 Surface Soil

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 1-7). 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 1-8 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 1-9 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 1-10 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 1-11). 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 1-7 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.

1.3.3.1.2 Subsurface Soils

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 1-12) 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 1-13 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 1-13. 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 1-14 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 1-15). 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 1-16). 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 1-8 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.

1.3.3.1.3 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.

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 1-17 and 1-18 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 1-19).

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 1-20, 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 1-21). 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 1-22). 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 1-22 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 1-23 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 1-24.

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.

1.3.3.1.4 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.

No organic contaminants were detected in Tank Creek. Figures 1-25 and 1-26 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 1-27 and 1-28 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.

1.3.3.1.5 Sediments

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

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 1-29 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 1-30). 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 1-31 and 1-32). 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 1-31). 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 1-33). 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 1-34 and 35). 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. 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.

1.3.3.1.5 Summary

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.

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.

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.

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.

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.

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.

1.3.3.2 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.

1.3.3.2.1 Surface Soil

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 1-36 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 1-36).

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 1-37. 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 1-38. 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 1-38. 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 1-39 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 1-9 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.

1.3.3.2.2 Subsurface Soils

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 1-40). 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 1-10

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.

1.3.3.2.3 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.

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 1-41 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.

1.3.3.2.4 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.

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

Seven TAL metals were detected. Figure 1-42 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 1-11).

1.3.3.2.5 Sediments

Results indicated the presence of volatiles, semivolatiles, pesticides, and inorganics in the three sediment samples collected from Henderson Pond. Refer to Figure 1-43 for the detected concentrations of volatiles and semivolatiles. Figure 1-44 presents the positive detections for pesticides in the sediment samples collected at Henderson Pond. TAL metals concentrations are presented on Figure 1-45.

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.

1.3.3.2.6 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.

1.4 Report Organization

The following sections are presented in this BLTMS report.

Section 2.0 Study Area Investigation
Section 3.0 Nature and Extent of Contamination
Section 4.0 Summary
Section 5.0 References

Section 2.0 describes the field sampling activities conducted during the BLTMS at OU No. 4. This section describes the purpose of the sampling procedures and sampling locations for all media. Figures are included to show sampling locations. This section also discusses quality control conducted during the sampling events. Physical characteristics of the study area are detailed and can be referred to in the RI Report (Baker, 1994).

Section 3.0 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 BLTMS.

Section 4.0 provides a summary of the contaminants detected in each media at Sites 41 and 74. The summary includes an analysis of the significance of the baseline study.

Section 5.0 includes references cited in this report.

SECTION 1.0 TABLES

TABLE 1-1

CONFIRMATION STUDY
DETECTED TARGET CONTAMINANTS IN GROUNDWATER SAMPLES, SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

(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
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

[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
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

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
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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
4,4'- DDD	0.0084	<0.0006	0.0006	0.0029	0.0006	0.0006
4,4'- DDE	0.044	0.006	0.0072	0.0051	0.001	0.0004
4,4'- DDT	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
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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
4,4'- DDD	NS	NS	<0.0008	<0.006	<0.0008	0.029	<0.006	<0.006	<0
4,4'- DDE	NS	NS	<0.0008	<0.006	0.001	<0.006	<0.006	<0.006	<0.006
4,4'- DDT	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

Notes:

(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
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

[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.

TABLE 1-7

**COMPARISON OF INORGANIC LEVELS IN SURFACE SOILS
AT SITE 41 TO BACKGROUND LEVELS
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

Background levels were determined based on a statistical evaluation of inorganic results from environmental samples collected prior to and including the RI for this site.

ND = Nondetect

TABLE 1-8

COMPARISON OF INORGANIC LEVELS IN SUBSURFACE SOILS
AT SITE 41 TO BASE BACKGROUND LEVELS
REMEDIAL INVESTIGATION - CTO - 352
MCB CAMP LEJEUNE, NORTH CAROLINA

	Site 41 (mg/kg)	Base Background (mg/kg)
Aluminum	4.86-13,500	16.9-11,000
Arsenic	1.92-2.94	0.355-6.9
Barium	0.518-3.02	0.033-15.4
Beryllium	3.15-186	0.65-22.6
Cadmium	0.187-0.31	0.01-0.31
Calcium	1.32-4.73	0.155-1.2
Chromium	37.3-18,900	4.75-4,410
Copper	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

Notes:

Background levels were determined based on a statistical evaluation of inorganic results from environmental samples collected prior to and including the RI for this site.

NA = Not Analyzed

TABLE 1-9

COMPARISON OF INORGANIC LEVELS IN SITE 74
SURFACE SOILS TO BACKGROUND LEVELS
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

Background levels were determined based on a statistical evaluation of inorganic results from environmental samples collected prior to and including the RI for this site.

ND = Nondetect

TABLE 1-10

COMPARISON OF INORGANIC LEVELS IN SITE 74
SUBSURFACE SOILS TO BASE BACKGROUND LEVELS
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
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

Notes:

Background levels were determined based on a statistical evaluation of inorganic results from environmental samples collected prior to and including the RI for this site.

NA = Not Analyzed

TABLE 1-11

COMPARISON OF TOTAL METALS IN SURFACE WATER AT SITE 74 TO BASE UPGRADIENT LEVELS BASELINE LONG-TERM MONITORING STUDY, CTO-0352 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

SECTION 1.0 FIGURES

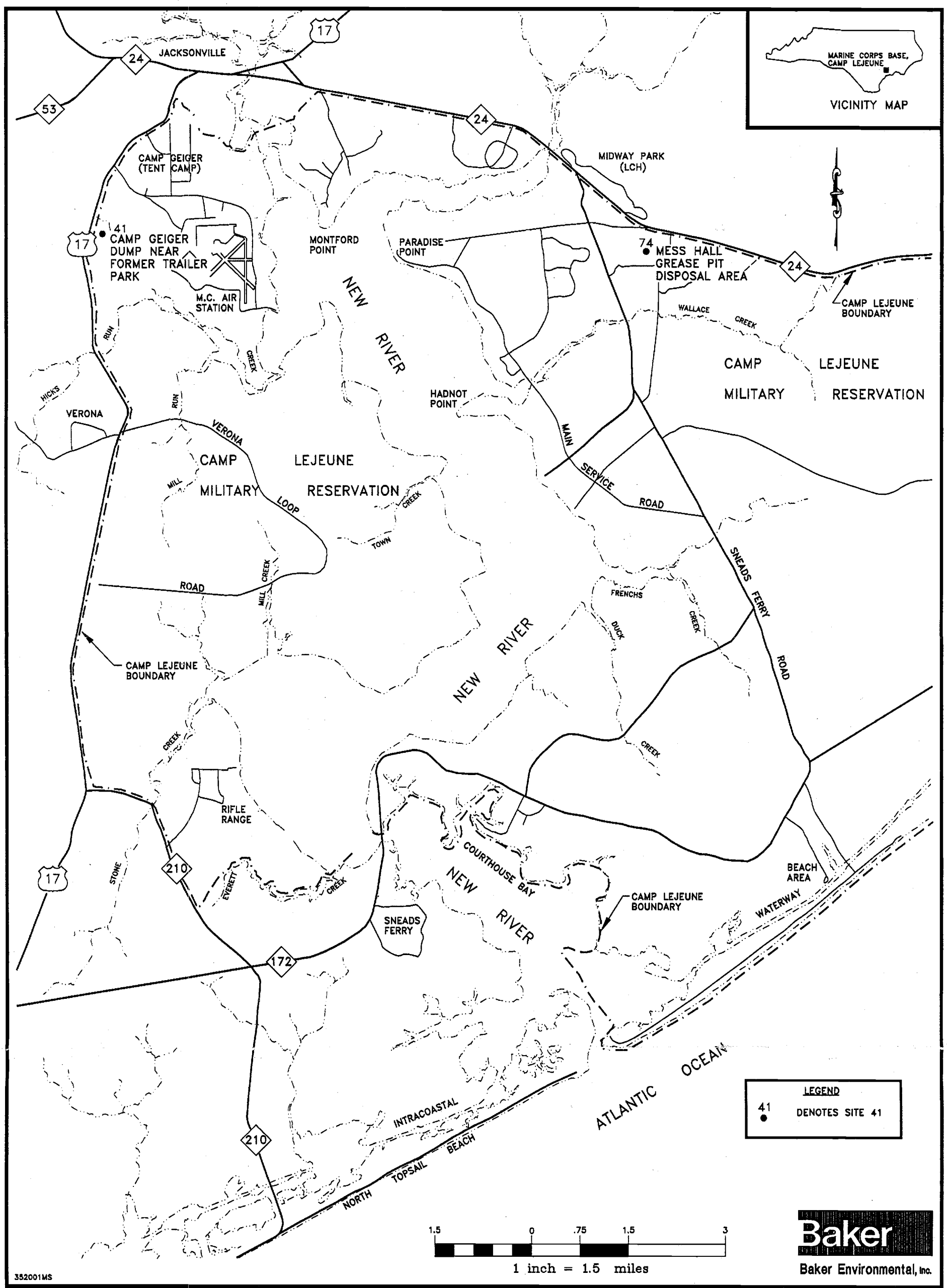


FIGURE 1–1
LOCATION MAP OPERABLE UNIT No. 4
SITES 41 AND 74
BASELINE LONG–TERM MONITORING STUDY CTO–0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01770 JJ BIZ

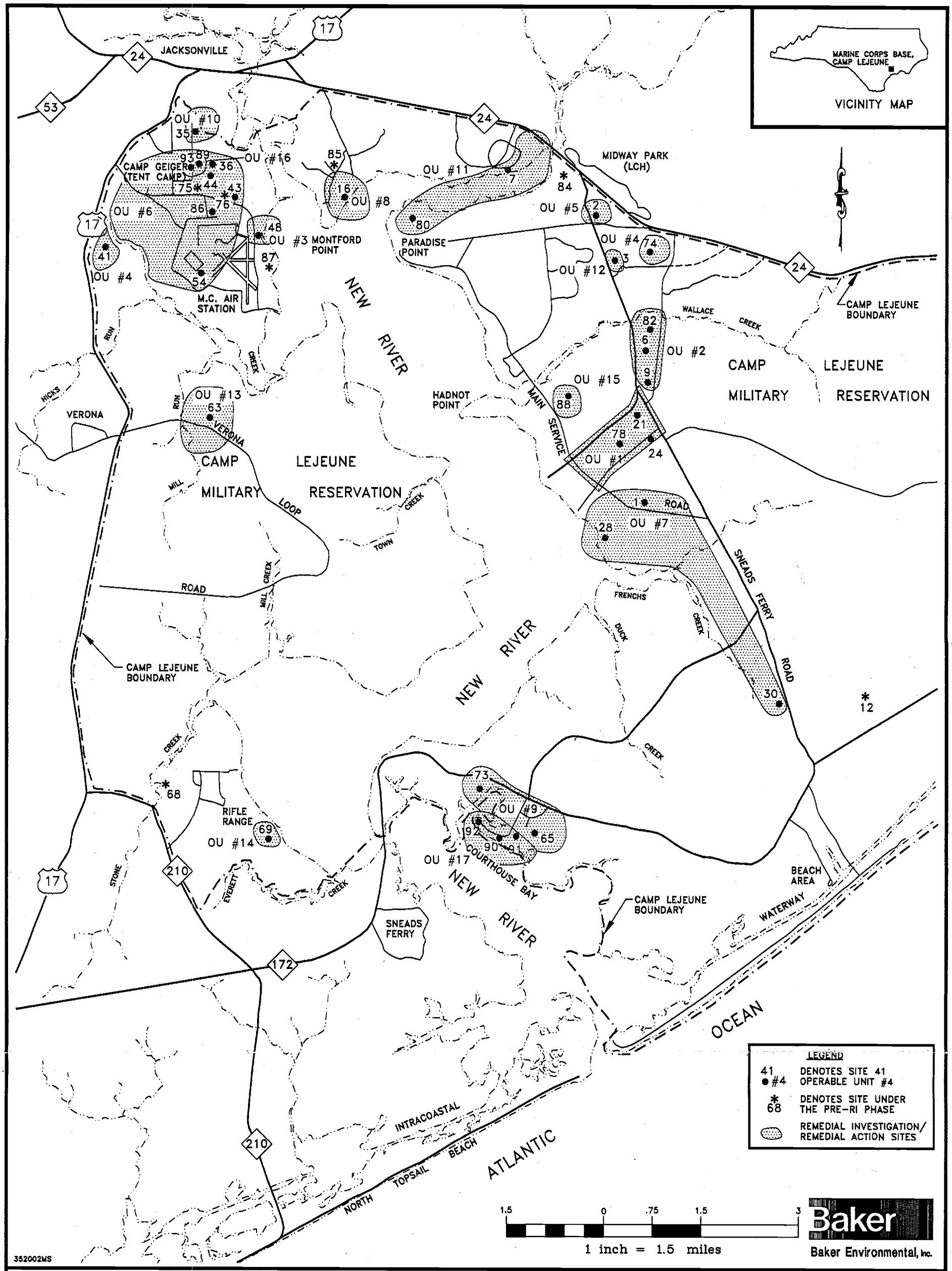
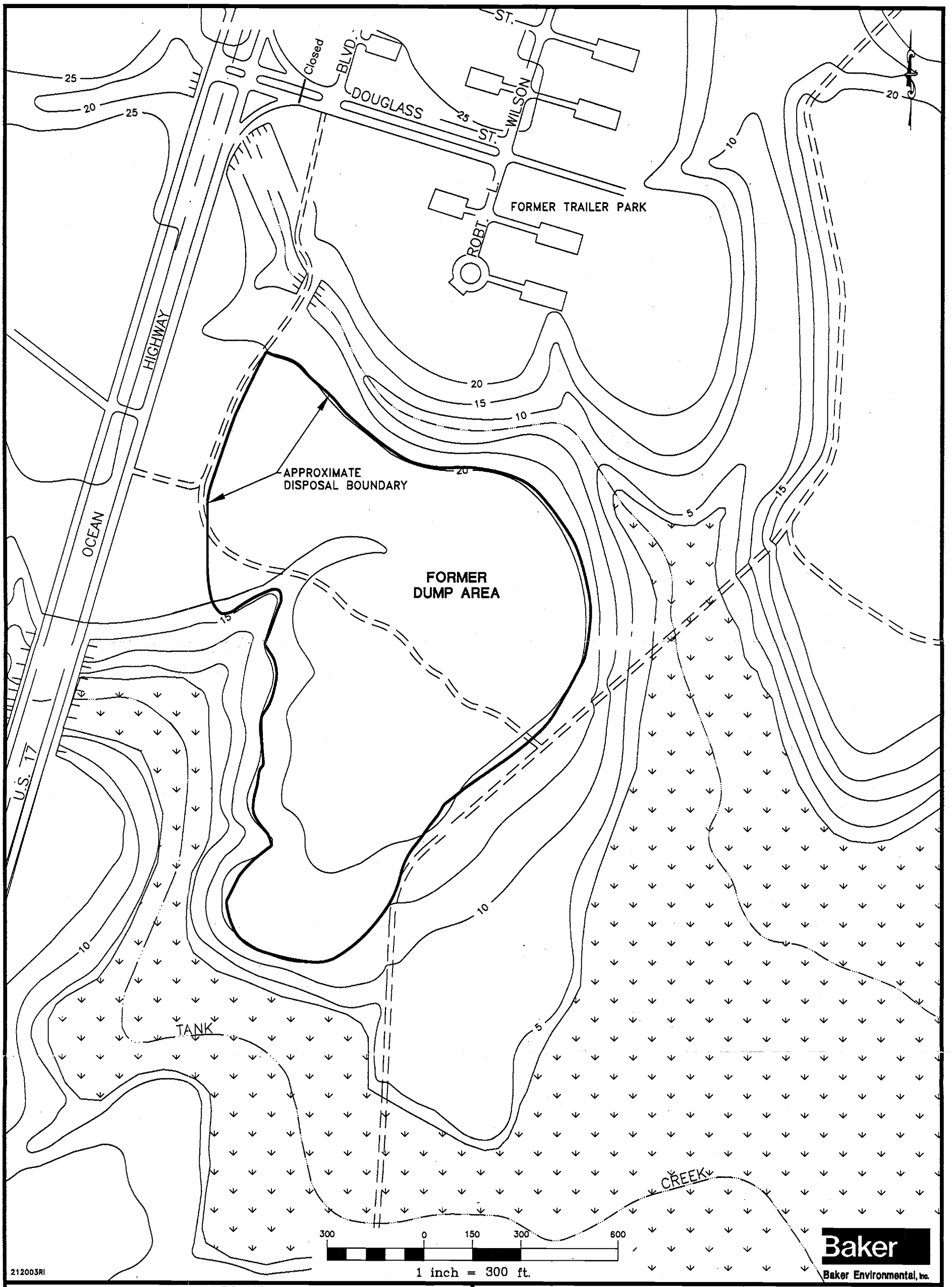


FIGURE 1-2
OPERABLE UNITS AND SITE LOCATIONS AT
MARINE CORPS BASE CAMP LEJEUNE
BASELINE LONG-TERM MONITORING STUDY CTO-0352

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

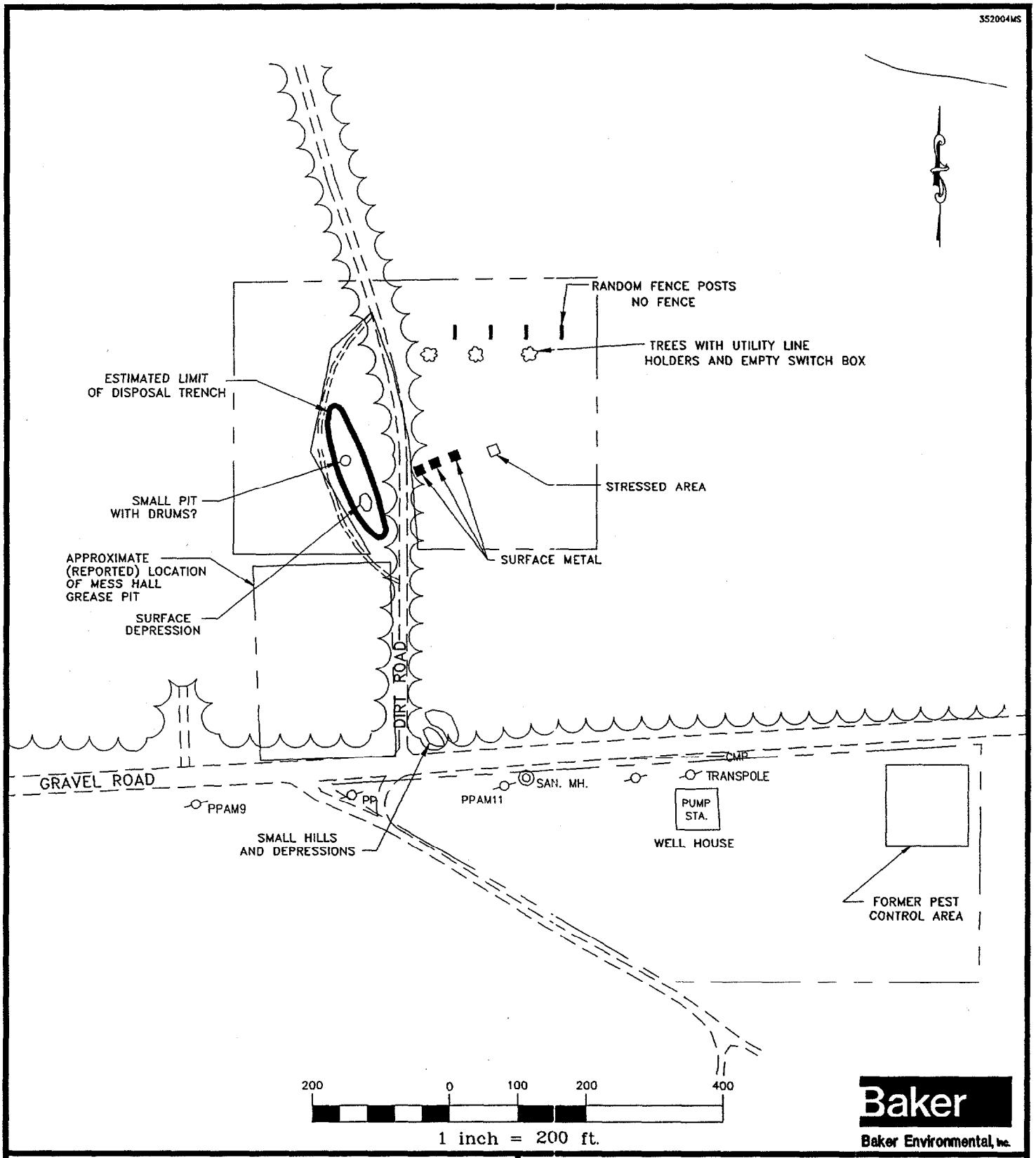


LEGEND

- MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)
- ROAD (IMPROVED)
- ROAD (UNIMPROVED)
- INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-3
SITE MAP
SITE 41 – CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



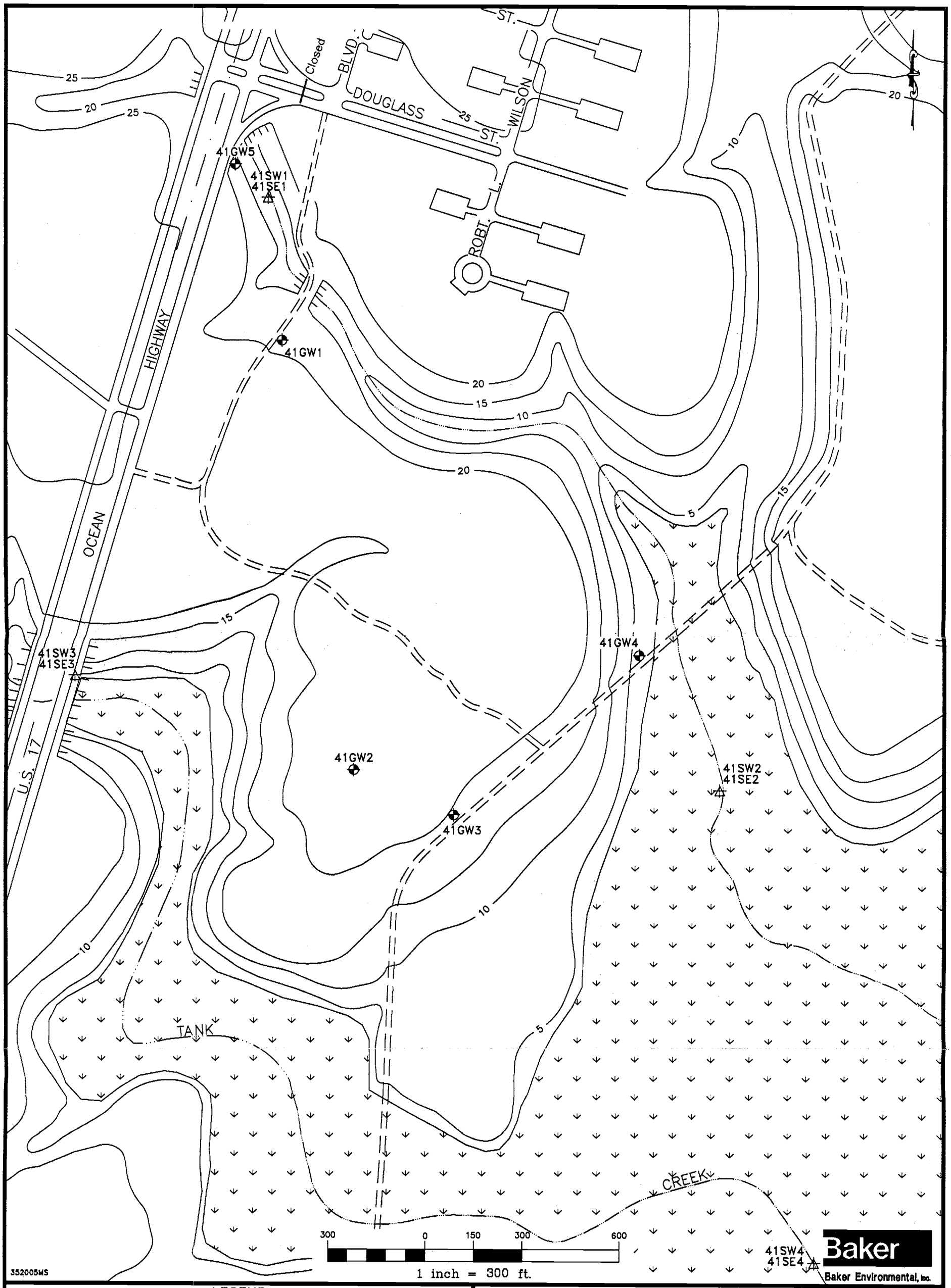
LEGEND

- VEGETATION

- ROAD (UNIMPROVED)

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-4
SITE MAP
SITE 74 - MESS HALL
GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING
STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



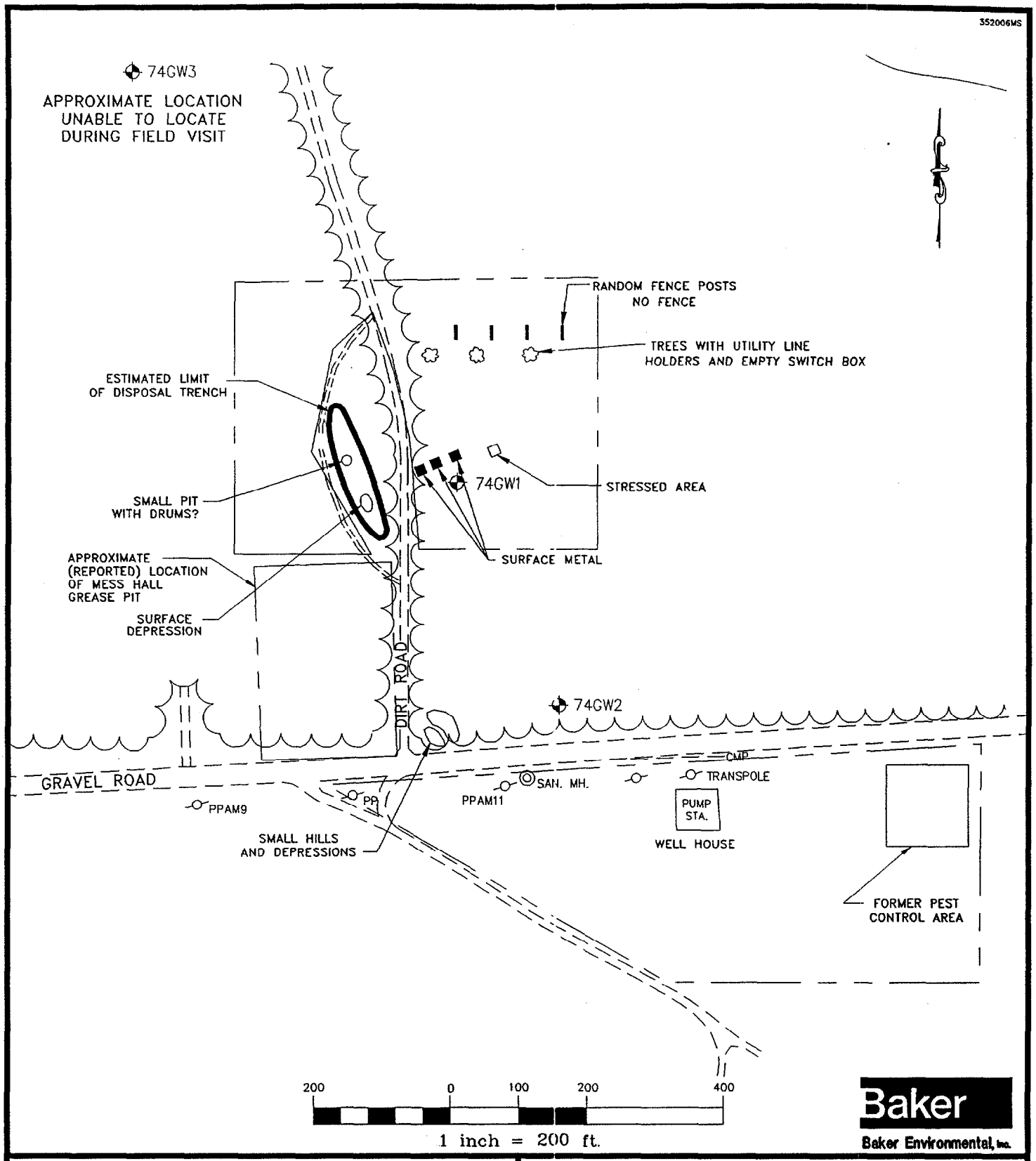
LEGEND

- 41GW1 – EXISTING GROUNDWATER MONITORING WELL
- 41SW1 41SE1 – SURFACE WATER/SEDIMENT SAMPLING LOCATION
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)
- – ROAD (IMPROVED) = = = – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-5
CONFIRMATION STUDY
SHALLOW MONITORING WELLS AND SURFACE WATER/SEDIMENT LOCATIONS – SITE 41
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01770JJ012



LEGEND

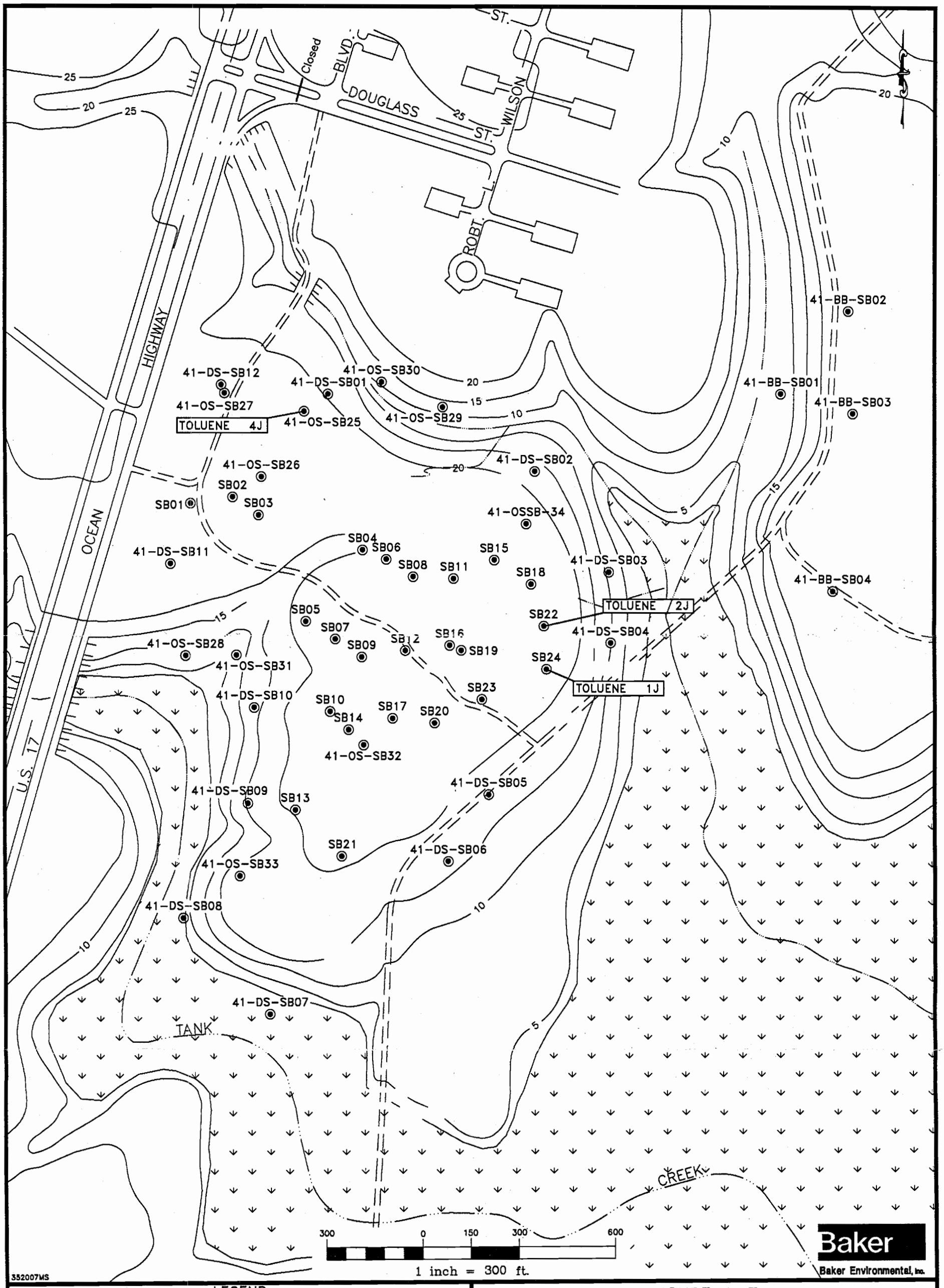
74GW1 – EXISTING SHALLOW WELL

– VEGETATION

– ROAD (UNIMPROVED)

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-6
CONFIRMATION STUDY
SHALLOW MONITORING WELL
LOCATIONS – SITE 74
BASELINE LONG-TERM MONITORING
STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



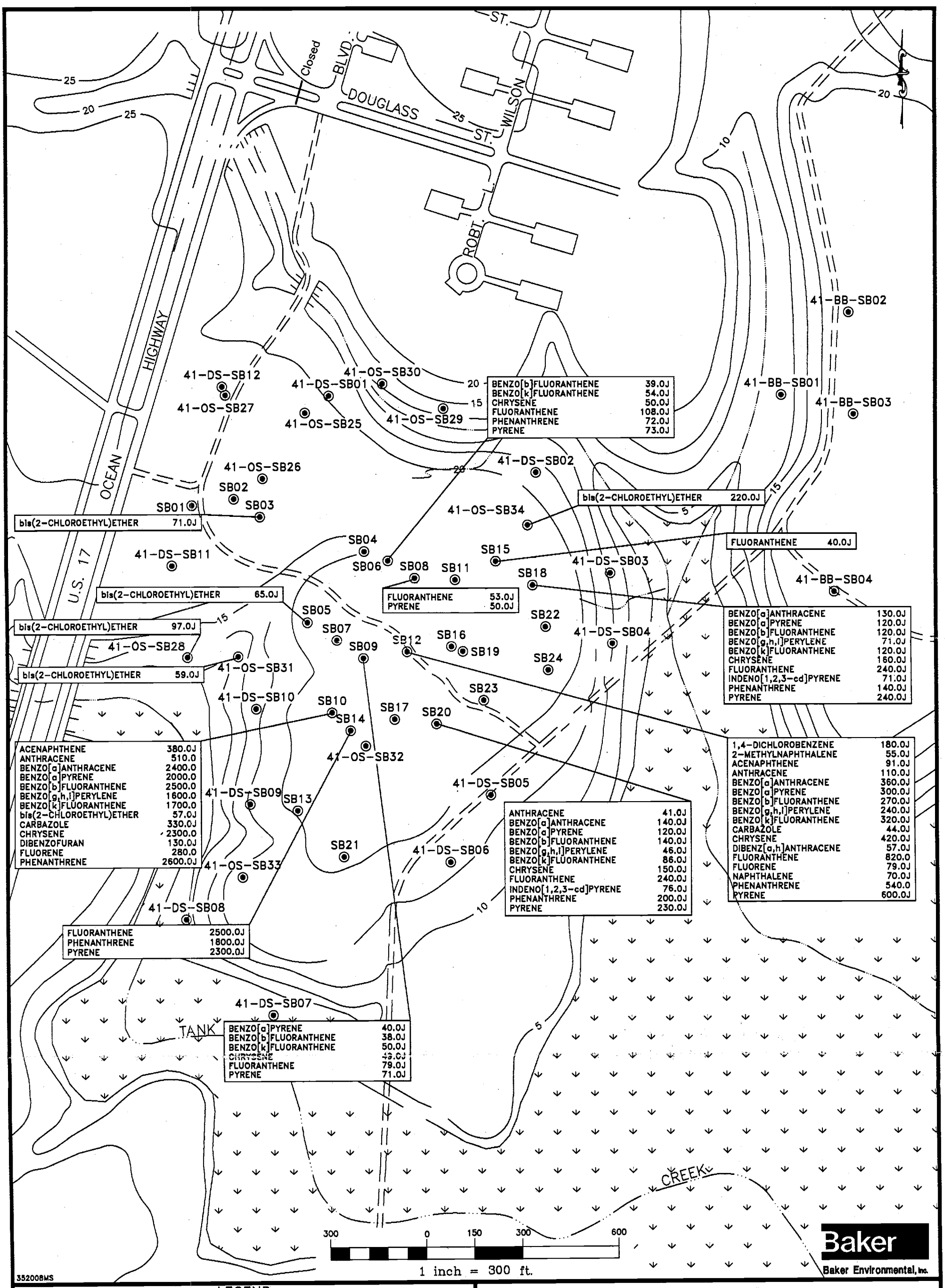
LEGEND

- SB01 – SOIL BORING LOCATION
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-7
POSITIVE DETECTIONS OF VOLATILES
IN SURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01770 JJ B2Z



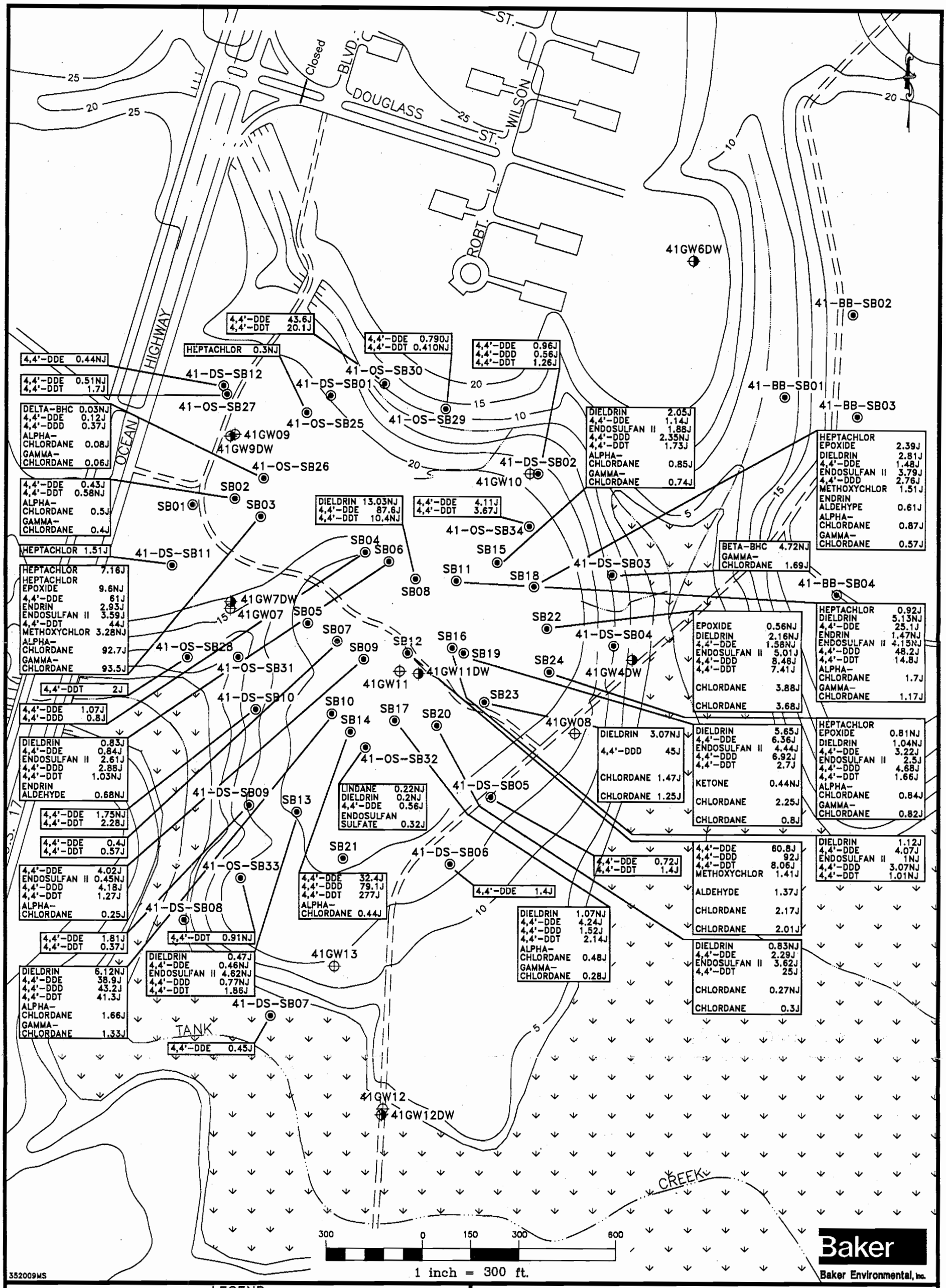
LEGEND

- SB01 – SOIL BORING LOCATION
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-8
POSITIVE DETECTIONS OF SEMIVOLATILES IN SURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41GW07 – SHALLOW MONITORING WELL LOCATION

41GW4D – DEEP MONITORING WELL LOCATION

SB01 – SOIL BORING LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

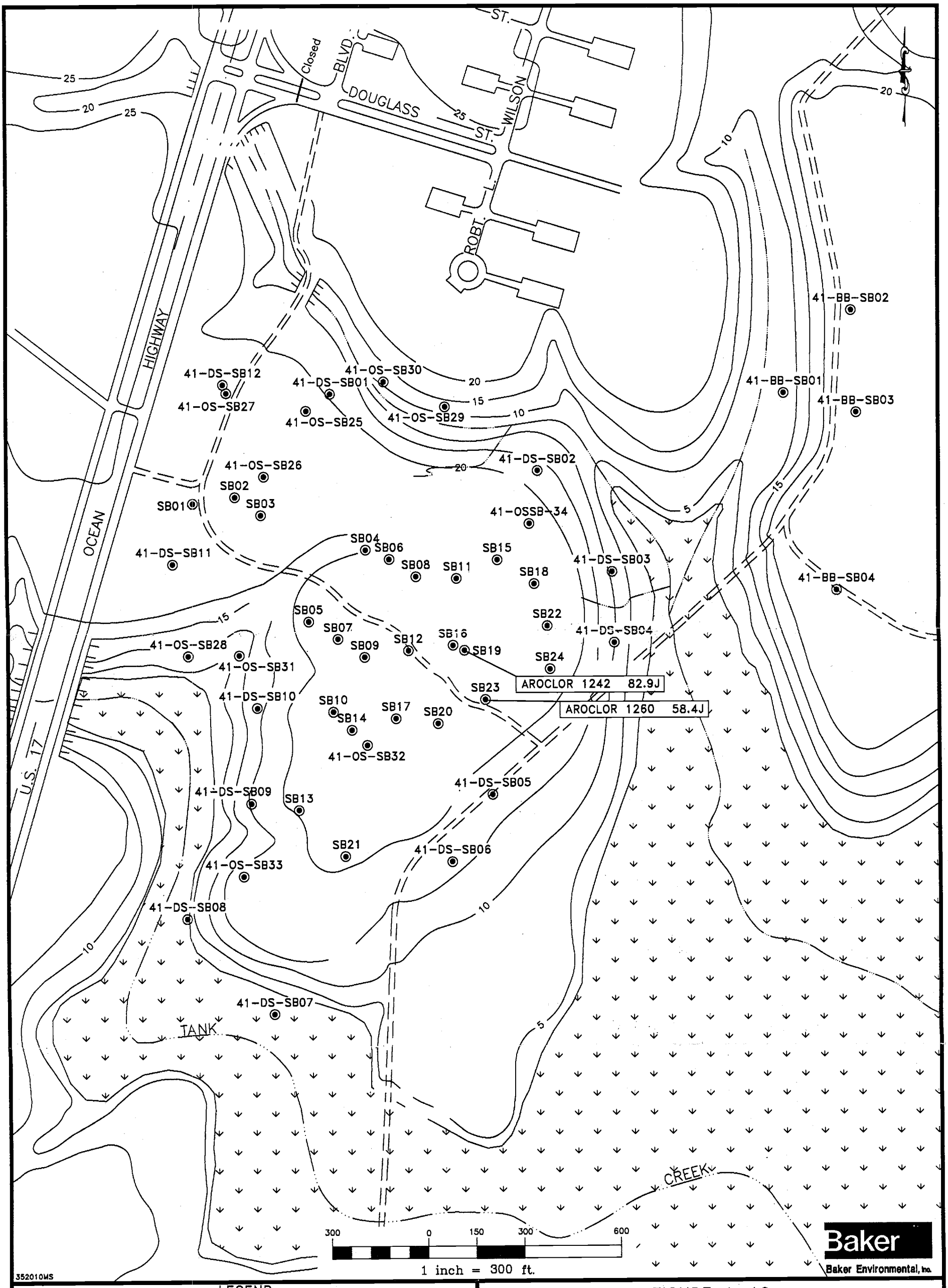
– ROAD (IMPROVED)

– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-9
POSITIVE DETECTIONS OF PESTICIDES ABOVE 1 ug/kg IN SURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

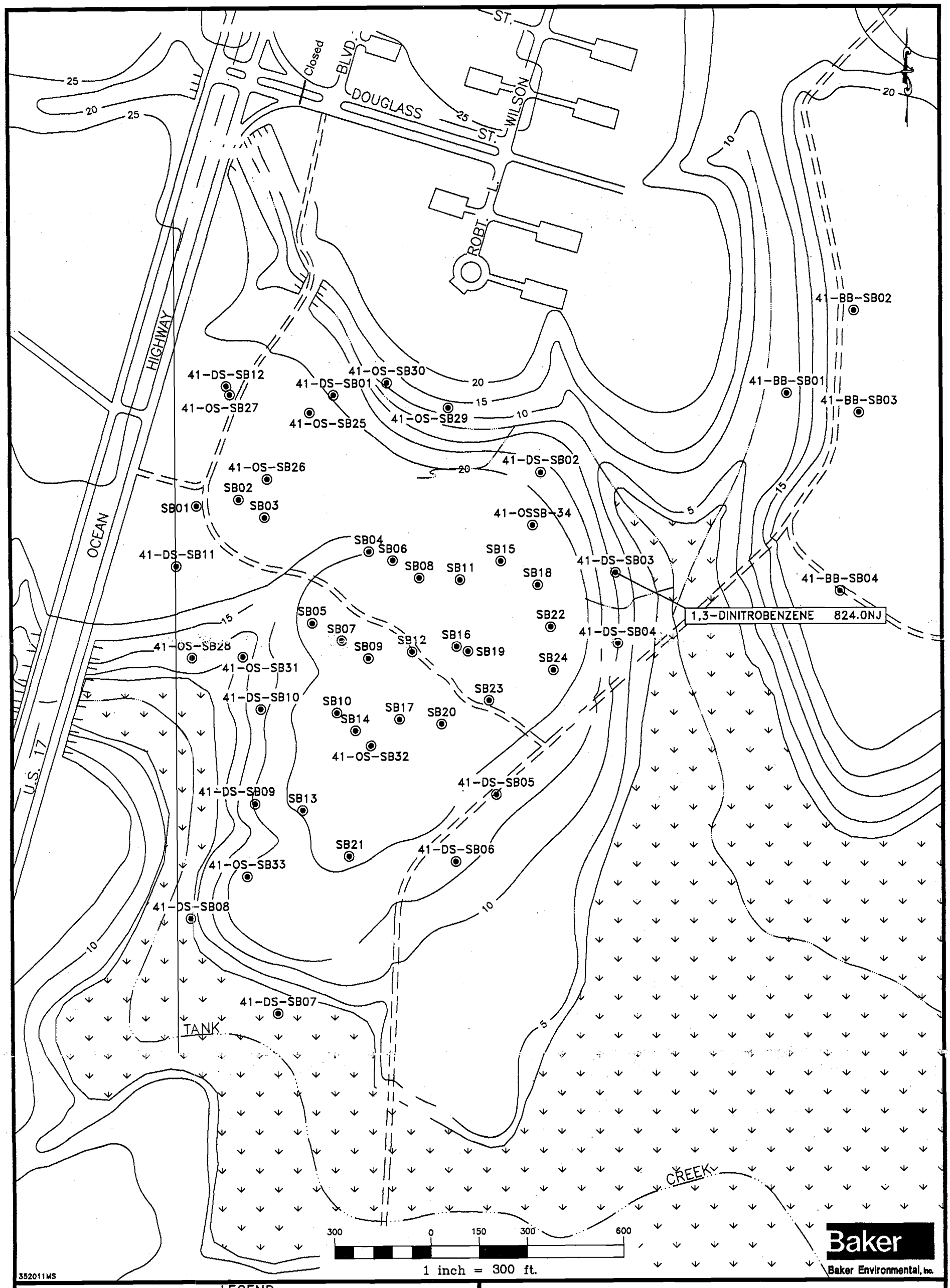


LEGEND

- SB01 – SOIL BORING LOCATION
- MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- ROAD (IMPROVED)
- ROAD (UNIMPROVED)
- INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-10
POSITIVE DETECTIONS OF PCBs IN SURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

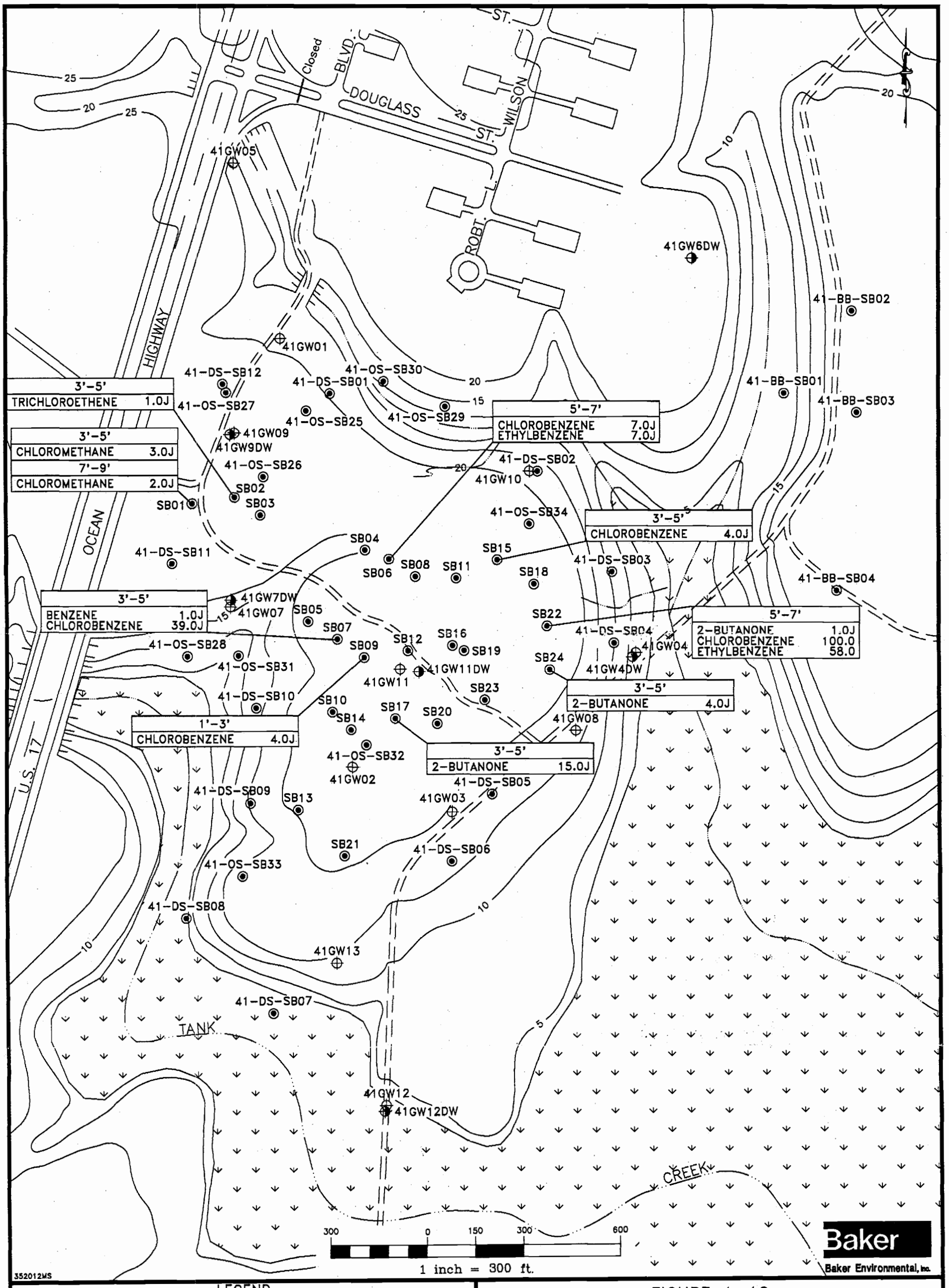


LEGEND

- SB01 – SOIL BORING LOCATION
- MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- ROAD (IMPROVED)
- ROAD (UNIMPROVED)
- INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-11
POSITIVE DETECTIONS OF ORDNANCE
IN SURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



Baker

Baker Environmental, Inc.

LEGEND

41GW07 – SHALLOW MONITORING WELL LOCATION

41GW4D – DEEP MONITORING WELL LOCATION

SB01 – SOIL BORING LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

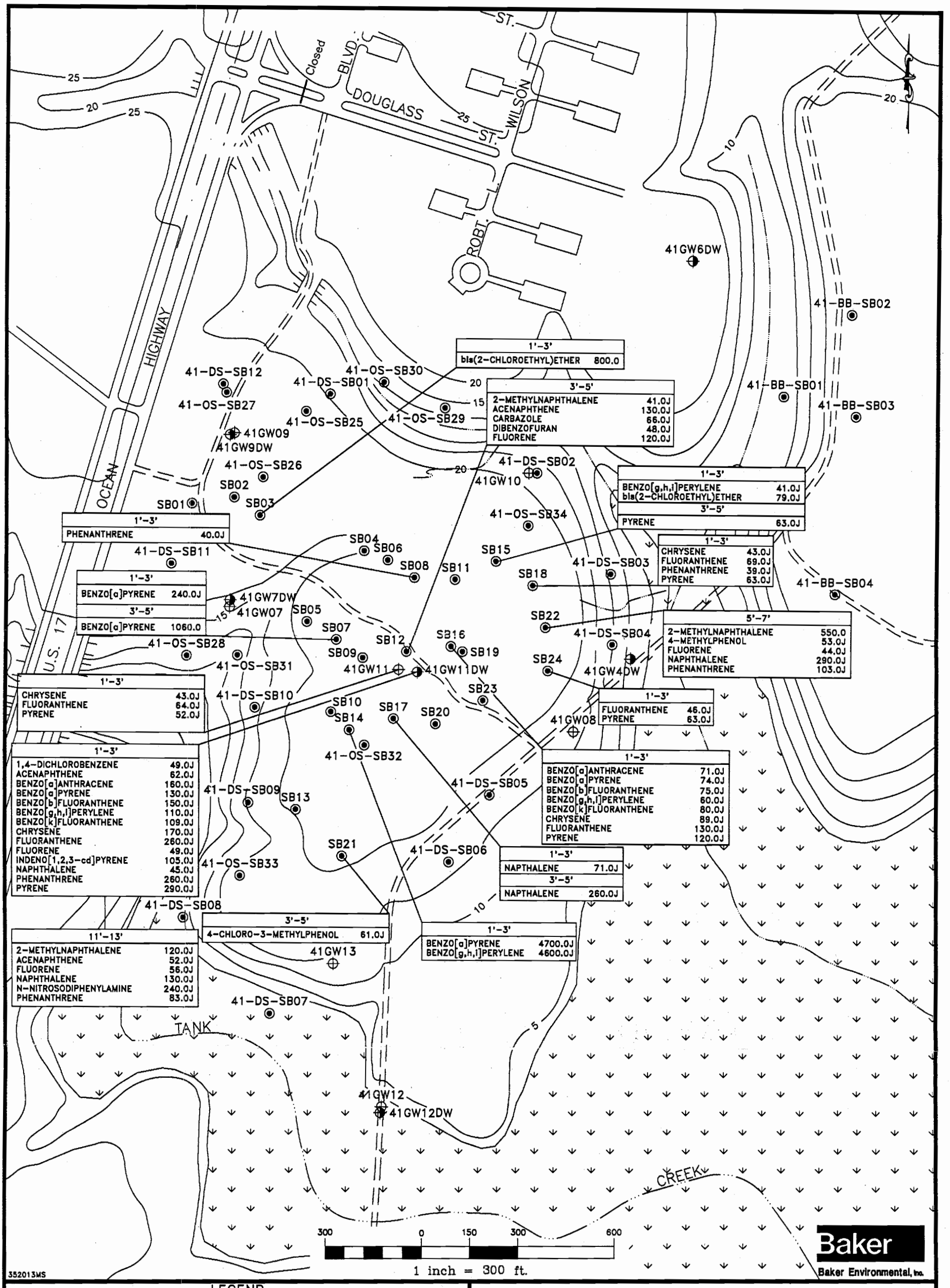
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-12
POSITIVE DETECTIONS OF VOLATILES
IN SUBSURFACE SOILS - SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



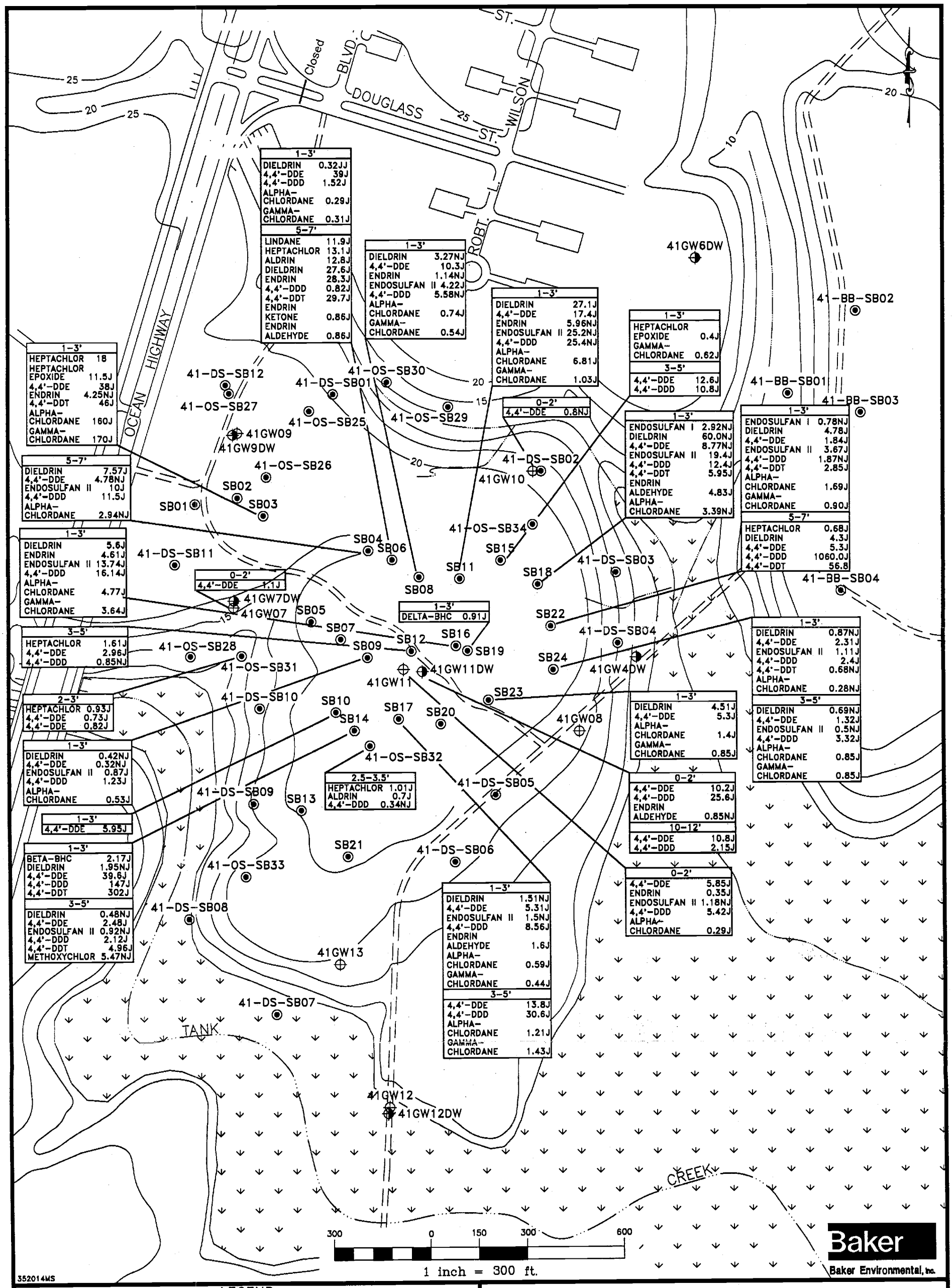
LEGEND

- 41GW07 — SHALLOW MONITORING WELL LOCATION
- 41GW4D — DEEP MONITORING WELL LOCATION
- SB01 — SOIL BORING LOCATION
- MARSH
- 5 — TOPOGRAPHIC ELEVATION LINES
- ROAD (IMPROVED)
- ROAD (UNIMPROVED)
- INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-13
POSITIVE DETECTIONS OF SEMIVOLATILES IN SUBSURFACE SOILS - SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



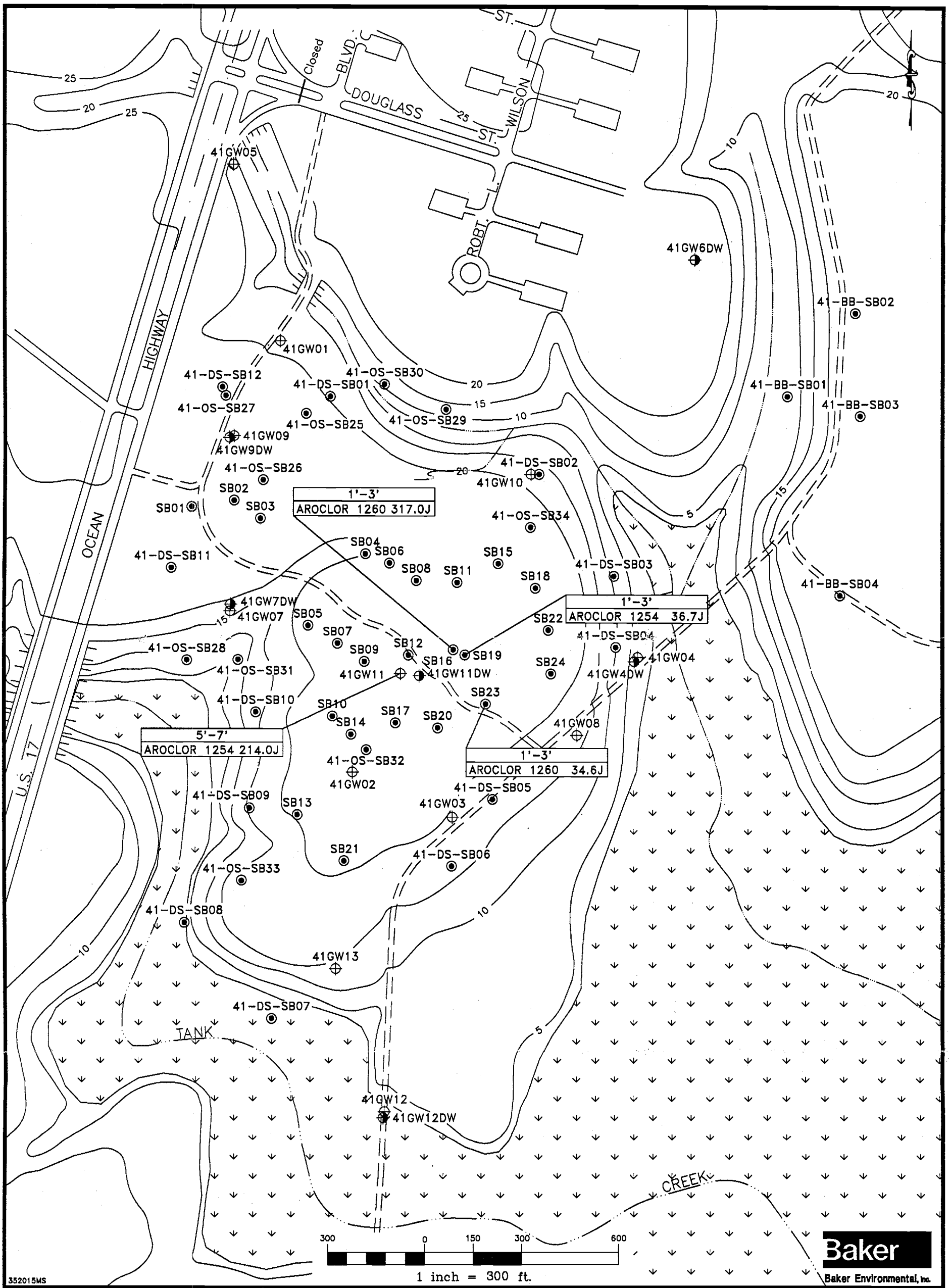
LEGEND

- 41GW07 – SHALLOW MONITORING WELL LOCATION
- 41GW4D – DEEP MONITORING WELL LOCATION
- SB01 – SOIL BORING LOCATION
- MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- ROAD (IMPROVED)
- ROAD (UNIMPROVED)
- INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-14
POSITIVE DETECTIONS OF PESTICIDES IN SUBSURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



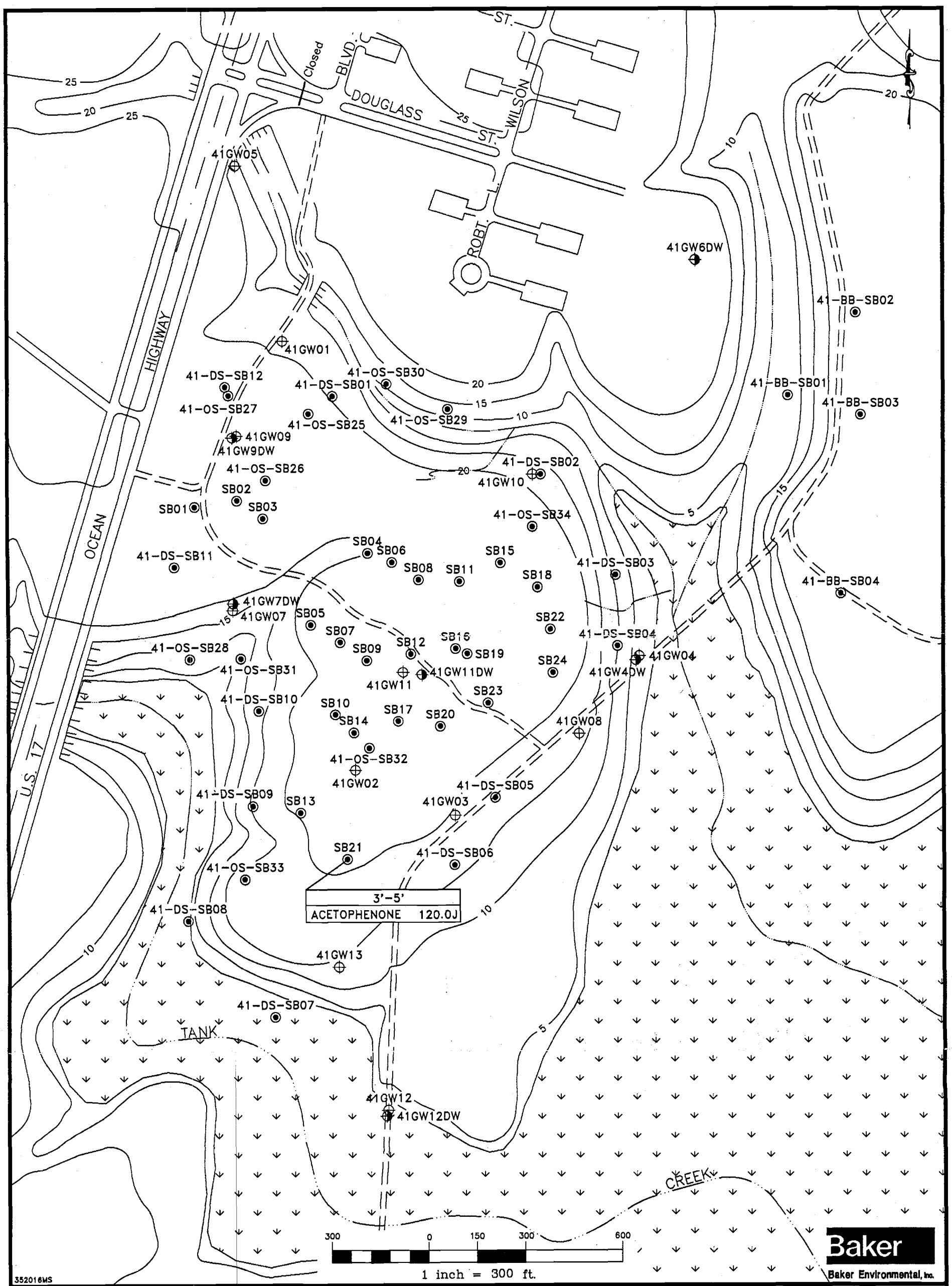
LEGEND

- 41GW07 – SHALLOW MONITORING WELL LOCATION
- 41GW4D – DEEP MONITORING WELL LOCATION
- SB01 – SOIL BORING LOCATION
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-15
POSITIVE DETECTIONS OF PCBs IN SUBSURFACE SOILS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41GW07 – SHALLOW MONITORING WELL LOCATION

41GW4D – DEEP MONITORING WELL LOCATION

SB01 – SOIL BORING LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

– ROAD (UNIMPROVED)

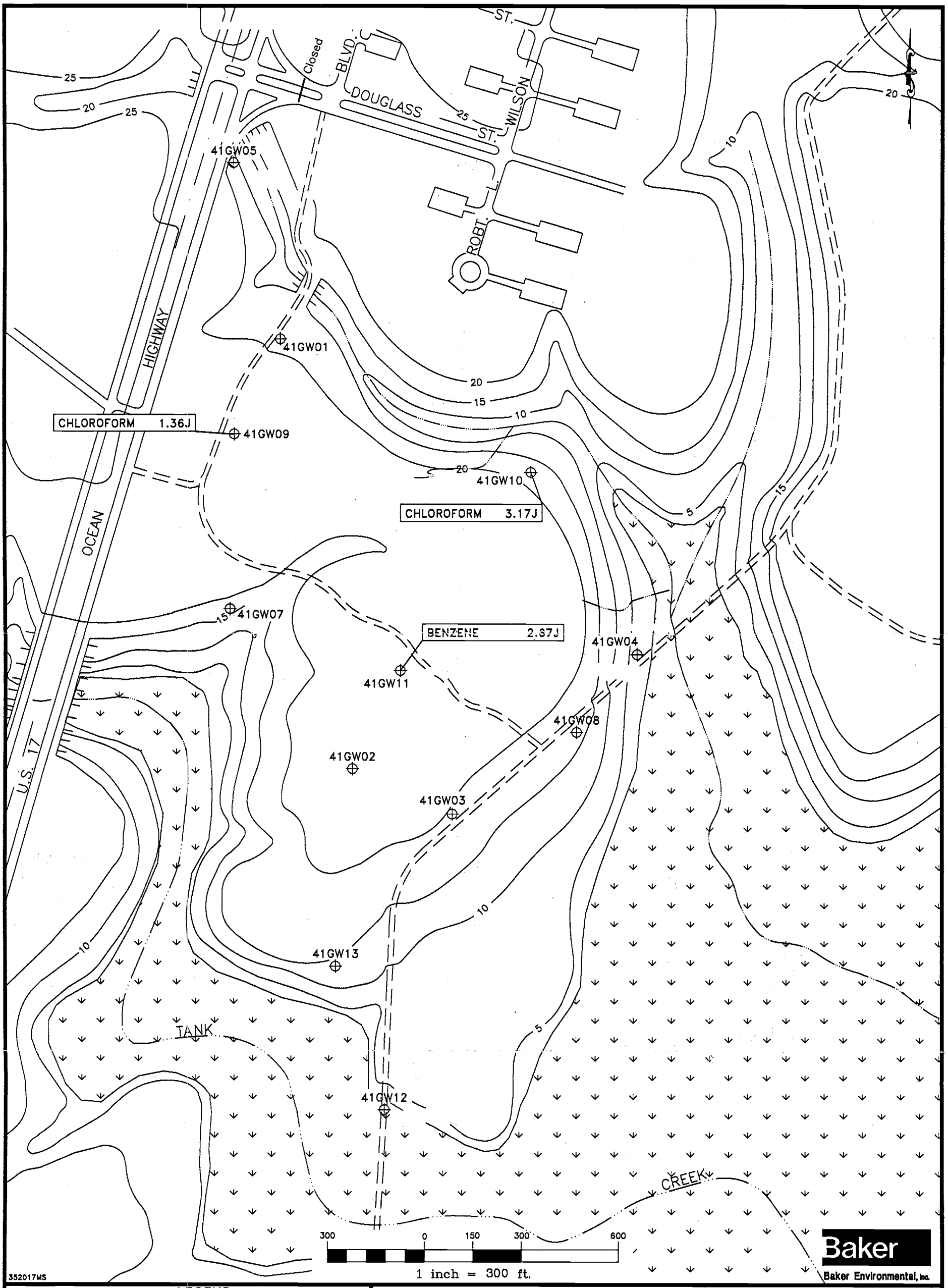
– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: LANTDIV, OCT. 1991

FIGURE 1–16
POSITIVE DETECTIONS OF CHEMICAL SURETY MATERIALS IN SUBSURFACE SOILS – SITE 41 CAMP GEIGER DUMP NEAR FORMER TRAILER PARK BASELINE LONG–TERM MONITORING STUDY CTO–0352

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

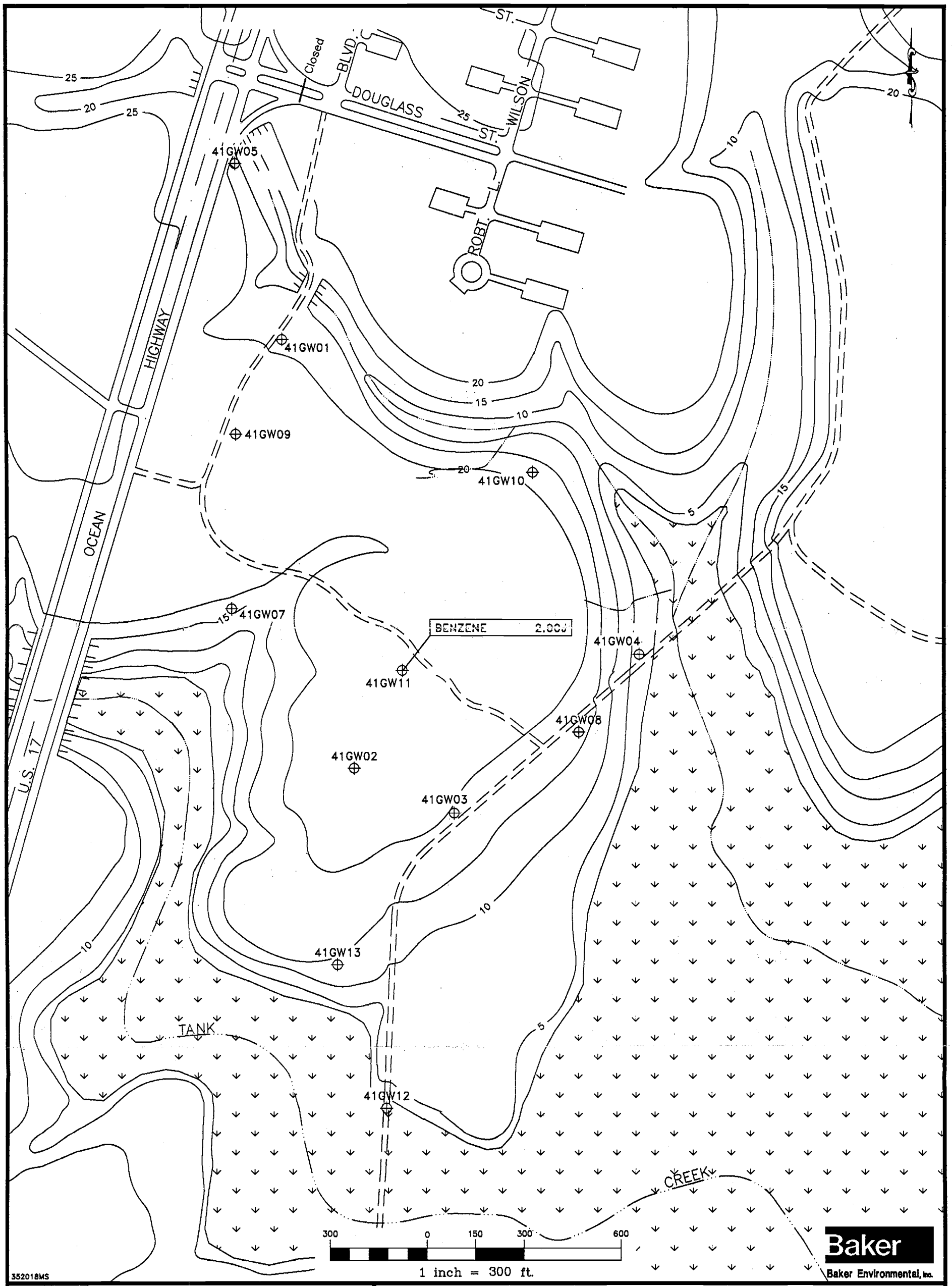


LEGEND

41GW01 – SHALLOW MONITORING WELL
– MARSH
5 – TOPOGRAPHIC ELEVATION LINES
– ROAD (IMPROVED)
– ROAD (UNIMPROVED)
– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1–17
POSITIVE DETECTIONS OF VOLATILES FOR ROUND 1 ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS
SITE 41 – CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG–TERM MONITORING STUDY
CTO–0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

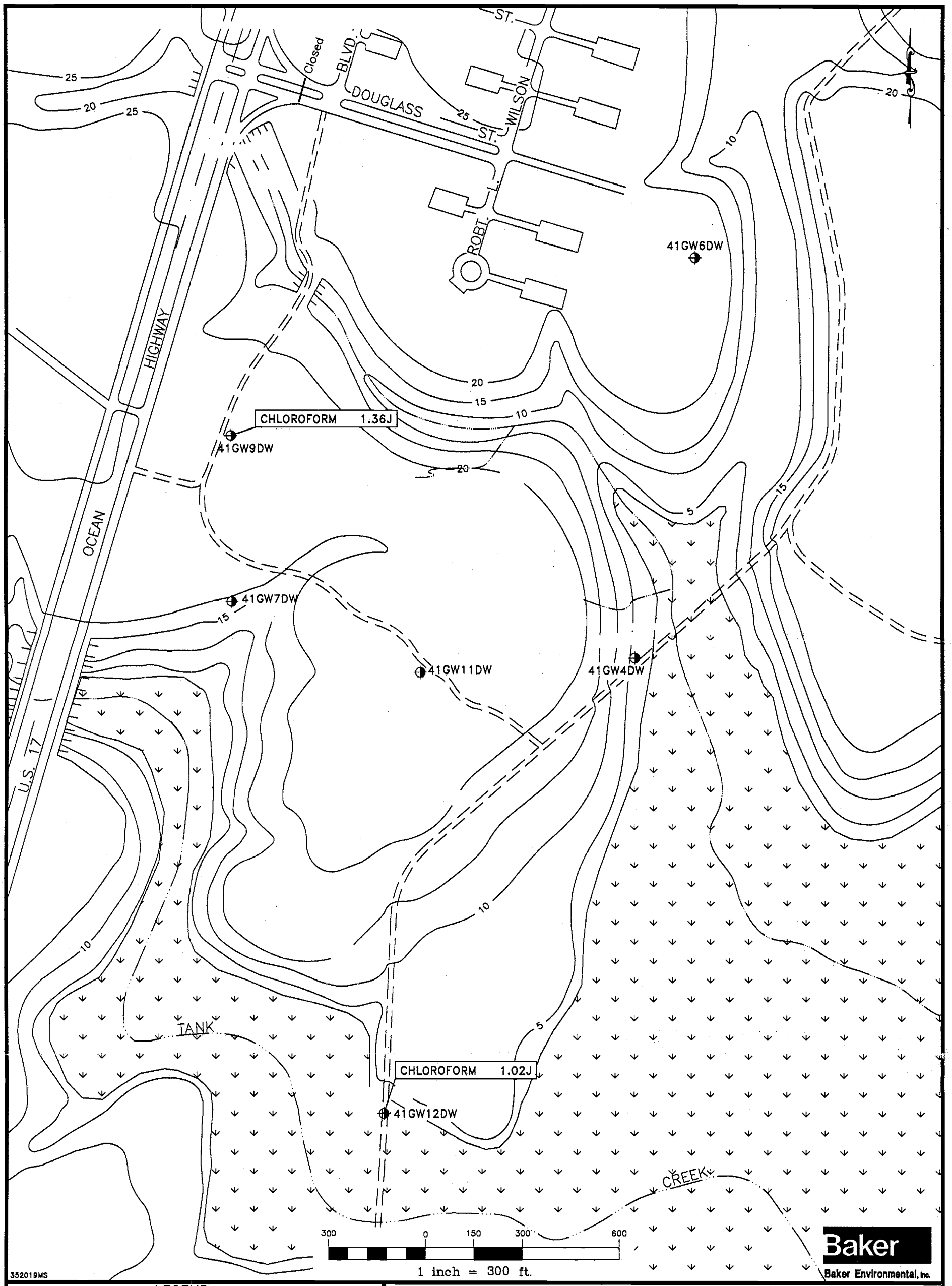


LEGEND

41GW01 – SHALLOW MONITORING WELL
– MARSH
5 – TOPOGRAPHIC ELEVATION LINES
– ROAD (IMPROVED)
– ROAD (UNIMPROVED)
– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1–18
POSITIVE DETECTIONS OF VOLATILES FOR ROUND 2 ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS
SITE 41 – CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG–TERM MONITORING STUDY
CTO–0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

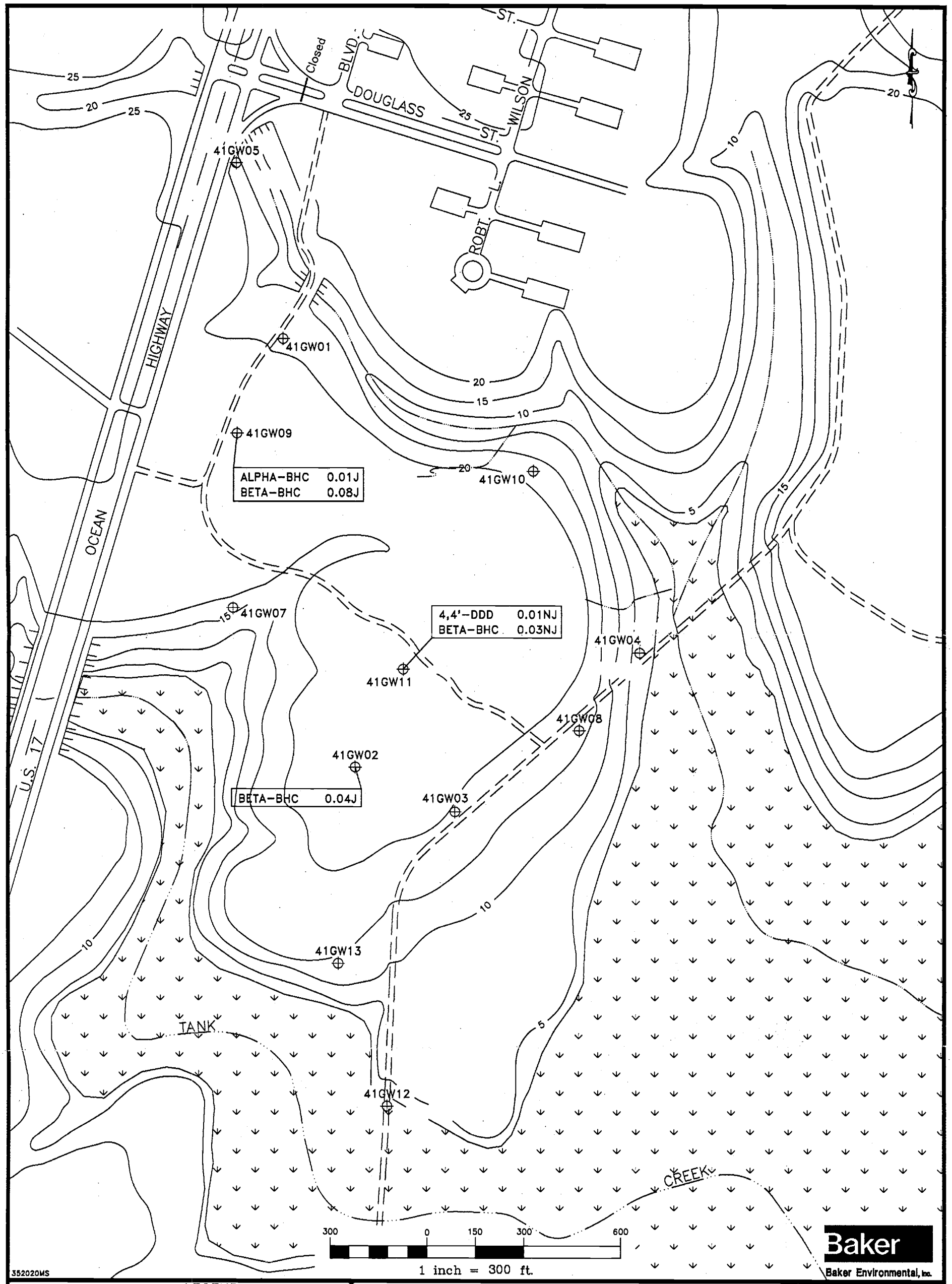


LEGEND

41GW4D – EXISTING DEEP MONITORING WELL
– MARSH
5 – TOPOGRAPHIC ELEVATION LINES
– ROAD (IMPROVED)
– ROAD (UNIMPROVED)
– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-19
POSITIVE DETECTIONS OF VOLATILES FOR ROUND 1 ABOVE FEDERAL MCLs AND/OR NCWQS IN DEEP WELLS - SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

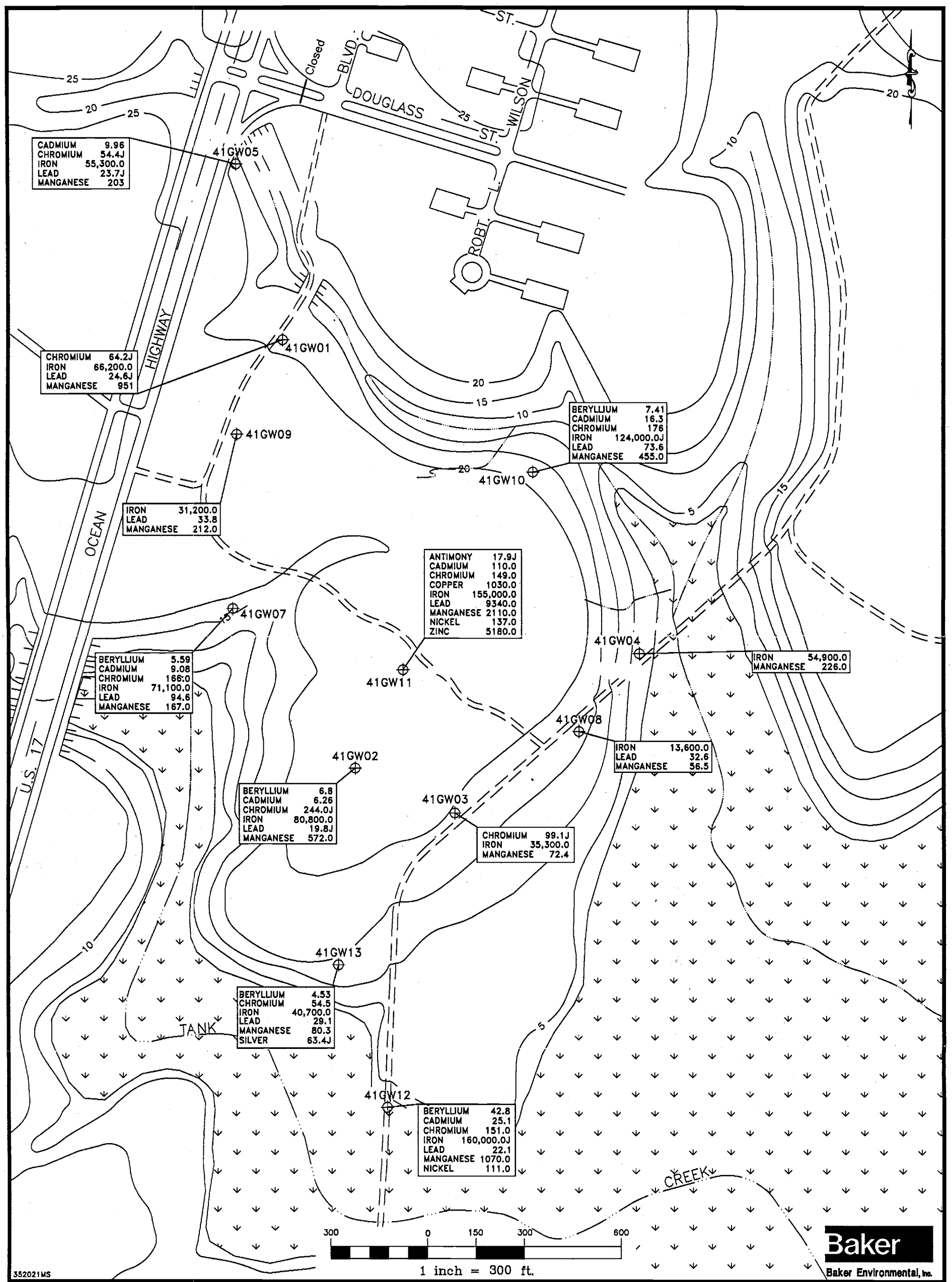


LEGEND

41GW01 – SHALLOW MONITORING WELL
– MARSH
5 – TOPOGRAPHIC ELEVATION LINES
– ROAD (IMPROVED)
– ROAD (UNIMPROVED)
– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-20
POSITIVE DETECTIONS OF PESTICIDES FOR ROUND 1 ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS - SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

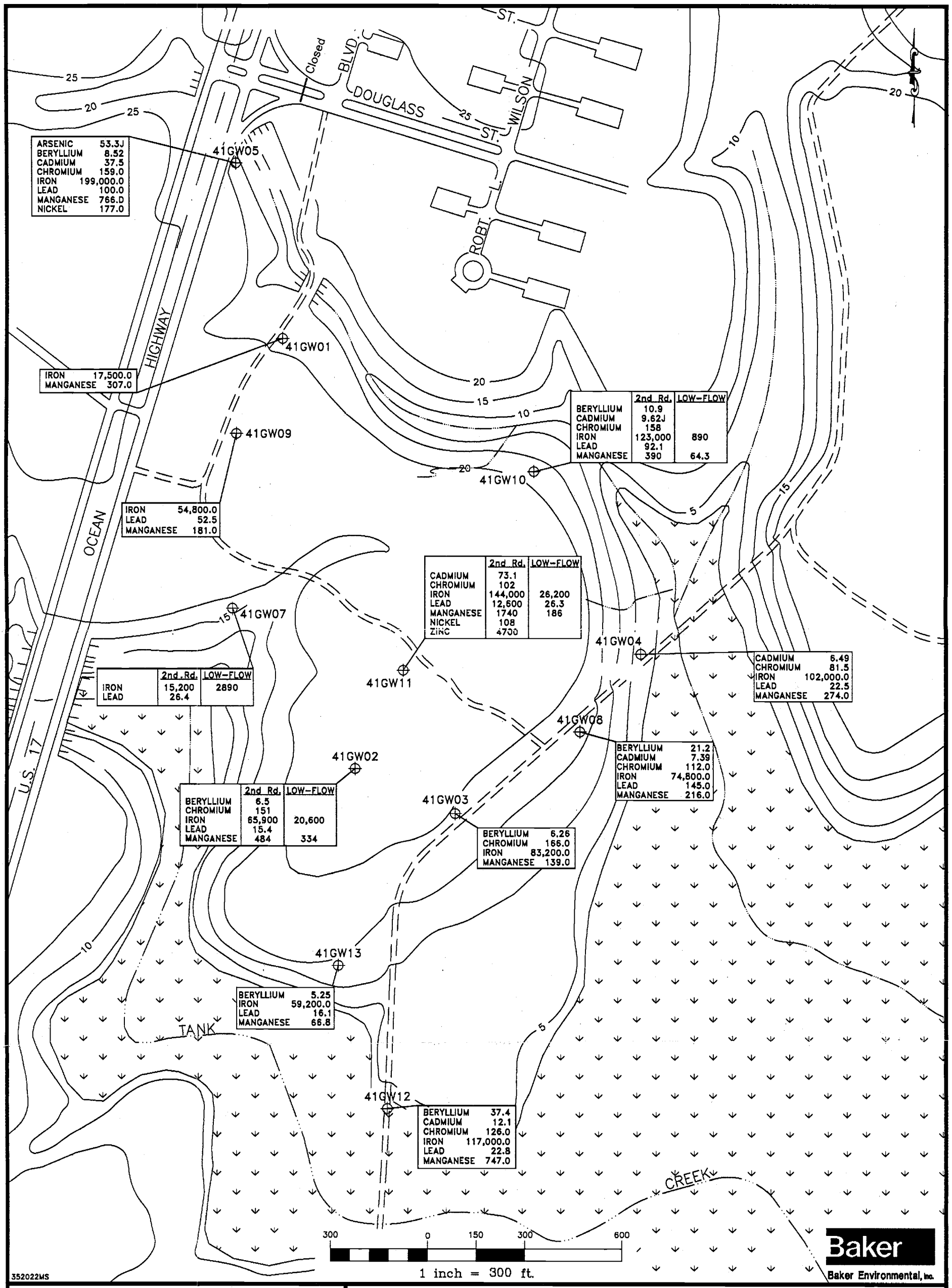


LEGEND

- 41GW01 – SHALLOW MONITORING WELL
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-21
POSITIVE DETECTIONS OF TAL METALS FOR ROUND 1 ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

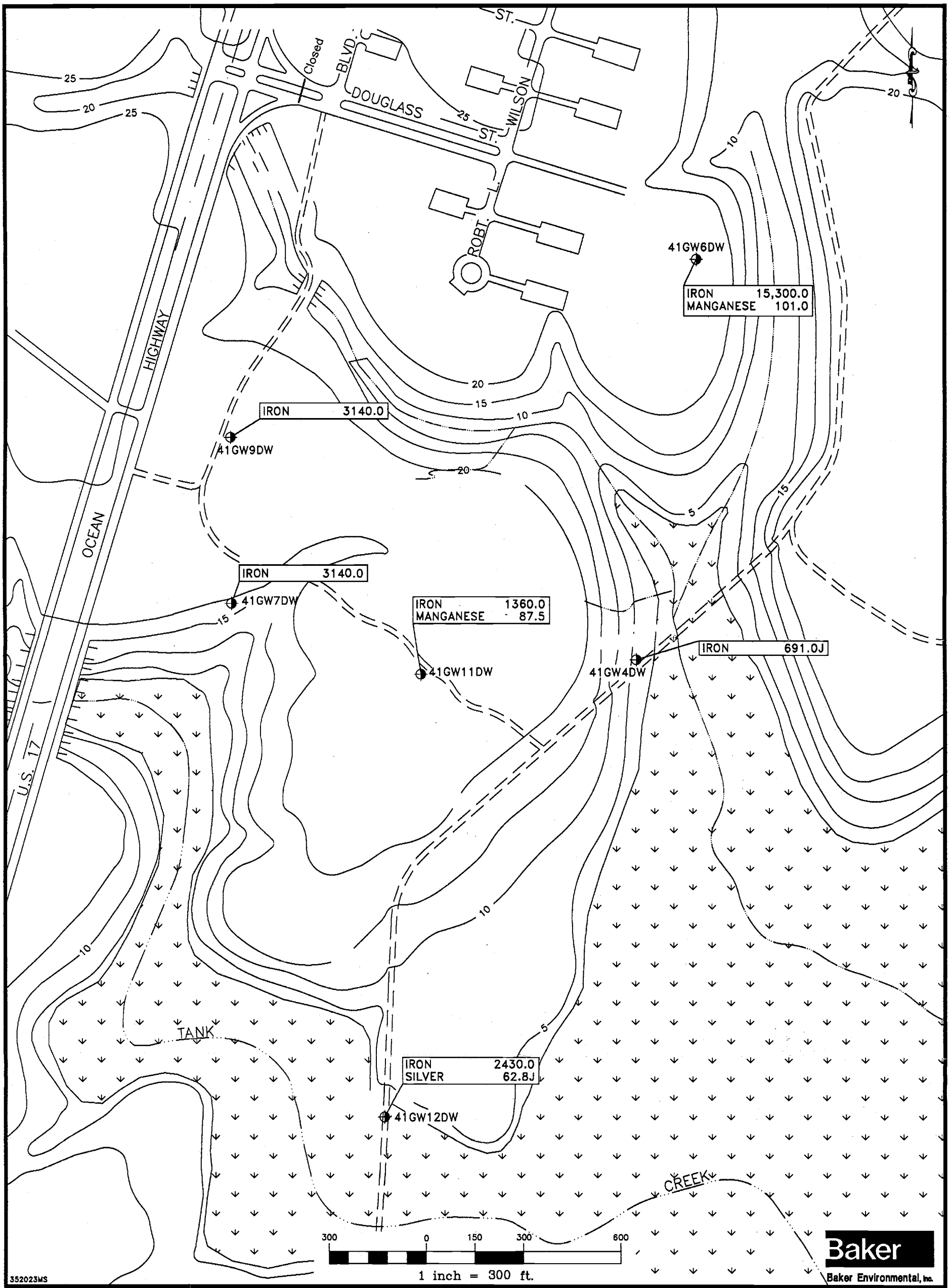


LEGEND

- 41GW01 – SHALLOW MONITORING WELL
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-22
POSITIVE DETECTIONS OF TOTAL METALS FOR ROUND 2 ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

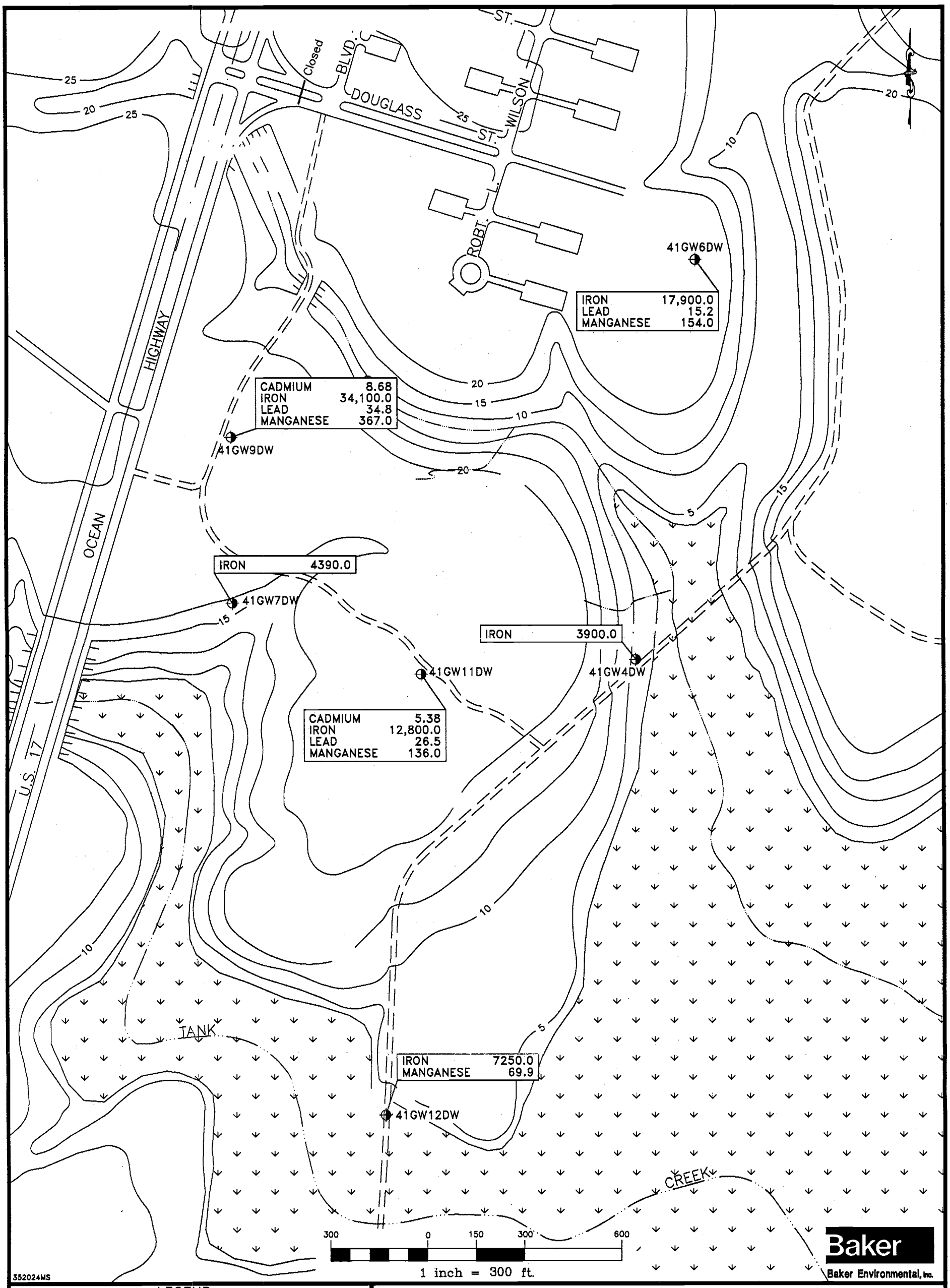


LEGEND

41GW4D – DEEP MONITORING WELL
– MARSH
5 – TOPOGRAPHIC ELEVATION LINES
– ROAD (IMPROVED)
– ROAD (UNIMPROVED)
– INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-23
POSITIVE DETECTIONS OF TAL METALS FOR ROUND 1 ABOVE FEDERAL MCLs AND/OR NCWQS IN DEEP WELLS – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

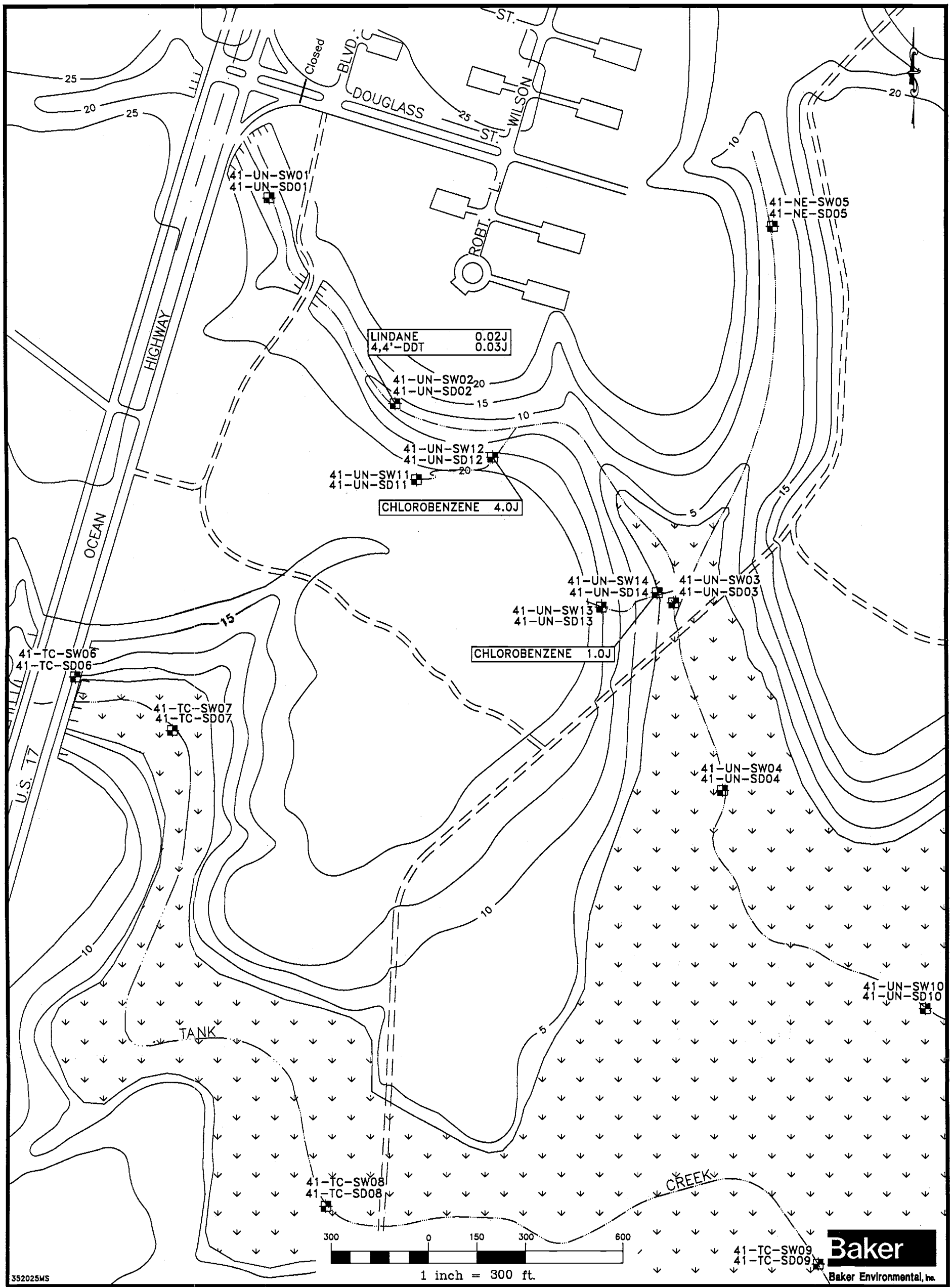


LEGEND

- 41GW4D – EXISTING DEEP MONITORING WELL
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-24
POSITIVE DETECTIONS OF TOTAL METALS FOR ROUND 2 ABOVE FEDERAL MCLs AND/OR NCWQS IN DEEP WELLS
SITE 41 – CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



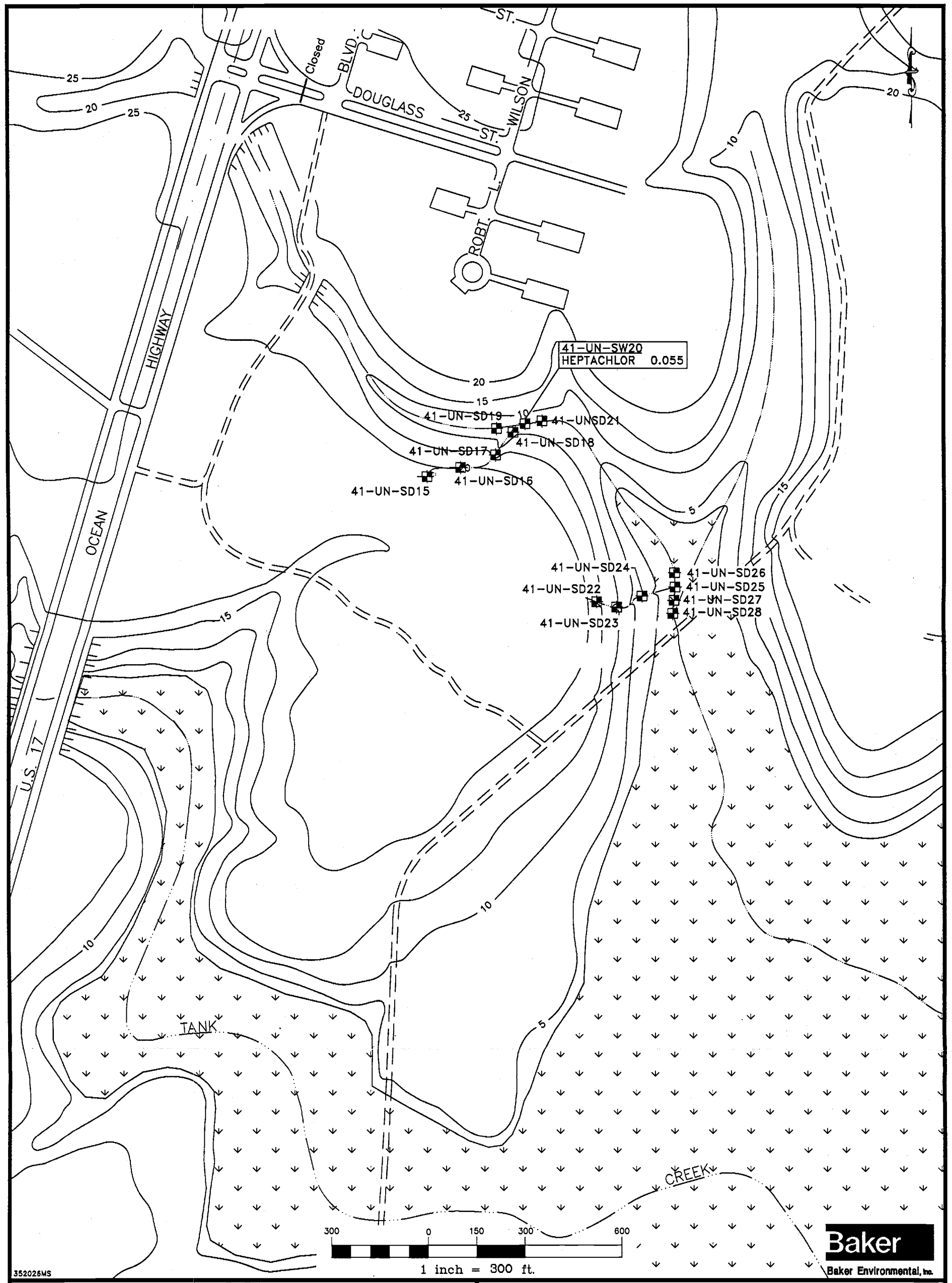
41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

LEGEND

5 – TOPOGRAPHIC ELEVATION LINES
– ROAD (IMPROVED)
– ROAD (UNIMPROVED)
– INTERMITTENT STREAM
– MARSH

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (ug/L).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-25
POSITIVE DETECTIONS OF VOLATILES AND PESTICIDES IN SURFACE WATER – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SD15 – SURFACE WATER/SEDIMENT SAMPLE LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

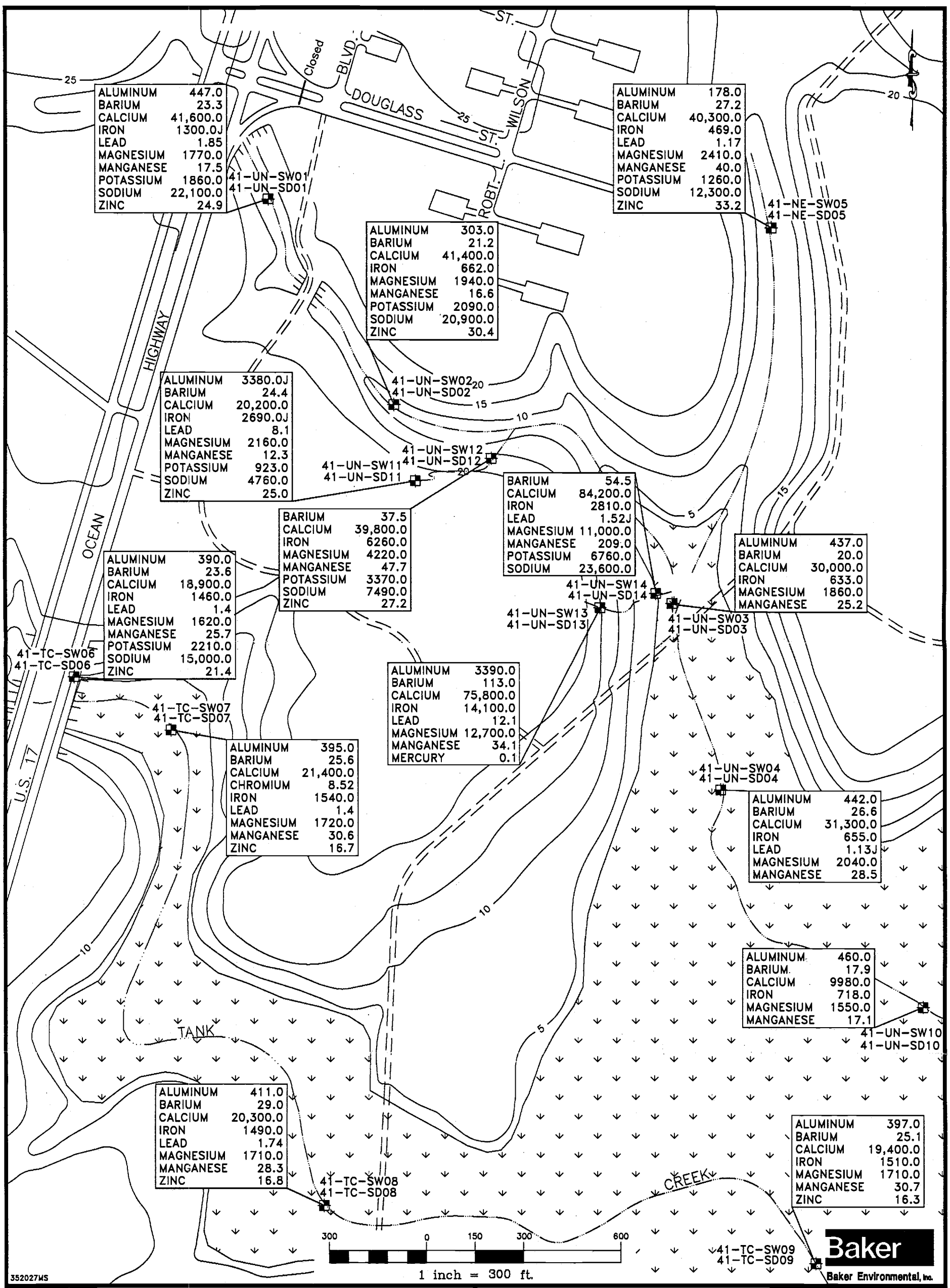
– ROAD (IMPROVED)

– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-26
POSITIVE DETECTIONS OF PESTICIDES FOR SECOND SAMPLING EVENT IN SURFACE WATER – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

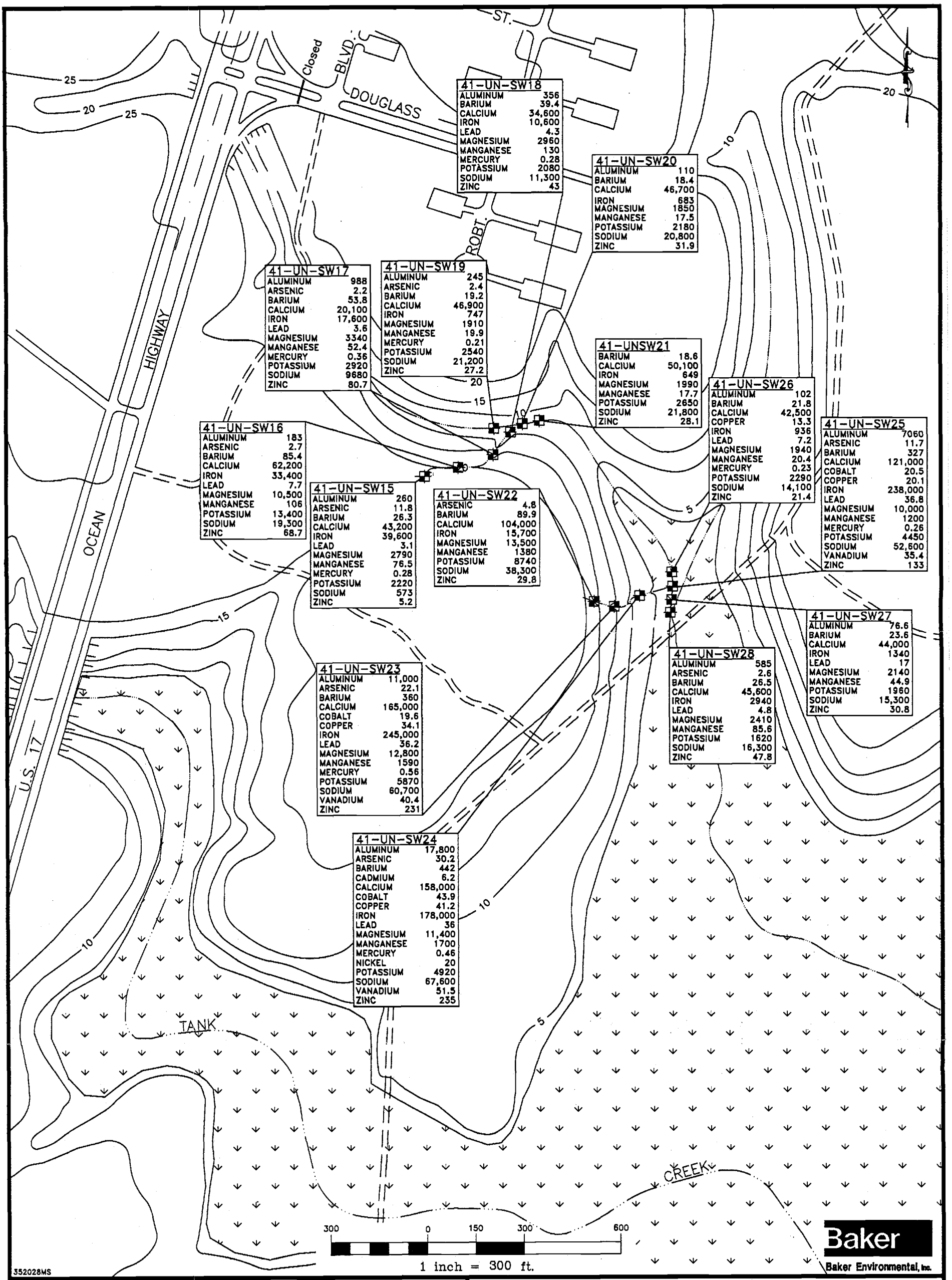
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

– MARSH

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-27
POSITIVE DETECTIONS OF TAL METALS
IN SURFACE WATER – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW15 – SURFACE WATER/SEDIMENT SAMPLE LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

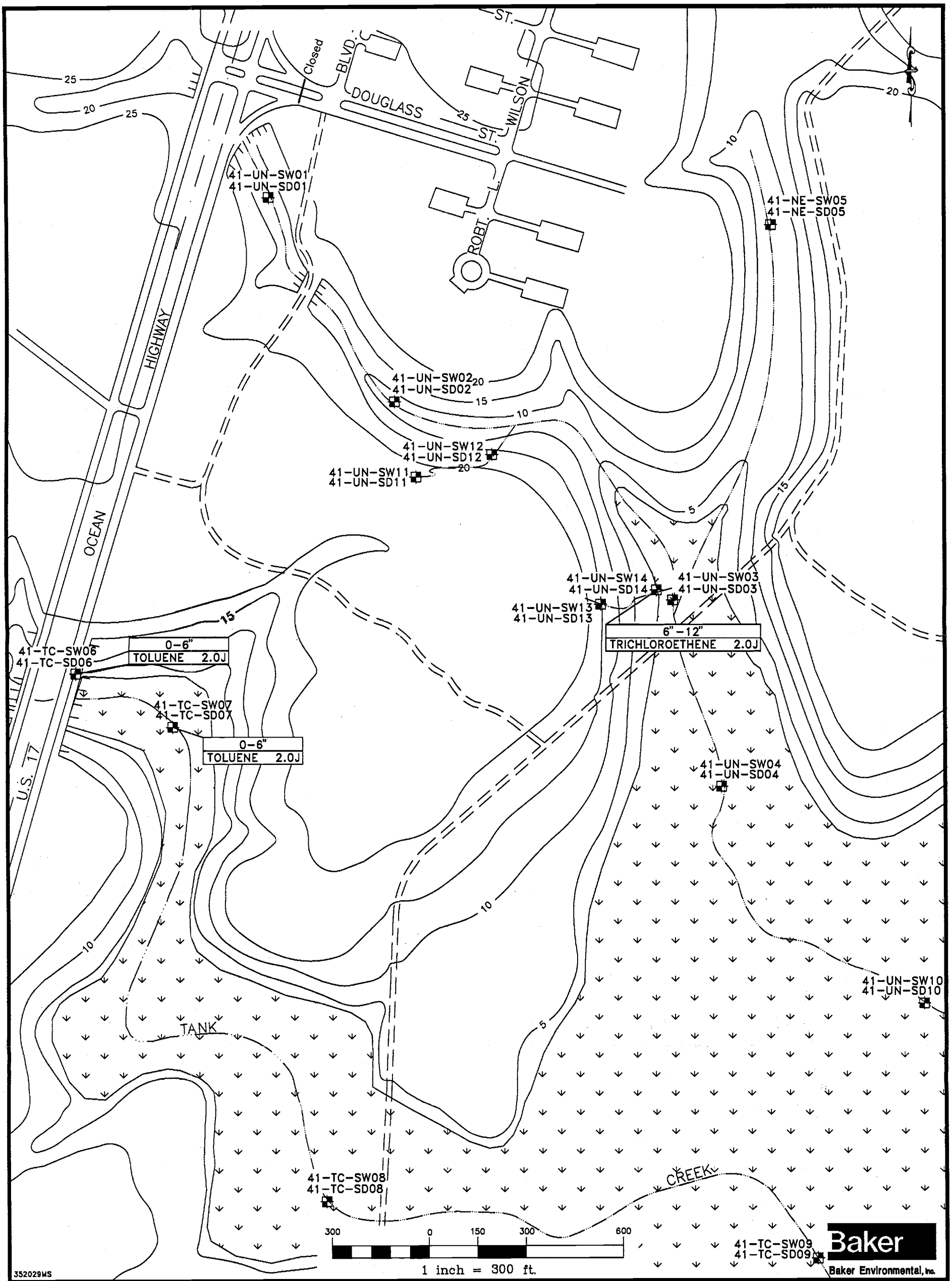
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-28
POSITIVE DETECTIONS OF TAL METALS FOR SECOND SAMPLING EVENT IN SURFACE WATER – SITE 41 CAMP GEIGER DUMP NEAR FORMER TRAILER PARK BASELINE LONG-TERM MONITORING STUDY CTO-0352

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

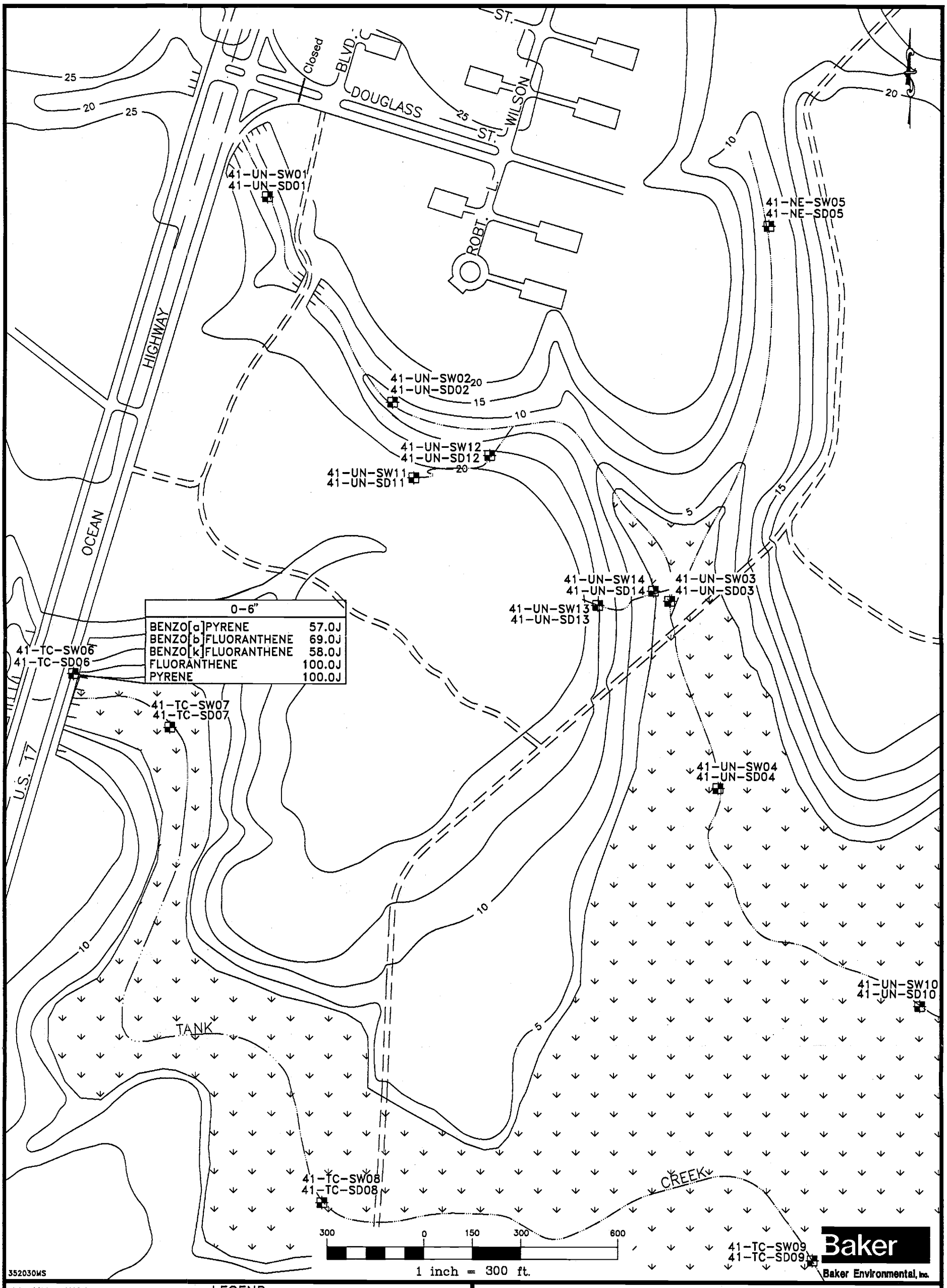
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

– MARSH

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-29
POSITIVE DETECTIONS OF VOLATILES
IN SEDIMENT – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

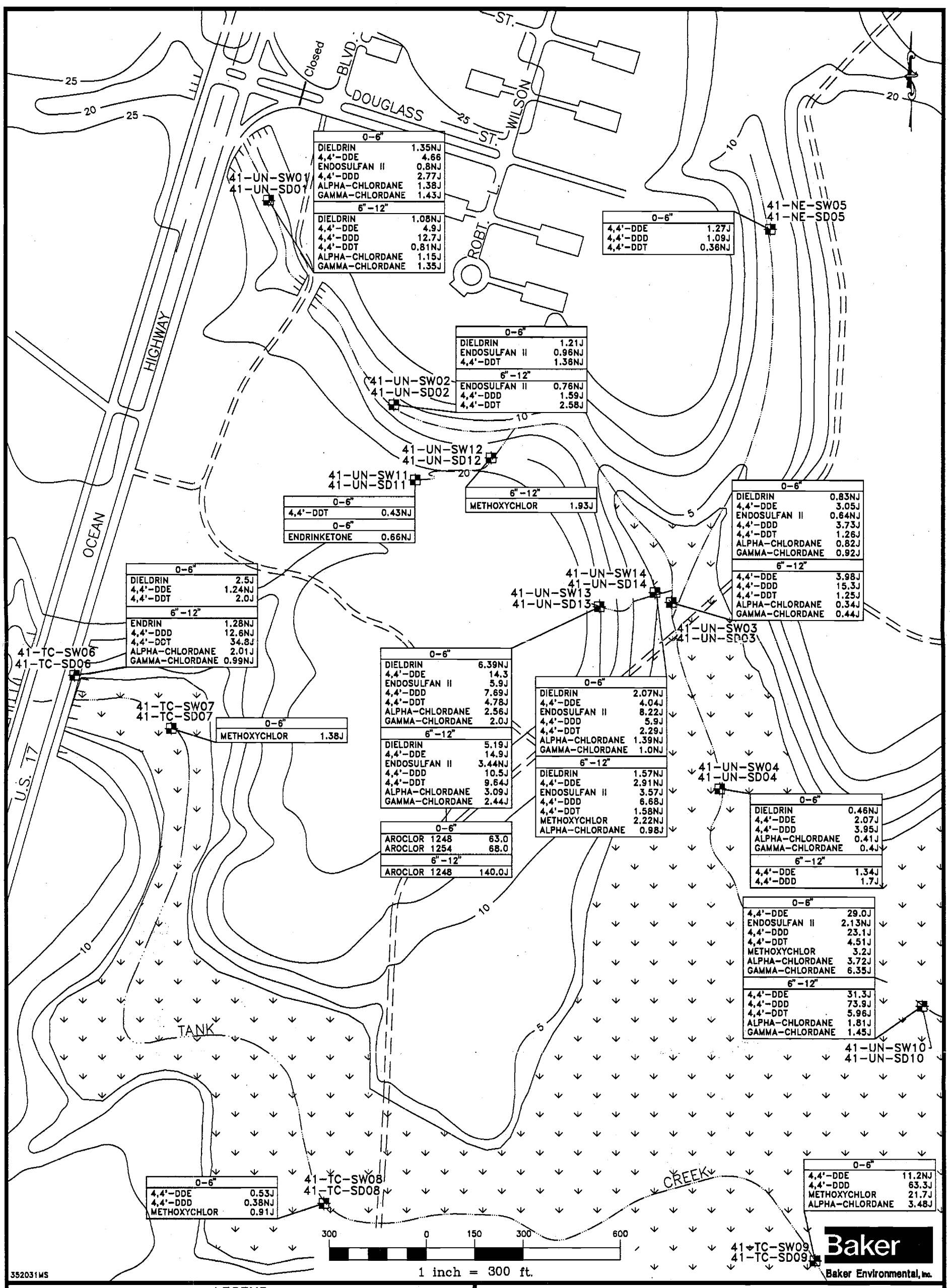
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

– MARSH

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-30
POSITIVE DETECTIONS OF SEMIVOLATILES
IN SEDIMENT – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

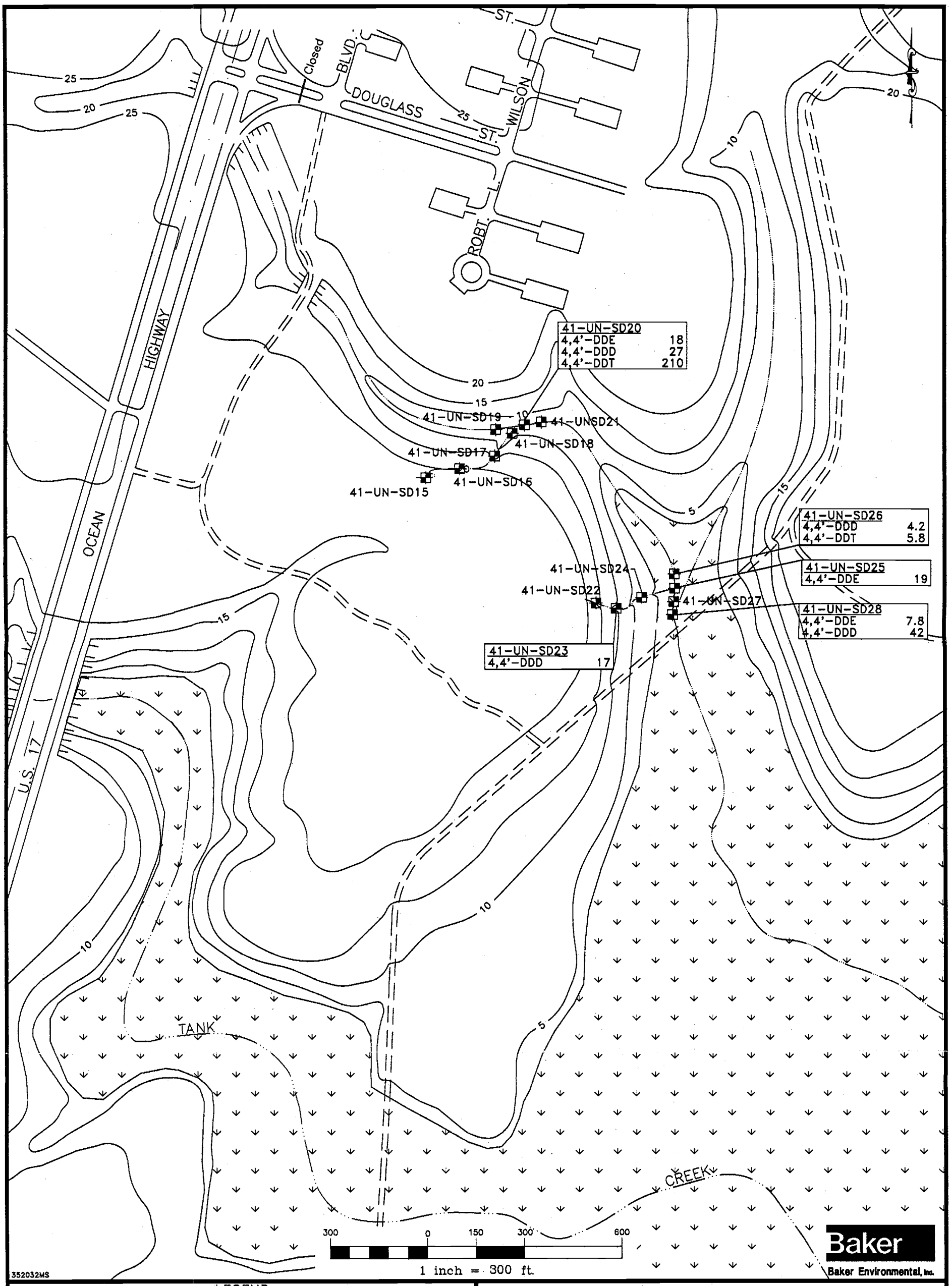
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

– MARSH

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-31
POSITIVE DETECTIONS OF PESTICIDES/ PCBs IN SEDIMENT - SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SD15 – SURFACE WATER/SEDIMENT SAMPLE LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

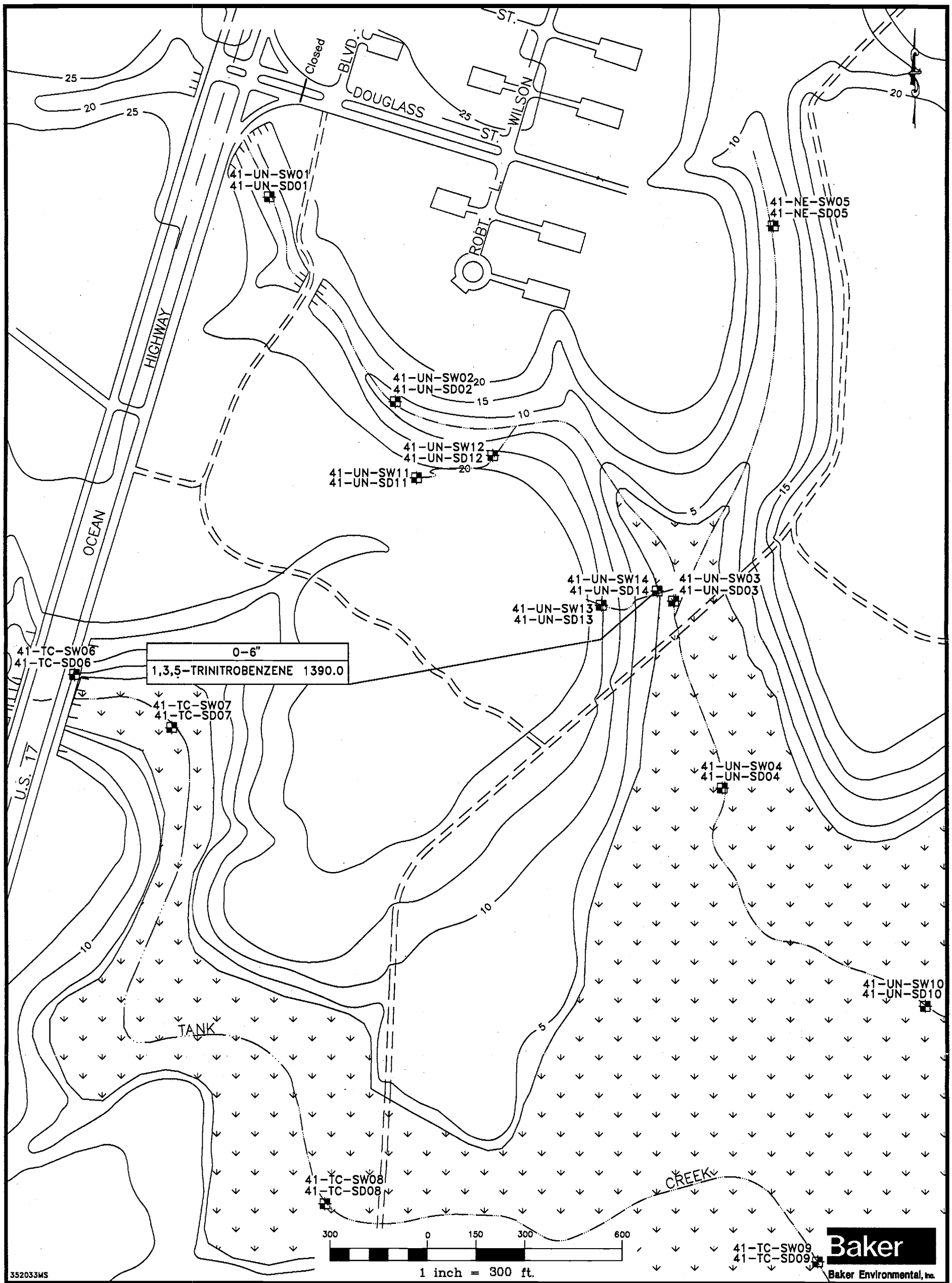
– ROAD (IMPROVED)

– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-32
POSITIVE DETECTIONS OF PESTICIDES FOR SECOND SAMPLING EVENT IN SEDIMENT – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

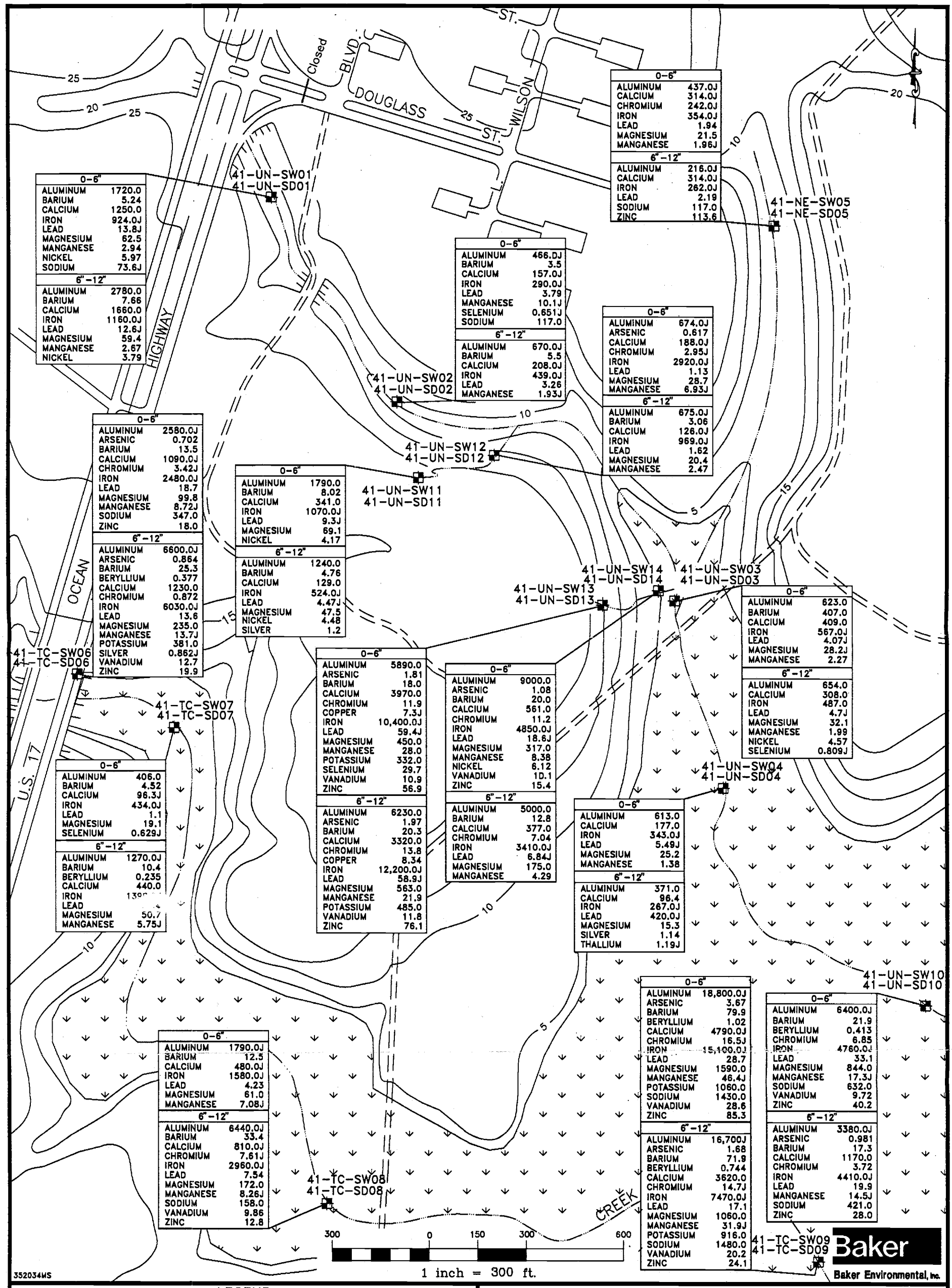
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

– MARSH

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-33
POSITIVE DETECTIONS OF ORDANCE
IN SEDIMENT - SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SW01
41-UN-SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

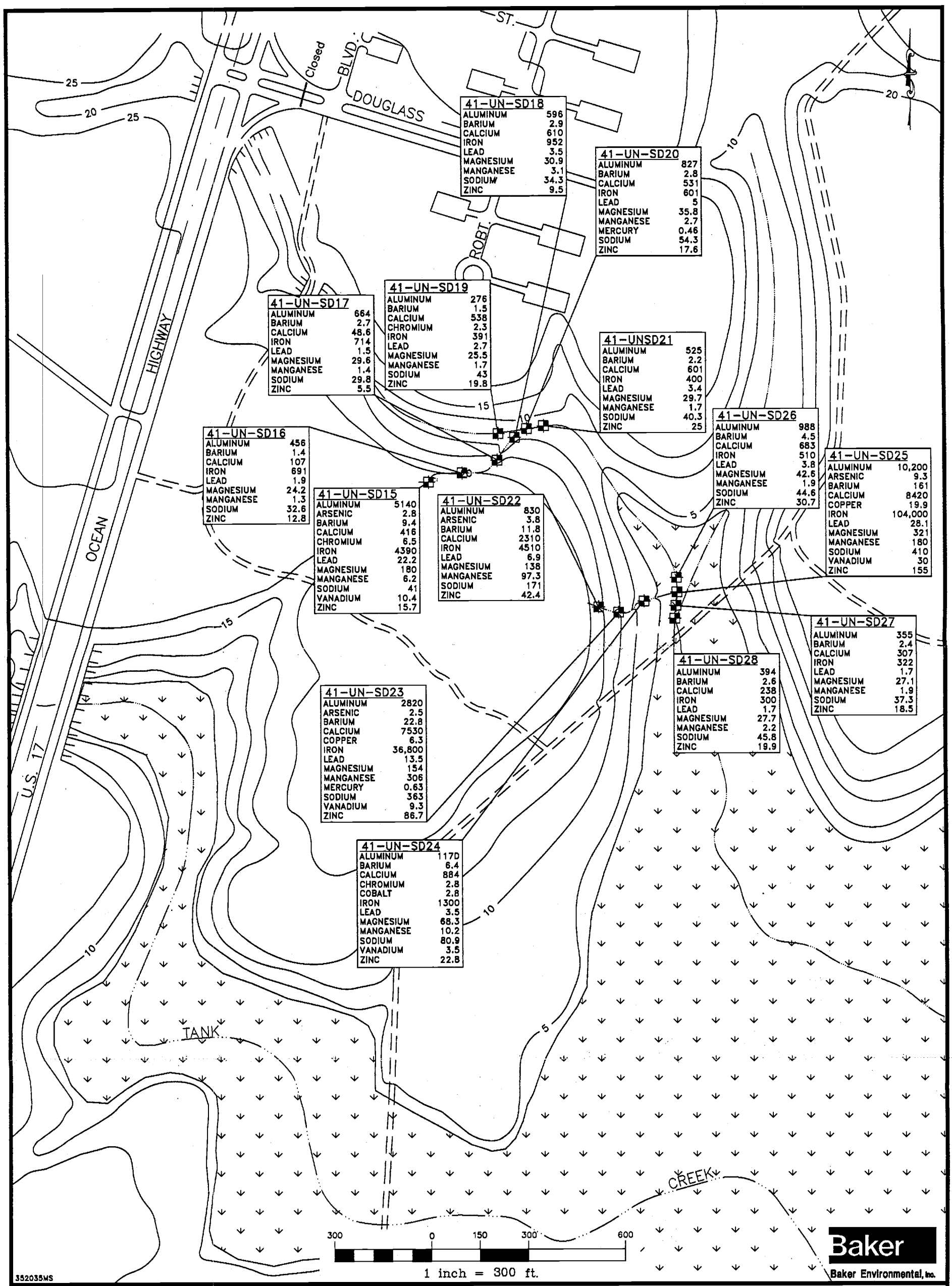
— 5 — – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED) = = – ROAD (UNIMPROVED)

– INTERMITTENT STREAM ⌄ ⌄ – MARSH

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, OCT. 1991

FIGURE 1-34
POSITIVE DETECTIONS OF TAL METALS IN SEDIMENT – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

41-UN-SD15 – SEDIMENT SAMPLE LOCATION

– MARSH

5 – TOPOGRAPHIC ELEVATION LINES

– ROAD (IMPROVED)

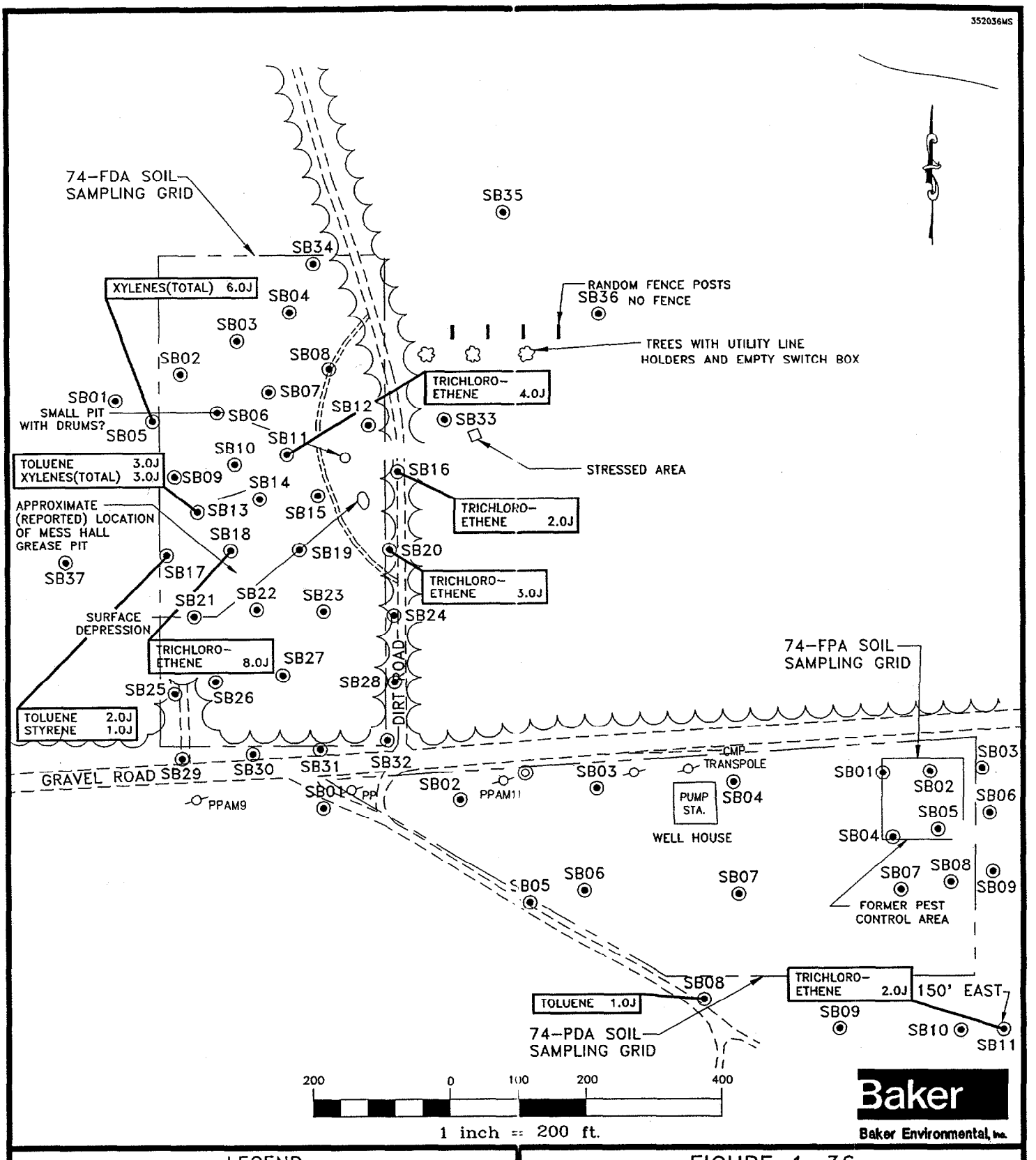
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-35
POSITIVE DETECTIONS OF TAL METALS FOR SECOND SAMPLING EVENT IN SEDIMENT – SITE 41
CAMP GEIGER DUMP NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

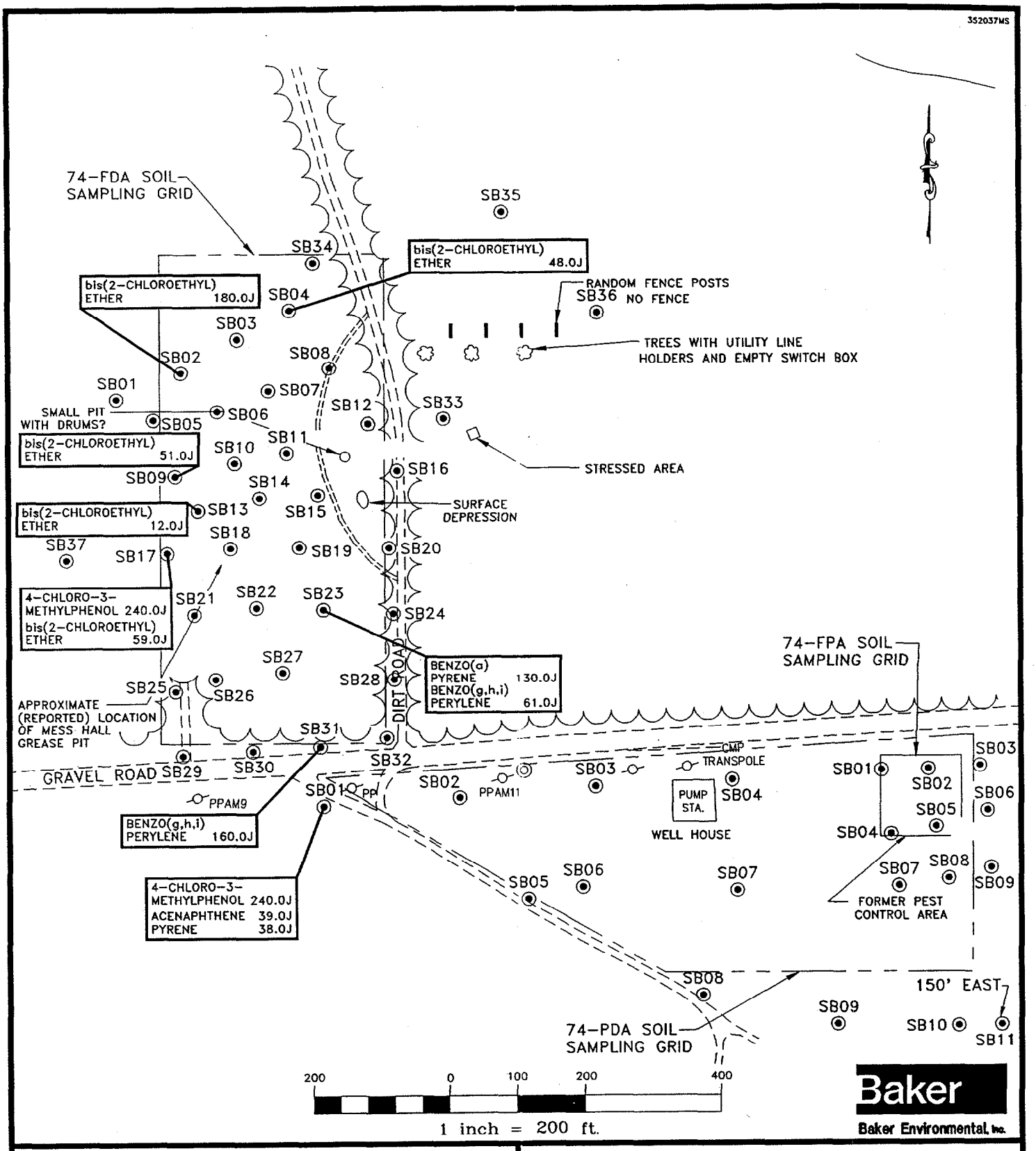


LEGEND

SB01 SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-36
POSITIVE DETECTIONS OF VOLATILES IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA



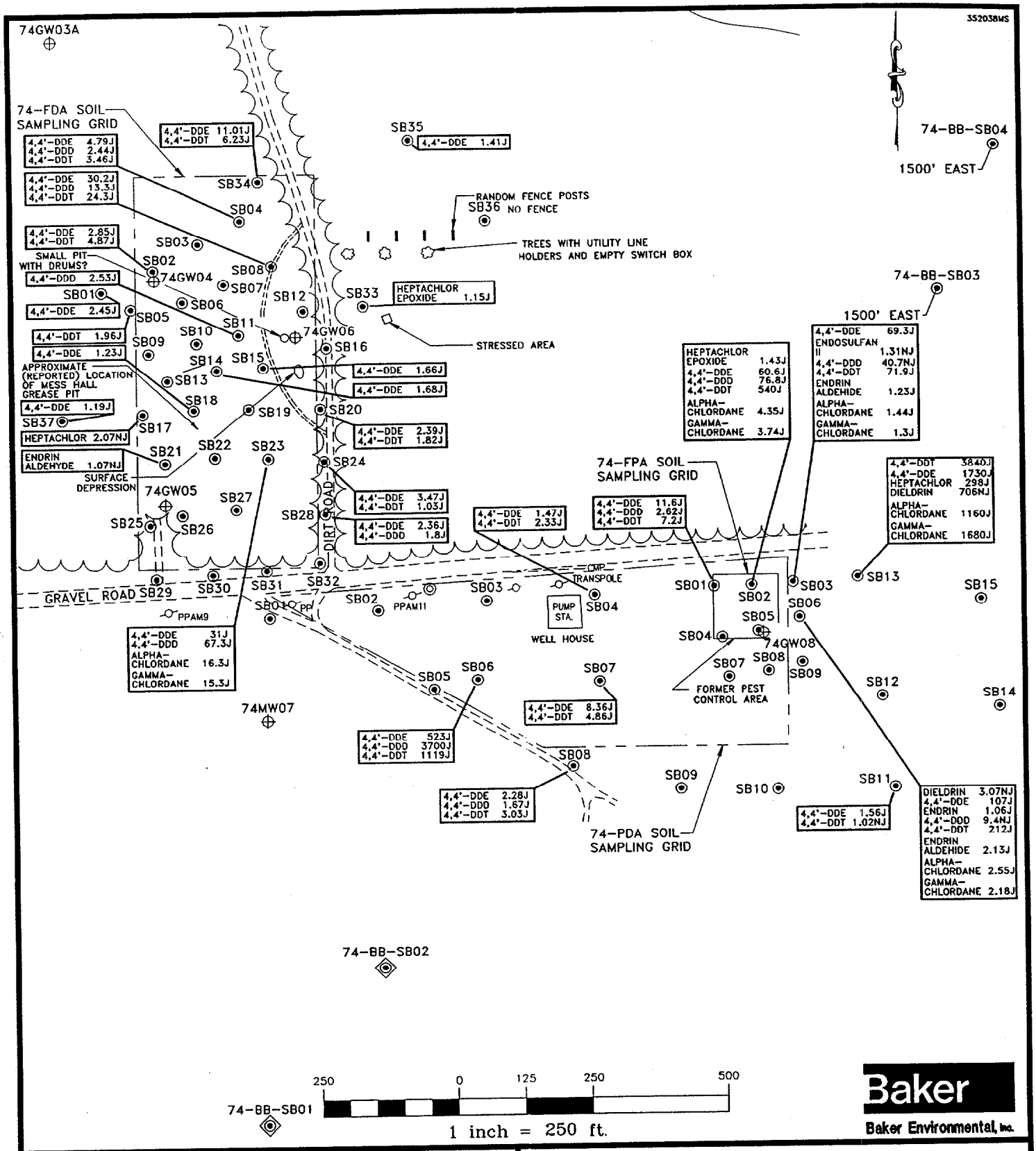
LEGEND

SB01 SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-37
POSITIVE DETECTIONS OF SEMIVOLATILES IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING
STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

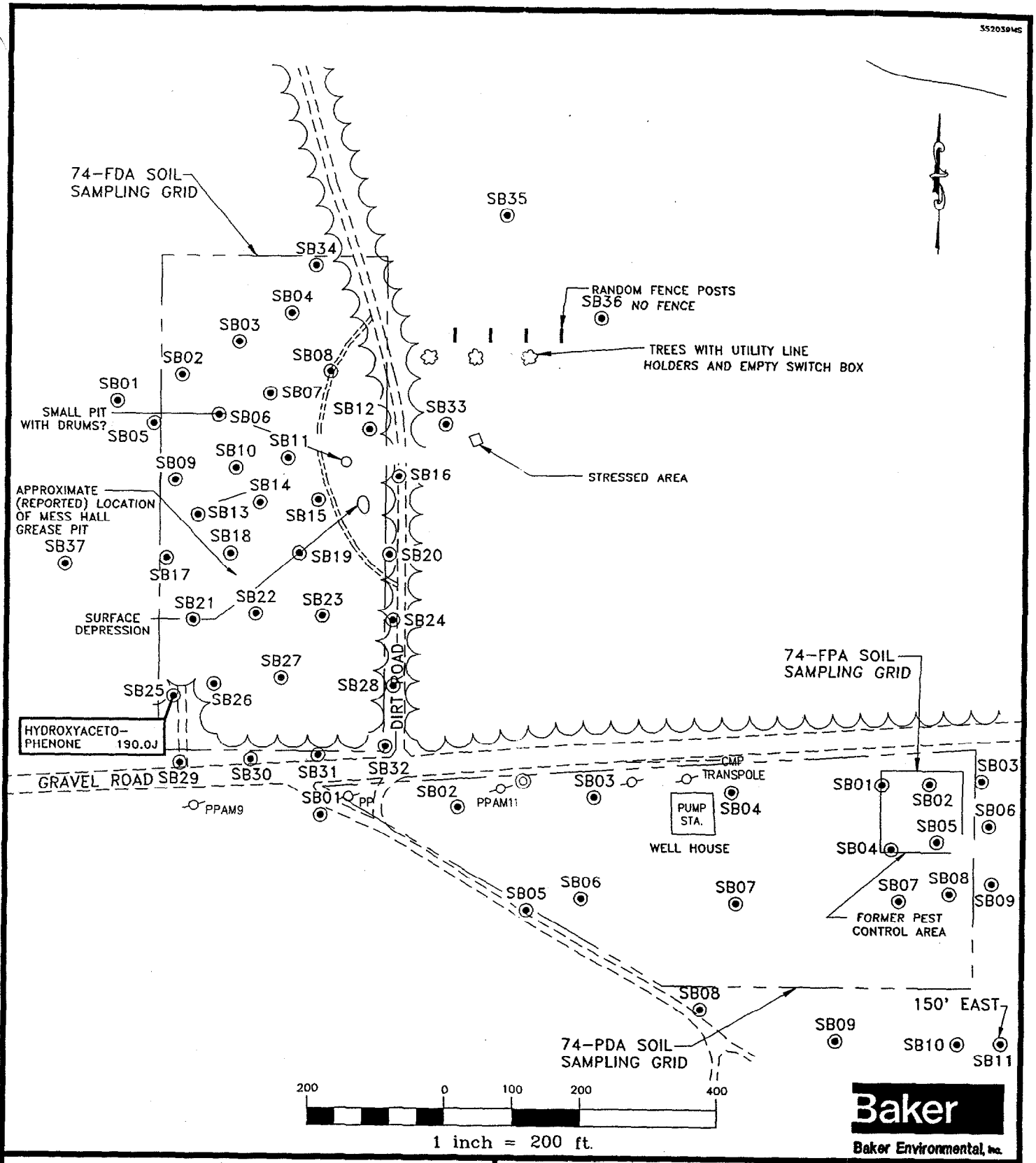


LEGEND

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

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-38
POSITIVE DETECTIONS OF PESTICIDES ABOVE 1 ug/kg IN SURFACE SOILS - SITE 74 MESS HALL GREASE PIT DISPOSAL AREA BASELINE LONG-TERM MONITORING STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

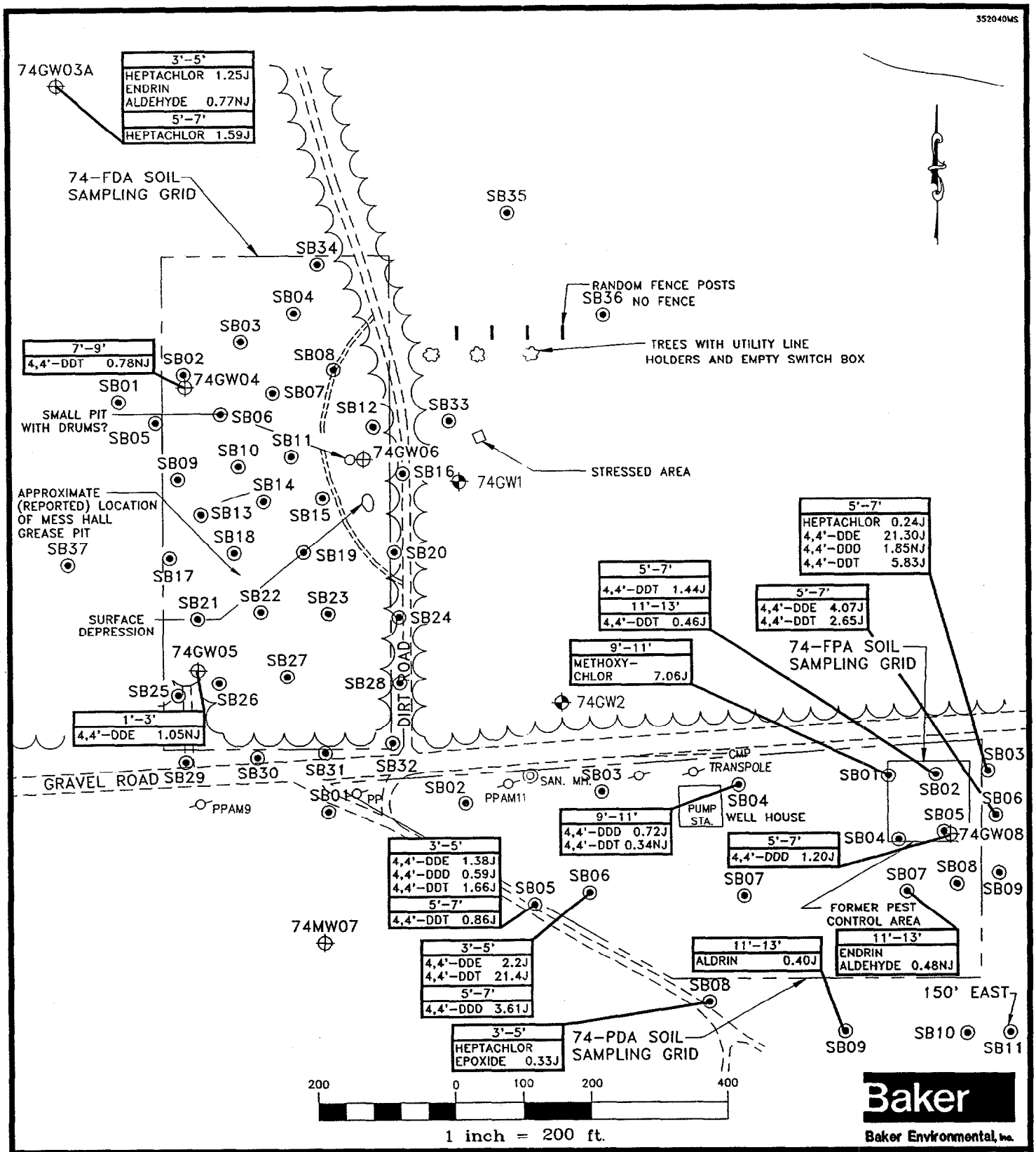
SB01 ◉ SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-39

POSITIVE DETECTIONS OF CHEMICAL SURETY MATERIALS IN SURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

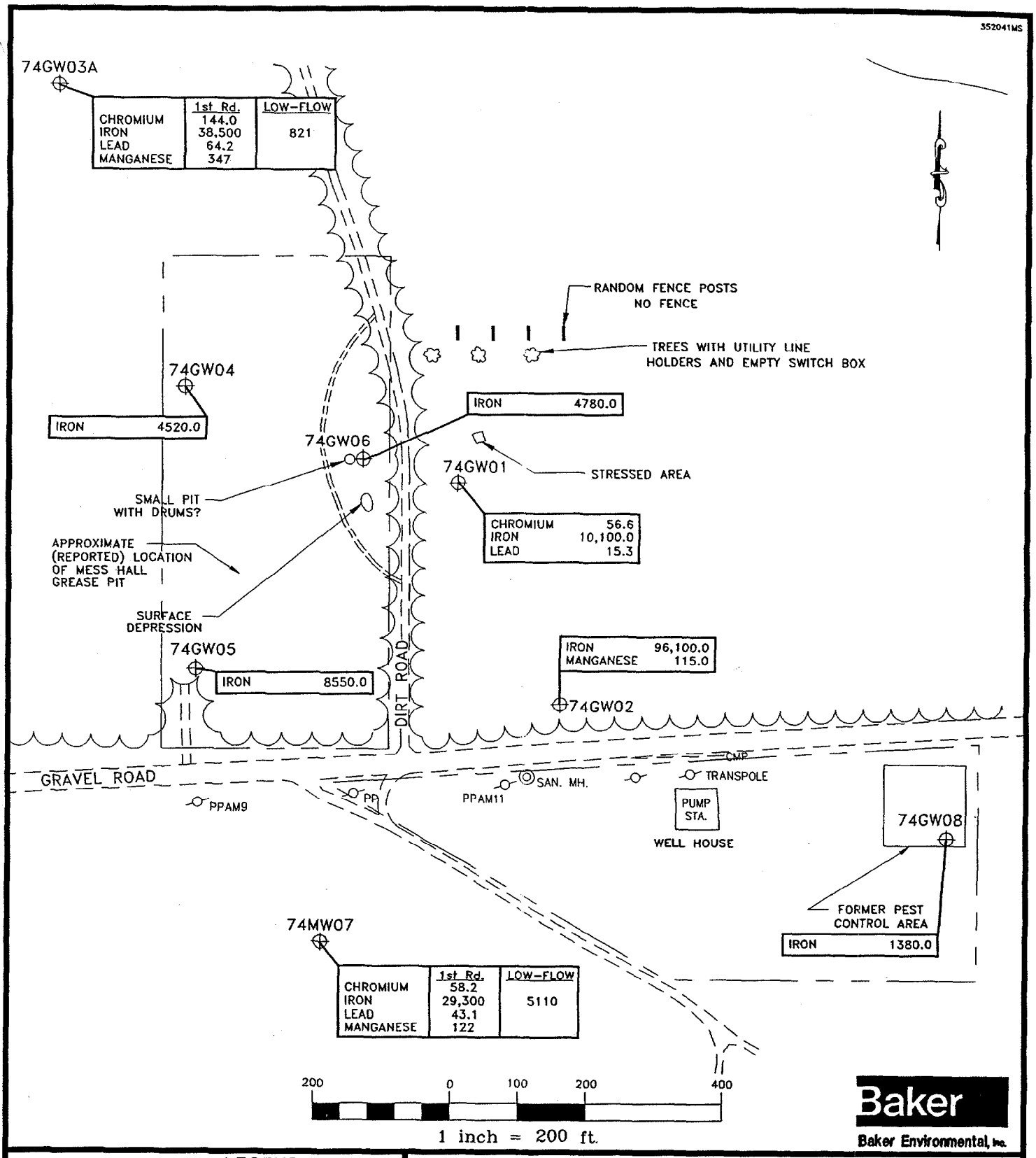
74GW03A ⊕ SHALLOW MONITORING WELL LOCATION

SB01 ⊙ SOIL BORING LOCATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 1-40
POSITIVE DETECTIONS OF PESTICIDES IN SUBSURFACE SOILS - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING
STUDY CTO-0352
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 1-41

POSITIVE DETECTIONS OF TAL METALS ABOVE FEDERAL MCLs AND/OR NCWQS IN SHALLOW WELLS

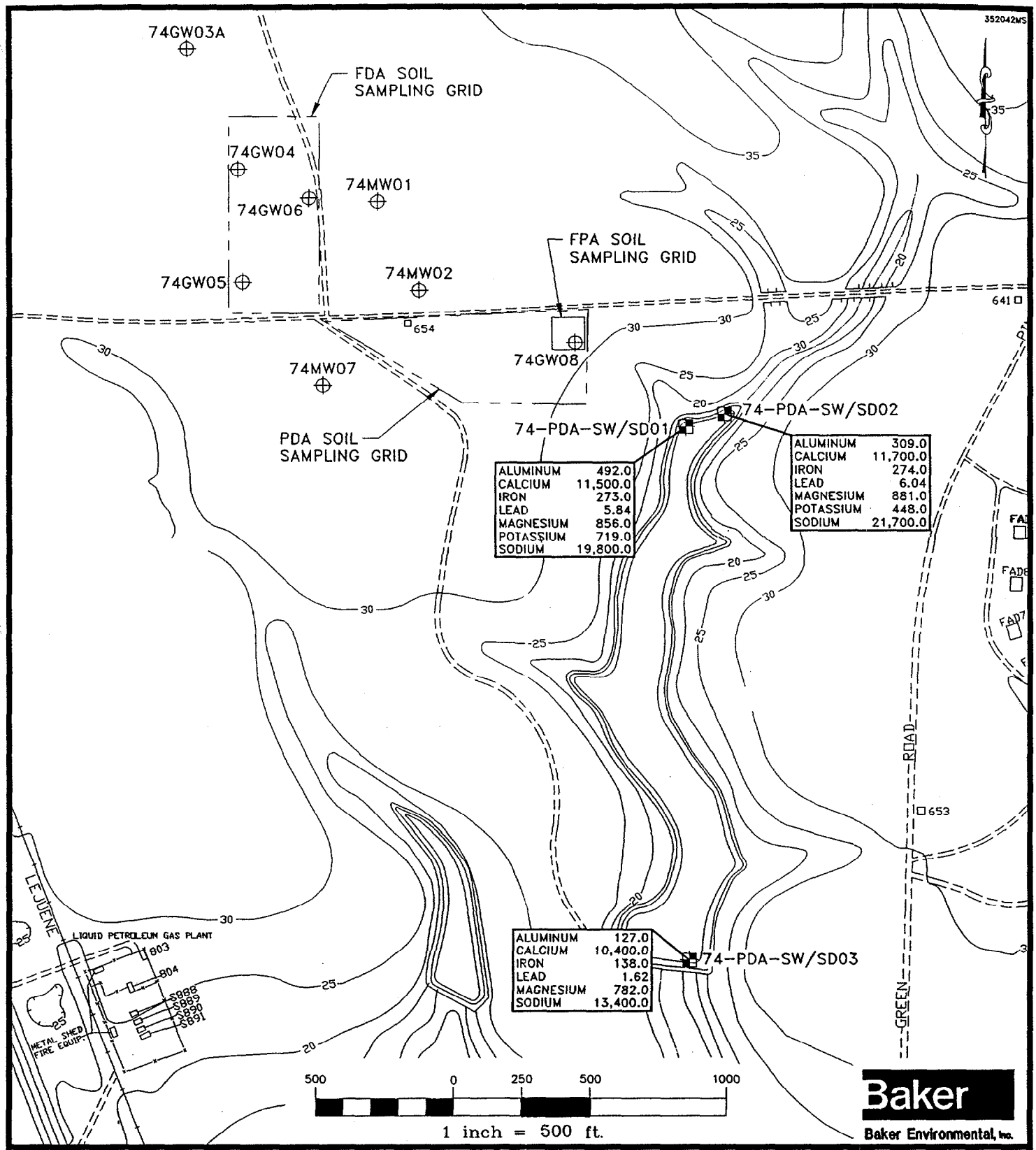
SITE 74 – MESS HALL GREASE PIT DISPOSAL AREA

BASELINE LONG-TERM MONITORING STUDY

CTO-0352

MARINE CORPS BASE, CAMP LEJEUNE

NORTH CAROLINA

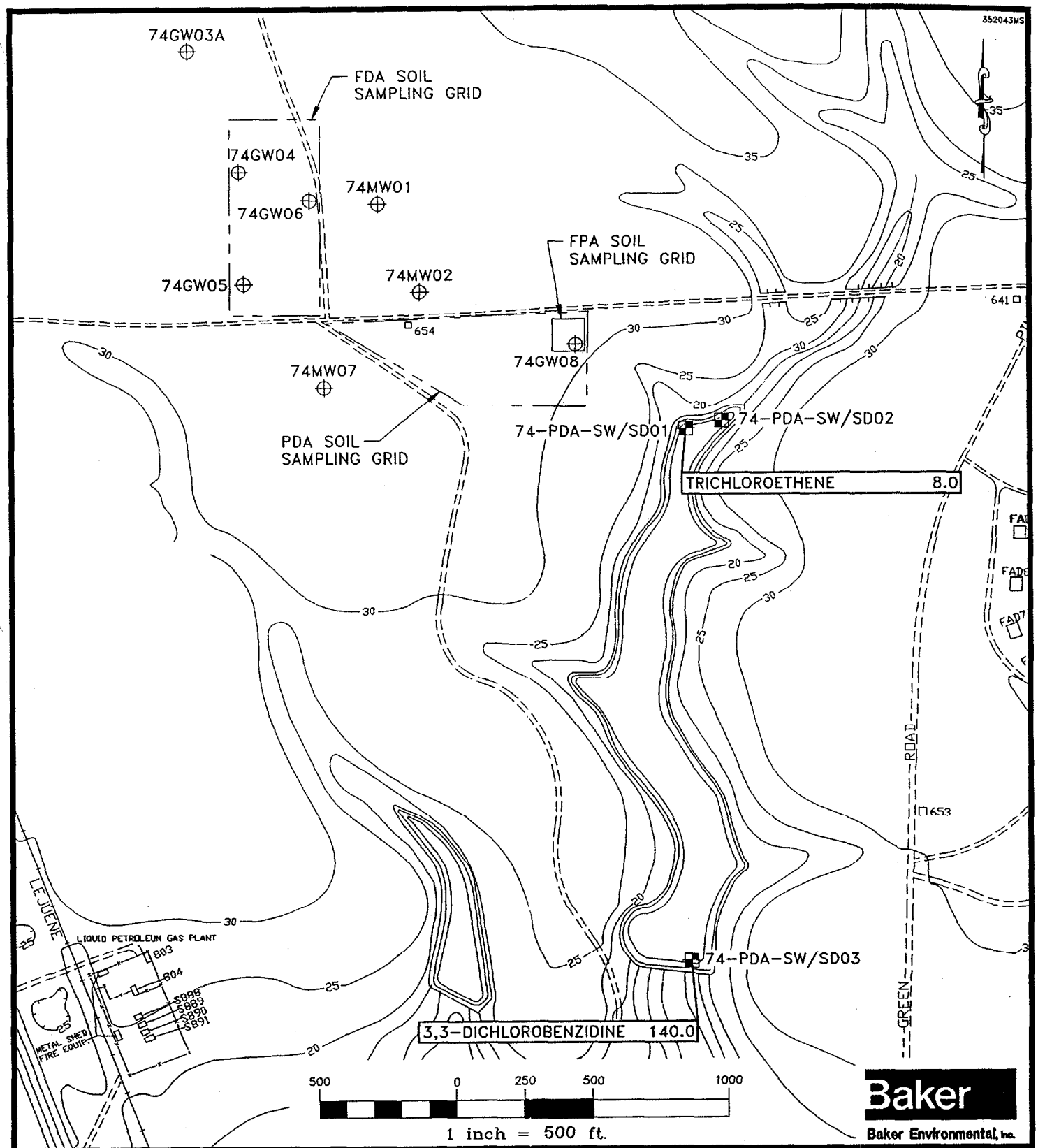


LEGEND

74-PDA-SW/SD01 — SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, FEB. 1994

FIGURE 1-42
POSITIVE DETECTIONS OF TAL METALS IN SURFACE WATER - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



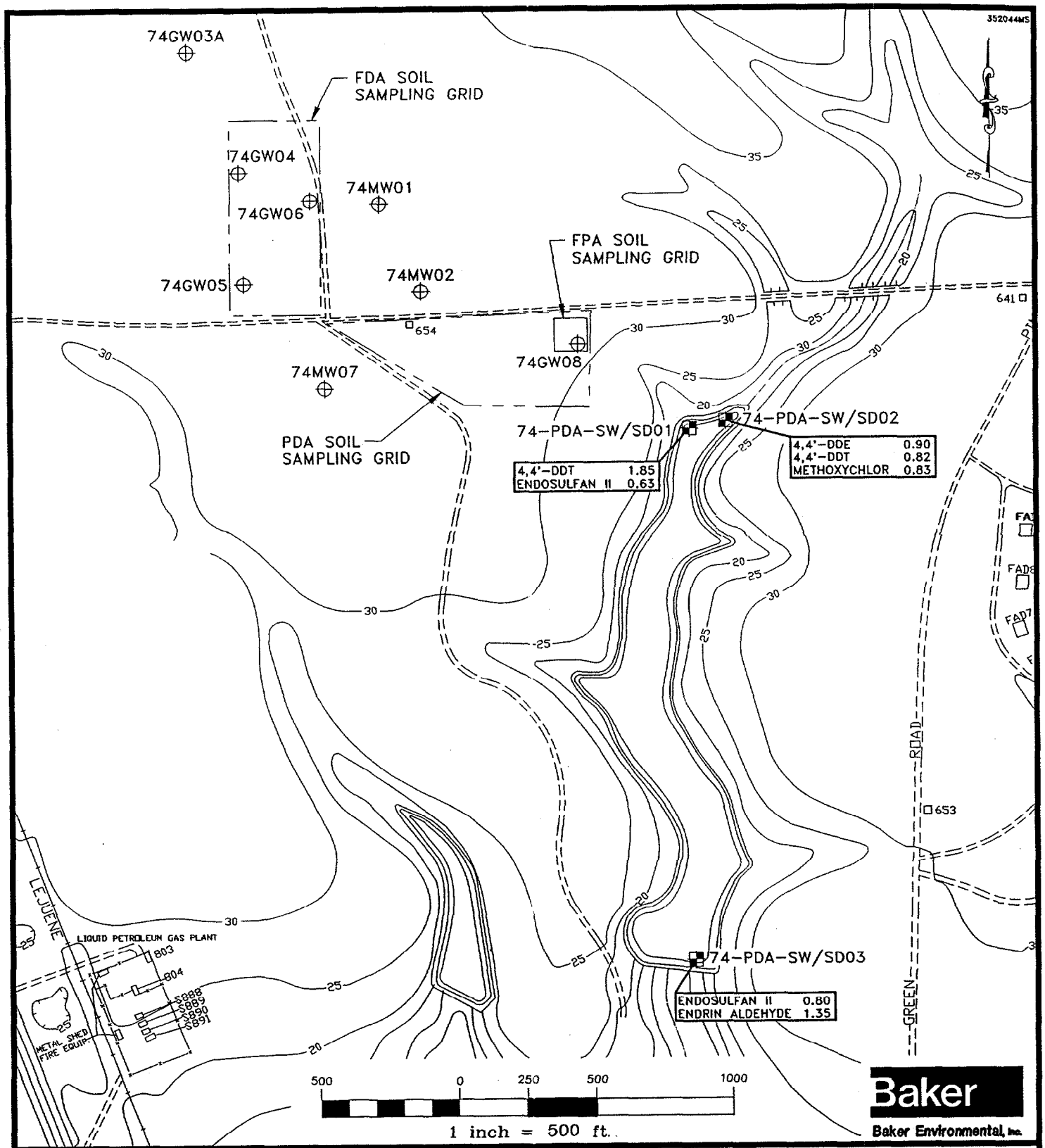
LEGEND

74-PDA-SW/SD01 SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).

SOURCE: LANTDIV, FEB. 1994

FIGURE 1-43
POSITIVE DETECTIONS OF VOLATILES AND SEMIVOLATILES IN SEDIMENT - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING
STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

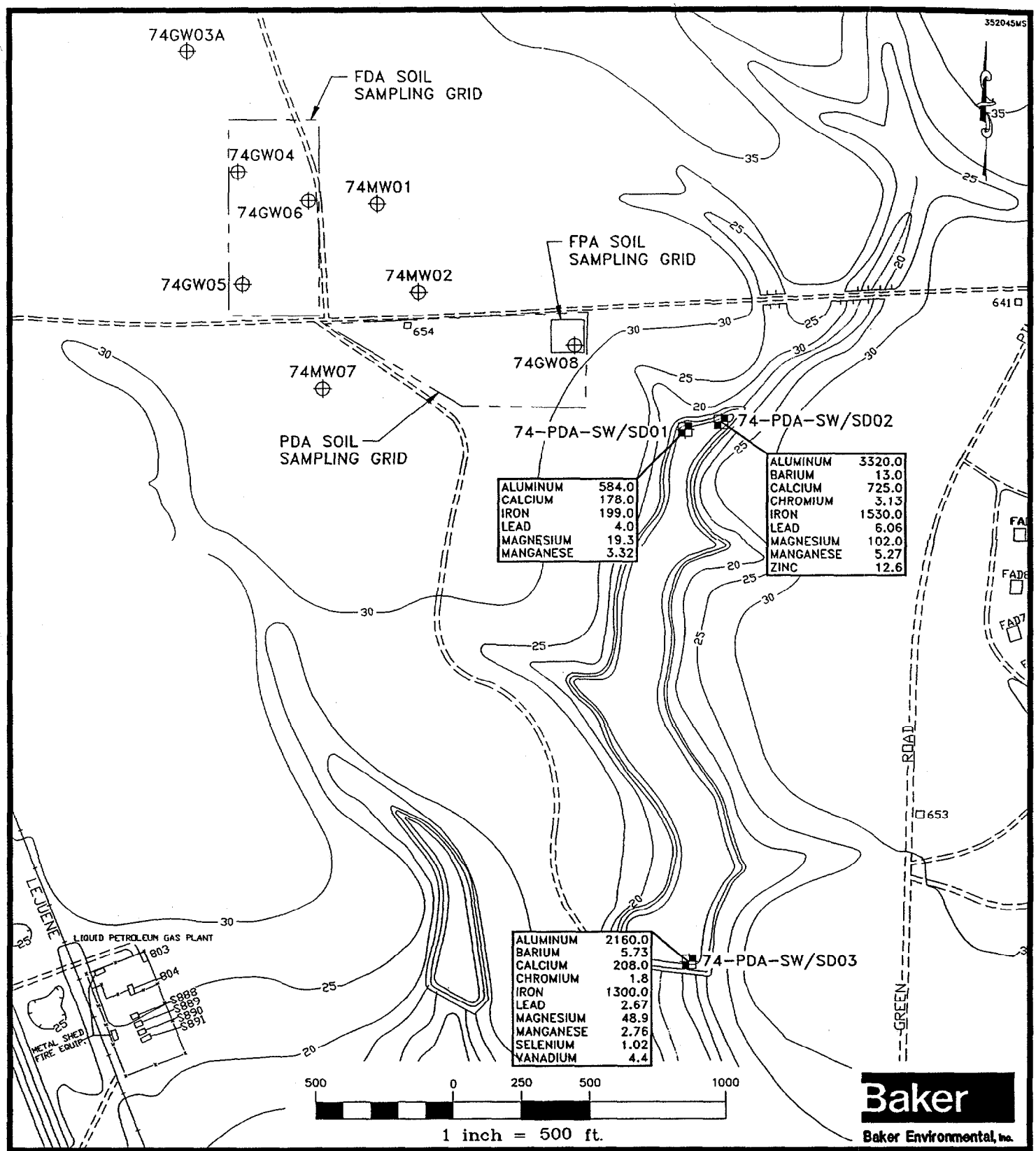


LEGEND

74-PDA-SW/SD01 SURFACE WATER/SEDIMENT SAMPLING STATION

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER KILOGRAM (ug/kg).
SOURCE: LANTDIV, FEB. 1994

FIGURE 1-44
POSITIVE DETECTIONS OF PESTICIDES IN SEDIMENT - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING
STUDY CTO-0352
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 1-45
POSITIVE DETECTIONS OF TAL METALS IN SEDIMENT - SITE 74
MESS HALL GREASE PIT DISPOSAL AREA
BASELINE LONG-TERM MONITORING STUDY CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SECTION 2

2.0 STUDY AREA INVESTIGATION

The BLTMS field program at OU No. 4 (Sites 41 and 74) was initiated to collect additional information for the purpose of preparing the Long-Term Monitoring Plan. This section discusses the site-specific BLTMS objectives for each site (Section 2.1) along with the BLTMS field activities conducted to fulfill those objectives for each site.

2.1 BLTMS Objectives

The purpose of this section is to define the site-specific BLTMS 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 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 is addressed on Table 2-1.

The BLTMS field investigation performed at Site 41 commenced on March 18 and continued through March 22, 1996. The field program implemented during the investigation consisted of a groundwater investigation including sampling of shallow and deep wells and surface water and sediment investigations.

2.2 Site 41 - Camp Geiger Dump Near Former Trailer Park

The BLTMS field investigation performed at Site 41 commenced on March 18 and continued through March 21, 1996. The field program implemented during the investigation consisted of a groundwater investigation including sampling and surface water and sediment investigations.

2.2.1 Groundwater Investigation

The groundwater investigation performed at Site 41 was intended to supplement existing groundwater data used assess the nature and extent of contamination which may have resulted from previous disposal practices or site activities. The groundwater was collected from existing groundwater monitoring wells; therefore, the monitoring well drilling and construction information for each well has not been included in this report.

2.2.1.1 Groundwater Sampling Procedures

Groundwater samples were collected from four existing shallow wells (41-MW11-03, 41-MW02-03, 41-MW12-03, and 41-MW10-03) and one existing deep well (41-MW-11DW-03). The locations of these wells are shown on Figure 2-1.

Prior to groundwater purging, water levels from each well were measured. 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. These measurements are presented on Table 2-2.

Water was purged from each well using a peristaltic pump. 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 (and are presented in Table 2-2).

Groundwater samples were collected using a decontaminated peristaltic pump. The samples were introduced directly from the pump apparatus 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, and TAL metals. Volatile samples were collected by slowly pouring water from the pump apparatus into 40 ml vials to minimize volatilization.

2.2.1.2 Analytical Program

One round of groundwater samples were analyzed from the four existing shallow wells. During the round of sampling, (conducted from March 18 through March 22, 1996) the groundwater samples were analyzed for volatiles, semivolatiles, pesticides/PCBs, and TAL metals.

2.2.2 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, and analytical requirements of the surface water and sediment investigations.

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

2.2.2.1 Surface Water and Sediment Sampling Locations

Eight surface water and eight sediment samples were collected at Site 41 during the sampling event. Three surface water and sediment samples were obtained from a unnamed tributary, which borders the site to the north and runs west to east. Another three surface water and sediment samples were obtained from Tank Creek, which borders the site to the south and runs west to east. Two surface water and sediment 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 2-2. 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.

2.2.2.2 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. 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 from 0 to 0.6 feet 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.

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.

2.2.2.3 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 collected during the sampling event were analyzed for TCL organics and TAL metals.

2.3 Site 74 - Mess Hall Grease Pit Disposal Area

The RI field investigation performed at Site 74 commenced on March 18 and continued through March 22, 1996. The field program implemented during the investigation consisted of a groundwater investigation.

The groundwater investigation performed at Site 74 was intended to supplement existing groundwater data used to assess the nature and extent of contamination which may have resulted from previous disposal practices or site activities. The groundwater was collected from existing groundwater monitoring wells; therefore, the monitoring well drilling and construction information for each well has not been included in this report.

2.3.1 Groundwater Sampling Procedures

Groundwater samples were collected from four existing shallow wells (74-MW01-02, 74-MW07-02, 74-MW-03A-02, and 74-MW02-02). The locations of these wells are shown on Figure 2-3.

Prior to groundwater purging, water levels from each well were measured. The total well depth also was 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. These measurements are presented on Table 2-3.

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. These measurements are presented on Table 2-3.

Water was purged from each well using a peristaltic pump. 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 and are presented in Table 2-3.

Groundwater samples were collected using a peristaltic pump. The samples were introduced directly from the pump apparatus 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, and TAL metals. Volatile samples were collected by slowly pouring water from the pump apparatus into 40 ml vials to minimize volatilization.

2.3.2 Analytical Program

One round of groundwater samples were analyzed from the four existing shallow wells. During the round of sampling (conducted from March 18 through March 22, 1996) the groundwater samples were analyzed for volatiles, semivolatiles, pesticides/PCBs, and TAL metals.

2.4 Quality Assurance and Quality Control Samples

QA/QC samples were collected during the groundwater, surface water and sediment investigations, and included equipment rinsate samples and trip blanks. Two equipment rinsate samples and three trip blanks were collected during the course of the field activities.

2.5 Decontamination Procedures

Decontamination procedures performed in the field were initiated in accordance with USEPA Region IV SOPs. Routine sample collection included the sediment collection equipment.

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.

2.6 Investigation Derived Waste (IDW) Handling

Field investigation activities at Sites 41 and 74 resulted in the generation of IDW. This IDW included 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 March 18 to March 22, 1996.

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.

SECTION 2.0 TABLES

TABLE 2-1

SUMMARY OF REMEDIAL INVESTIGATION OBJECTIVES
SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Medium or Area of Concern	Long Term Monitoring	Criteria for Meeting Objective	Investigation/Study
Site 41 1. Groundwater	1a. To provide a baseline for subsequent selection of parameters for long-term monitoring.	Evaluate groundwater quality and compare to ARARs.	Groundwater Investigation
	1b. To determine which wells are necessary to fulfill the objectives of the long-term monitoring program.	Evaluate groundwater quality and compare to ARARs.	Groundwater Investigation
2. Surface Water	2a. To provide a baseline for subsequent selection of parameters for long-term monitoring.	Characterize the nature and extent of contamination in the surface water.	Surface Water Investigation
	2b. To determine which surface water sample stations are necessary to fulfill the objectives of the long-term monitoring program.	Determine surface water quality in the unnamed Creek, Tank Creek, and the drainage ditches.	Surface Water Investigation
3. Sediment	3a. To provide a baseline for subsequent selection of parameters for long-term monitoring.	Characterize the nature and extent of contamination in the sediments.	Sediment Investigation
	3b. To determine which sediment sample stations are necessary to fulfill the objectives of the long-term monitoring program.	Determine sediment quality in the unnamed Creek, Tank Creek, and the drainage ditches.	Sediment Investigation

TABLE 2-1 (Continued)

SUMMARY OF REMEDIAL INVESTIGATION OBJECTIVES
SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Medium or Area of Concern	Long Term Monitoring	Criteria for Meeting Objective	Investigation/Study
Site 74 1. Groundwater	1a. To provide a baseline for subsequent selection of parameters for long-term monitoring.	Evaluate groundwater quality and compare to ARARs.	Groundwater Investigation
	1b. To determine which wells are necessary to fulfill the objectives of the long-term monitoring programs.	Evaluate groundwater quality and compare to ARARs.	Groundwater Investigation

TABLE 2-2

GROUNDWATER FIELD MEASUREMENT
SITE 74
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Top of PVC Casing Elevation (feet, below msl)	Surface Water Level	Volume Removed (gal)	pH	Temperature (°C)	Conductivity mmhos/cm (corrected to 25°C)
74-MW01-02	25	20.4	7.0	4.79	12.8	4
74-MW07-02	19	3.68	5.0	4.87	14.8	67
74-MW03A-02	21.62	4.52	3.0	4.36	14.4	55
74-MW02-02	26.5	19.15	7.0	5.4	13.9	56

TABLE 2-3

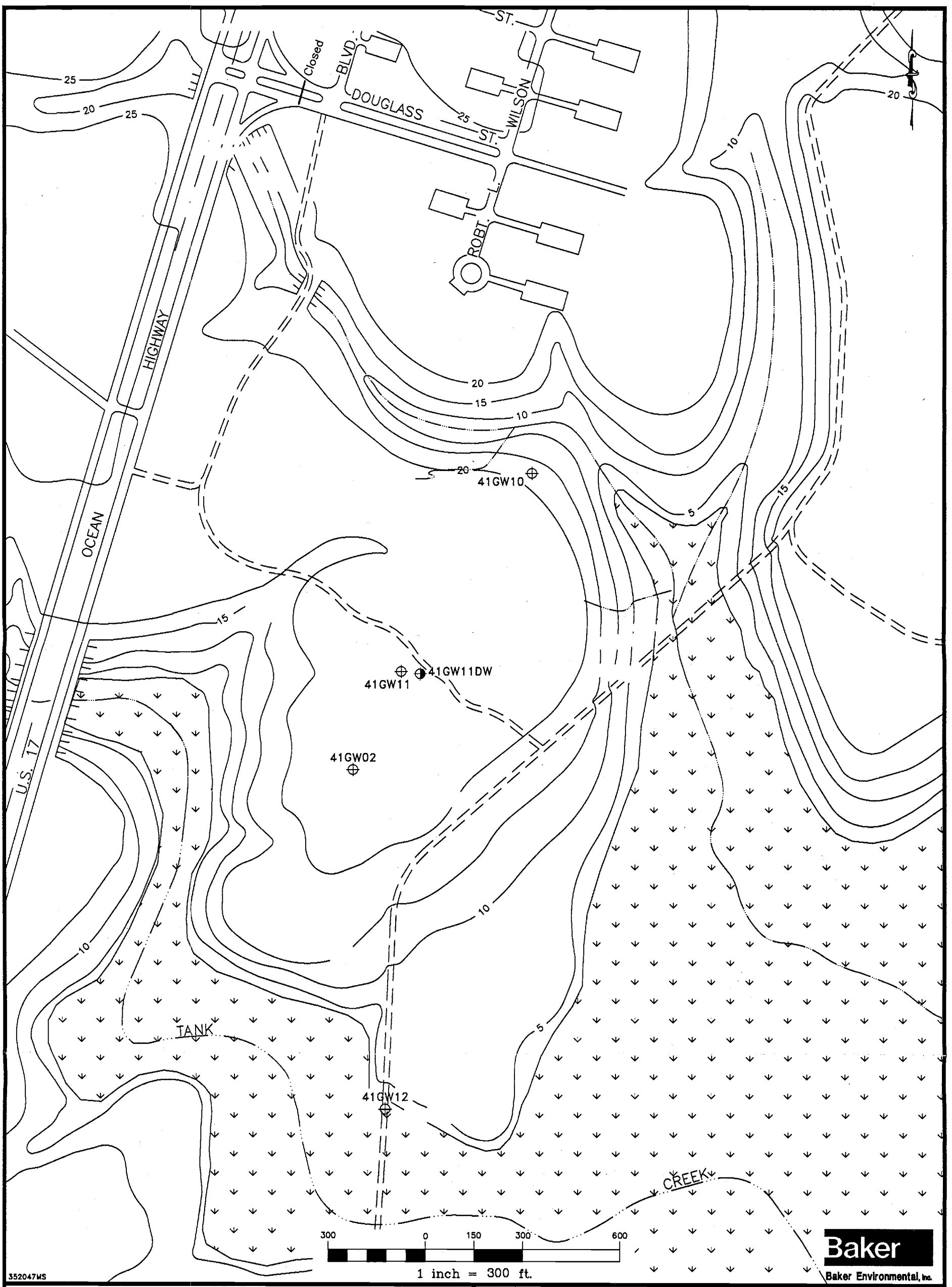
GROUNDWATER FIELD MEASUREMENT
SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Top of PVC Casing Elevation (feet, below msl)	Surface Water Level	Volume Removed (gal)	pH	Temperature (°C)	Conductivity mmhos/cm (corrected to 25°C)
41-GW11-03	15.5	9.10	3.0	6.68	12.9	700
41-GW02-03	21.92	3.95	3.0	6.55	11.65	691
41-GW12-03	16	3.66	4.0	6.57	14.8	NA
41GW10-03	13.5	5.21	3.0	4.55	11	140
41-GW11DW-03	50.5	12.3	3.07	6.84	13.0	240

Note:

NA = Not available

SECTION 2.0 FIGURES



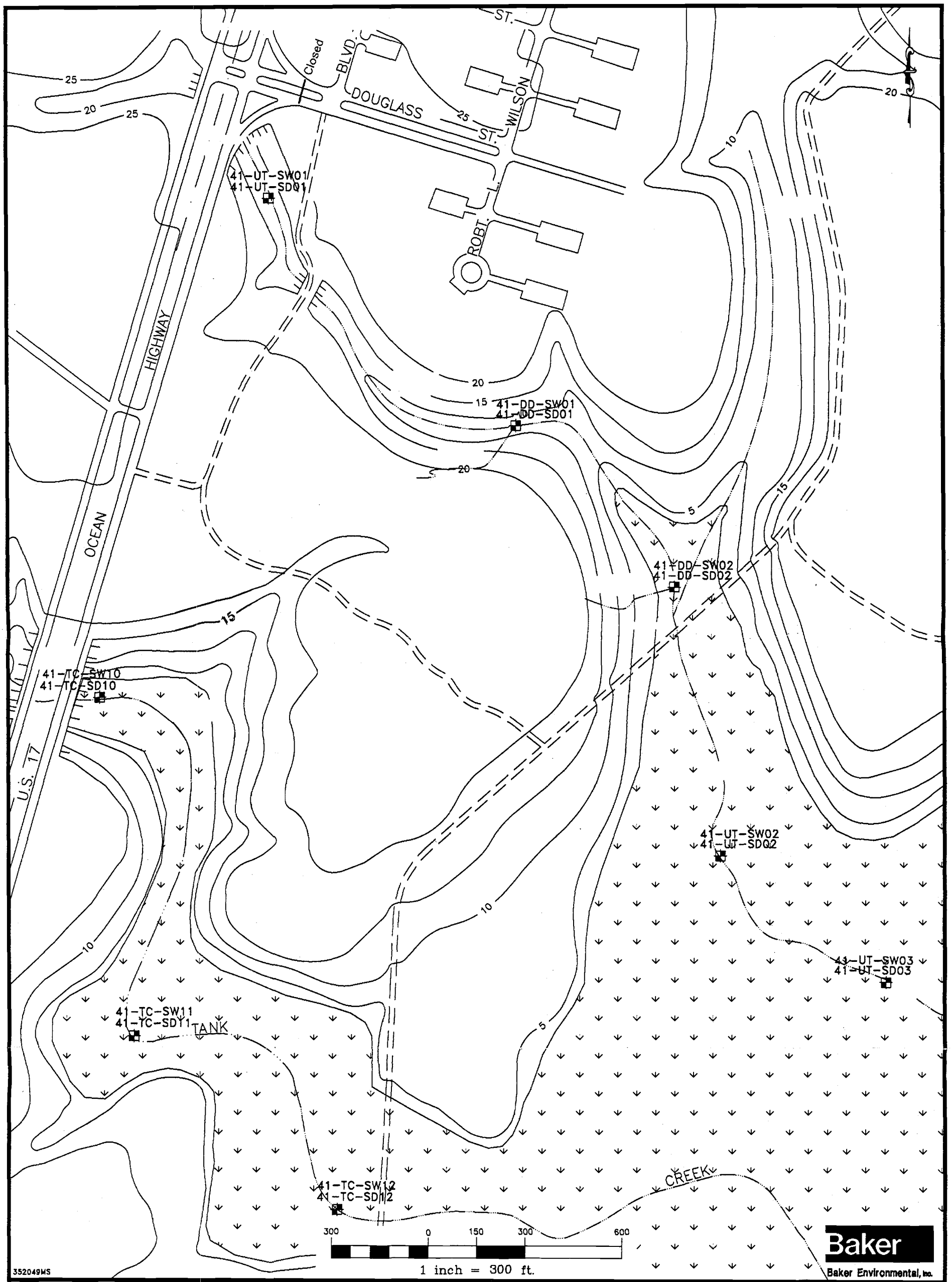
LEGEND

- 41GW01 – SHALLOW MONITORING WELL
- 41GW4DW – DEEP MONITORING WELL
- – MARSH
- 5 – TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)
- – ROAD (IMPROVED)
- – ROAD (UNIMPROVED)
- – INTERMITTENT STREAM

SOURCE: LANTDIV, OCT. 1991

FIGURE 2-1
SHALLOW AND DEEP MONITORING WELL LOCATIONS
SITE 41 – CAMP GEIGER DUMP
NEAR FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01770JJB3Z



LEGEND

41SW01
41SD01 – SURFACE WATER/SEDIMENT SAMPLING STATIONS

5 – TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)

– ROAD (IMPROVED)

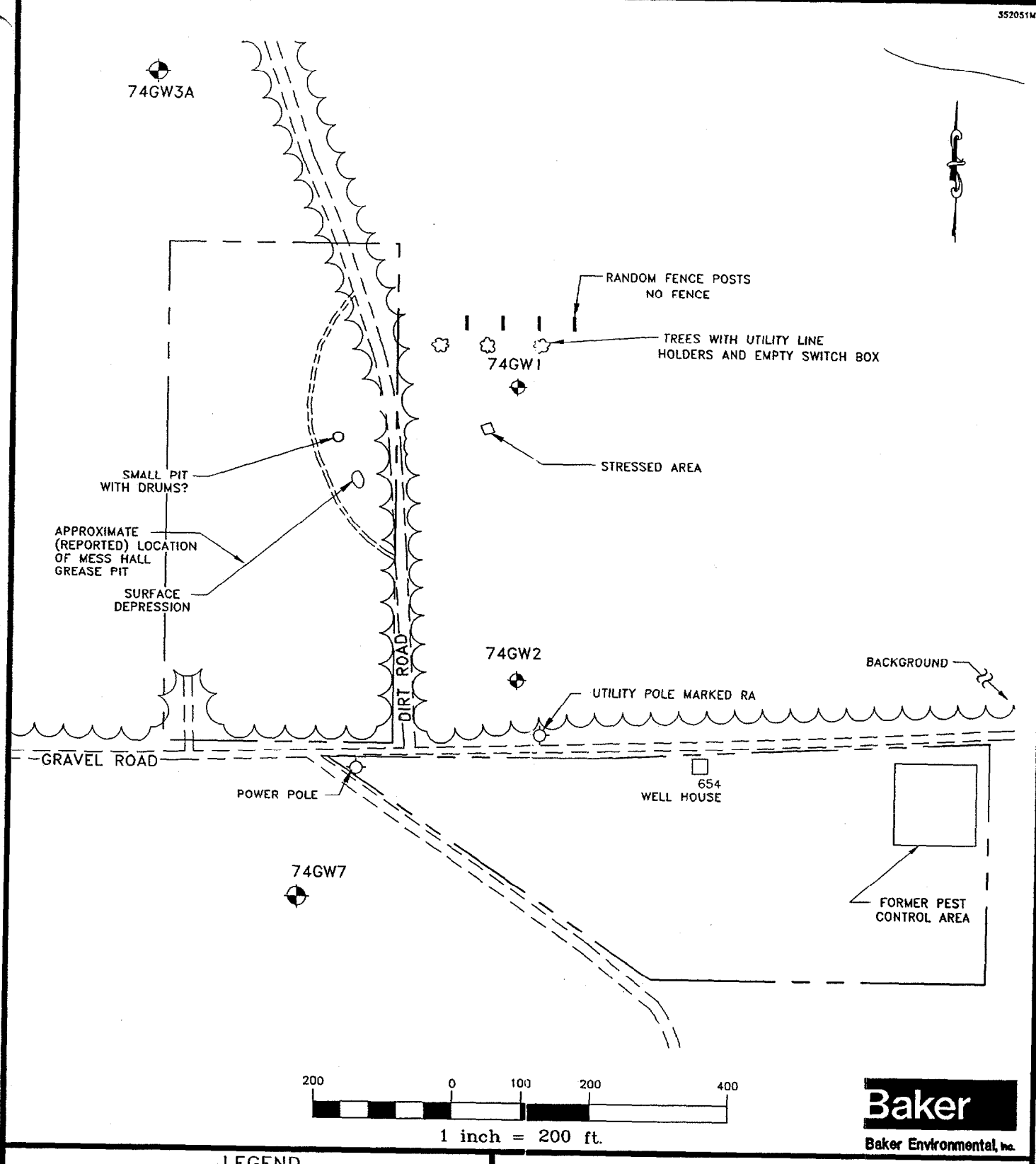
– ROAD (UNIMPROVED)

– INTERMITTENT STREAM

– MARSH

SOURCE: LANTDIV, OCT. 1991

FIGURE 2-2
SURFACE WATER/SEDIMENT SAMPLING LOCATIONS
SITE 41 – CAMP GEIGER DUMP NEAR
FORMER TRAILER PARK
BASELINE LONG-TERM MONITORING STUDY
CTO-0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

74GW1 ⊕ – EXISTING SHALLOW WELL

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 2–3
SHALLOW MONITORING WELL LOCATIONS
SITE 74 – MESS HALL
GREASE DISPOSAL PIT AREA
BASELINE LONG–TERM MONITORING
STUDY CTO–0352
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SECTION 3

3.0 NATURE AND EXTENT OF CONTAMINATION

This section presents and evaluates the results of the BLTMS 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 3.1 and 3.2, respectively. The positive detection summary tables and detection figures referenced in this section for each site are presented at the end of Section 3.

3.1 Site 41 - Camp Geiger Dump Near Former Trailer Park

The analytical results for Site 41 groundwater, surface water, and sediment are presented in the following sections.

3.1.1 Groundwater

Groundwater was collected from four shallow groundwater monitoring wells (41-MW11-03, 41-MW02-03, 41-MW12-03, and 41-MW10-03) and one deep groundwater monitoring well (41-MW11DW-03) 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.

Table 3-1 presents the positive detection summaries for organics and total metal at the five groundwater monitoring wells. Table 3-2 provides a comparison of groundwater findings to EPA federal Maximum Contaminant Levels (MCLs) and the North Carolina Water Quality Standards (NCWQS). This summary includes the Federal and State standards, the range of positive detections, the location of the maximum concentration, the frequency of detection, and the number of exceeds above the Federal and State criteria.

3.1.1.1 Shallow Aquifer

Organics

VOCs (benzene and chlorobenzene) were detected in one of the four shallow groundwater monitoring wells (41-MW11-03) at low concentrations, 4 µg/L and 5 µg/L, respectively. SVOC were detected in the same shallow well and included 1,4-dichlorobenzene and naphthalene, and known artifacts associated with laboratory procedures (diethyl phthalate and bis(2-ethylhexyl)phthalate). These SVOCs were detected at low concentrations.

Pesticides and PCBs were not detected in any of the shallow groundwater monitoring wells.

Metals

As shown on Figure 3-2, 14 metals were detected in all the shallow groundwater samples at Site 41. The only metals that exceeded the Federal and State criteria were iron and manganese.

3.1.1.2 Castle Hayne Aquifer

Organics

Four VOCs were detected in the Castle Hayne Aquifer at Site 41 at low concentrations. Vinyl chloride and 1,2-dichloropropane were the only VOCs that exceeded the NCWQS; where none of the VOCs exceeded the Federal MCLs. The only two SVOCs, butyl benzyl phthalate and bis(2-ethylhexyl) phthalate, detected in the deep well are typically associated with laboratory procedures.

The pesticides alpha- and gamma-chlordane were detected in the deep groundwater sample at a concentration that exceeded the NCWQS. No PCBs were detected in the deep well groundwater sample.

Metals

Ten metals were detected in the Castle Hayne groundwater sample at Site 41. The total metals detected above Federal and/or State standards in the Castle Hayne Aquifer are summarized in Table 3-2. Iron and magnesium were the only metals that exceeded both the Federal and State water quality criteria. Additionally, arsenic exceeded the NCWQS criteria.

3.1.2 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.

Tables 3-4 through 3-6 present the positive detection summaries for organics and total metals at the three surface water bodies. Table 3-7 summarizes the compounds detected in the 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, the frequency of detection, and the number of exceedences above the Federal and State criteria.

3.1.2.1 Organics

One VOC (chlorobenzene) and one SVOC (1,4-dichlorobenzene) were detected in the groundwater seeps at low concentrations. Neither of these concentrations exceeded the Federal or State criteria. No VOC, SVOC, pesticides, or PCBs were detected in the surface water in Tank Creek and the unnamed tributary. Additionally, pesticides and PCBs were not detected in the two groundwater seeps.

3.1.2.2 Metals

As shown on Table 3-7, 14 metals were detected in all surface water samples collected at Site 41. Arsenic and iron exceeded the Federal AWQC criteria in three and eight of the surface water samples, respectively. Manganese exceeded both the AWQC and NCWQS criteria in two of the surface water samples.

3.1.3 Sediments

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

Tables 3-8 through 3-10 present the positive detection summaries for organics and total metals at the three sediment stations. The concentrations of the components detected in the sediment samples were compared to established National Oceanic and Atmospheric Administration (NOAA) guidelines. The guideline values are effects range-low (ER-L) and effects range-median (ER-M).

Table 3-11 summarizes the organic compounds detected in the sediments at Site 41. This summary includes applicable Federal and State criteria for sediment, the range of positive detections, the location of the highest concentration, the frequency of detection, and the number of exceedences over the Federal and State criteria.

3.1.2.1 Organics

Two SVOCs that are known contaminants associated with laboratory and field procedures (di-n-butyl phthalate and bis (2-ethylhexyl) phthalate) were detected in one of the eight sediment sampling locations. Aside from these two SVOCs, no other organic contaminants were detected in the sediments at Site 41.

3.1.2.2 Metals

As shown on Table 3-10, 17 metals were detected in the three sediment samples collected at Site 41. However, none of the sediment samples exceeded the ER-L or ER-M.

3.2 Site 74 - Mess Hall Grease Pit Disposal Area

The analytical results for the Site 74 groundwater investigation are presented in the following section.

3.2.1 Groundwater

Groundwater was collected from four shallow groundwater monitoring wells (74-MW01-02, 74-MW07-02, 74-MW03A-02, and 74-MW02-02) 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.

Tables 4-12 present the positive detection summaries for organics and total metal at the four groundwater monitoring wells. Table 3-13 provides a comparison of groundwater findings to EPA Federal Maximum Contaminant Levels (MCLs) and the North Carolina Water Quality Standards (NCWQS). This summary includes the Federal and State standards, the range of positive detections, the location of the maximum concentration, the frequency of detection, and the number of exceeds above the Federal and State criteria.

3.2.1.1 Organics

VOCs, SVOCs, pesticides, and PCBs were not detected in any of the groundwater monitoring wells at Site 74.

3.2.1.2 Metals

As shown on Figure 3-13, 15 metals were detected in all the groundwater samples at Site 41. Iron was detected in two of the groundwater samples at concentrations that exceeded the Federal MCLs and NCWQS. The other 14 metals were detected in the groundwater samples at concentrations below the Federal and State criteria.

SECTION 3.0 TABLES

TABLE 3-1
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER (SHALLOW AND DEEP)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-GW02-03	41-GW10-03	41-GW11-03	41-GW11DW-03	41-GW12-03
DATE SAMPLED	03/19/96	03/22/96	03/20/96	03/20/96	03/19/96
VOLATILES (ug/L)					
VINYL CHLORIDE	10 U	10 U	10 U	1 J	10 U
1,2-DICHLOROETHENE (TOTAL)	10 U	10 U	10 U	1 J	10 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	1 J	10 U
BENZENE	10 U	10 U	4 J	1 J	10 U
CHLOROBENZENE	10 U	10 U	5 J	10 U	10 U
SEMIVOLATILES (ug/L)					
1,4-DICHLOROBENZENE	11 U	10 U	1 J	10 U	11 U
NAPHTHALENE	11 U	10 U	8 J	10 U	11 U
DIETHYL PHTHALATE	11 U	10 U	1 J	10 U	11 U
BUTYL BENZYL PHTHALATE	11 U	10 U	11 U	39	11 U
BIS(2-ETHYLHEXYL) PHTHALATE	11 U	10 U	1 J	2 J	11 U
PESTICIDE/PCB's (ug/L)					
ALPHA-BHC	0.055 UJ	0.052 UJ	0.053 UJ	0.05 UJ	0.055 U
ALPHA-CHLORDANE	0.055 UJ	0.052 UJ	0.053 UJ	0.064 J	0.055 U
GAMMA-CHLORDANE	0.055 UJ	0.052 UJ	0.053 UJ	0.49 J	0.055 U

TABLE 3-1 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
GROUNDWATER (SHALLOW AND DEEP)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-GW02-03	41-GW10-03	41-GW11-03	41-GW11DW-03	41-GW12-03
DATE SAMPLED	03/19/96	03/22/96	03/20/96	03/20/96	03/19/96
TOTAL METALS (ug/L)					
ALUMINUM	137	2860	32	21.8 U	25.8
ARSENIC	5.1	2.2 U	3.5	4.3	2.2 U
BARIUM	75.4	52.4	437	53.7	21.8
CALCIUM	134000	12500	110000	242000	53800
COPPER	3 U	5.6	3 U	3 U	3 U
IRON	28900	228	60200	3340	4820
LEAD	0.88 U	0.88 U	3.5	0.88 U	0.88 U
MAGNESIUM	23600	2640	16500	7440	2520
MANGANESE	432	14.4	259	138	119
POTASSIUM	17200	513 U	19400	1880	513 U
SODIUM	29200	17100	22500	208000	7350
THALLIUM	3.8	3.7 U	3.7 U	3.7 U	3.7 U
VANADIUM	20.4	4.2	8.2	32.2	15.7
ZINC	4.9	197	17.3	3.3	14.1

TABLE 3-2

SUMMARY OF GROUNDWATER DATA (SHALLOW WELLS), SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Criteria (µg/L)		Frequency	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Exceedences (µg/L)	
	Federal MCL	NCWQS				MCL	NCWQS
Volatiles (µg/L)							
Benzene	5	1	1/4	4J	41-MW11-03	0	1
Chlorobenzene	--	50	1/4	5J	41-MW11-03	NA	0
Semivolatiles (µg/L)							
1,4-Dichlorobenzene	75	--	1/4	1J	41-MW11-03	0	NA
Naphthalene	--	--	1/4	8J	41-MW11-03	NA	NA
Diethyl phthalate	--	5,000	1/4	1J	41-MW11-03	NA	0
bis(2-ethylhexyl)phthalate	--	--	1/4	1J	41-MW11-03	NA	NA
Total Metals (µg/L)							
Aluminum	--	--	4/4	25.8 - 2,860	41-MW10-03	NA	NA
Arsenic	50	--	2/4	3.5 - 5.1	41-MW02-03	0	NA
Barium	2,000	2,000	4/4	21.8 - 437	41-MW11-03	0	0
Calcium	--	--	4/4	12,500 - 134,000	41-MW02-03	NA	NA
Copper	1,300	1,000	1/4	5.6 - 5.6	41-MW10-03	0	0
Iron	300	300	4/4	228 - 60,200	41-MW11-03	3	3
Lead	15	15	1/4	3.5 - 3.5	41-MW11-03	0	0
Magnesium	--	--	4/4	2,520 - 23,600	41-MW02-03	NA	NA
Manganese	50	50	4/4	14.4 - 432	41-MW02-03	3	3
Potassium	--	--	2/4	17,200 - 19,400	41-MW11-03	NA	NA
Sodium	--	--	4/4	7,350 - 29,200	41-MW02-03	NA	NA
Thallium	--	--	1/4	3.8 - 3.8	41-MW02-03	NA	NA
Vanadium	--	--	4/4	4.2 - 20.4	41-MW02-03	NA	NA
Zinc	--	2,100	4/4	4.9 - 197	41-MW10-03	0	0

Notes:

-- = Not established
MCL = Maximum Contaminant Level
NCWQS = North Carolina Water Quality Standard
µg/L = microgram per liter

TABLE 3-3

SUMMARY OF GROUNDWATER DATA (DEEP WELLS), SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Criteria (µg/L)		Frequency	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Exceedences (µg/L)	
	Federal MCL	NCWQS				MCL	NCWQS
Volatiles (µg/L)							
Vinyl Chloride	2	0.015	1/1	1J	41-GW11DW-03	0	1
1,2-Dichloroethene (total)	100	--	1/1	1J	41-GW11DW-03	0	NA
1,2-Dichloropropane	5	0.56	1/1	1J	41-GW11DW-03	0	1
Benzene	5	1	1/1	1J	41-GW11DW-03	0	0
Semivolatiles (µg/L)							
Butyl benzyl phthalate	--	100	1/1	39 - 39	41-GW11DW-03	NA	0
Bis(2-ethylhexyl)phthalate	--	--	1/1	2J - 2J	41-GW11DW-03	NA	NA
Pesticide/PCBs (µg/L)							
Alpha-Chlordane	2	0.027	1/1	0.064J - 0.064J	41-GW11DW-03	0	1
Gamma-Chlordane	2	0.027	1/1	0.49J - 0.49J	41-GW11DW-03	0	1
Total Metals (µg/L)							
Arsenic	50	1	1/1	4.3 - 43	41-GW11DW-03	0	1
Barium	2,000	2,000	1/1	53.7 - 53.7	41-GW11DW-03	0	0
Calcium	--	--	1/1	242,000 - 242,000	41-GW11DW-03	NA	NA
Iron	300	300	1/1	3,340 - 3,340	41-GW11DW-03	1	1
Magnesium	--	--	1/1	7,440 - 7,440	41-GW11DW-03	NA	NA
Manganese	50	50	1/1	138 - 138	41-GW11DW-03	1	1
Potassium	--	--	1/1	1,880 - 1,880	41-GW11DW-03	NA	NA
Sodium	--	--	1/1	208,000 - 208,000	41-GW11DW-03	NA	NA
Vanadium	--	--	1/1	32.2 - 32.2	41-GW11DW-03	NA	NA
Zinc	--	21,000	1/1	3.3 - 3.3	41-GW11DW-03	NA	0

Notes:

-- = Not established
MCL = Maximum Contaminant Level
NCWQS = North Carolina Water Quality Standard
µg/L = microgram per liter
NA = Not Applicable

TABLE 3-4
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SURFACE WATER (UNNAMED CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-UT-SW01	41-UT-SW02	41-UT-SW03
DATE SAMPLED	03/21/96	03/21/96	03/21/96
VOLATILES (ug/L)			
SEMIVOLATILES (ug/L)			
PESTICIDE/PCBs (ug/L)	No Detects		

TABLE 3-4 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SURFACE WATER (UNNAMED CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-UT-SW01	41-UT-SW02	41-UT-SW03
DATE SAMPLED	03/21/96	03/21/96	03/21/96
TOTAL METALS (ug/L)			
ALUMINUM	245	235	205
ARSENIC	2.2 U	2.2 U	2.3
BARIUM	22.5	21.6	19.4
CALCIUM	44800	41900	40400
COPPER	3 U	4.6	3 U
IRON	978	861	759
MAGNESIUM	1780	2230	2150
MANGANESE	19.3	37.8	34.6
POTASSIUM	1480	1280	1130
SELENIUM	1.8 U	1.8 U	2.3
SODIUM	19600	13200	12900
VANADIUM	10.9	10.8	13.2
ZINC	18.7	37	35.4

TABLE 3-5
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SURFACE WATER (TANK CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-TC-SW10	41-TC-SW11	41-TC-SW12
DATE SAMPLED	03/21/96	03/21/96	03/21/96
VOLATILES (ug/L)			
SEMIVOLATILES (ug/L)			
PESTICIDE/PCBs (ug/L)	No Detects		

TABLE 3-5 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SURFACE WATER (TANK CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-TC-SW10	41-TC-SW11	41-TC-SW12
DATE SAMPLED	03/21/96	03/21/96	03/21/96
TOTAL METALS (ug/L)			
ALUMINUM	405	465	370
ARSENIC	2.2 U	2.4	2.2 U
BARIUM	27.6	29	27.4
CADMIUM	6.7	2.8 U	2.8 U
CALCIUM	18700	20200	18700
COPPER	3.3	7.1	4.1
IRON	1400	1310	1220
MAGNESIUM	1670	1750	1660
MANGANESE	30	31.2	29.6
POTASSIUM	1810	1670	1650
SELENIUM	1.8 U	1.8 U	2.7
SODIUM	13900	14600	13500
VANADIUM	6	6.1	6.9
ZINC	25.9	15.1	19.3

TABLE 3-6
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SURFACE WATER (DRAINAGE DITCH)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-DD-SW01	41-DD-SW02
DATE SAMPLED	03/21/96	03/21/96
VOLATILES (ug/L)		
CHLOROBENZENE	1 J	2 J
SEMIVOLATILES (ug/L)		
1,4-DICHLOROBENZENE	2 J	10 U

TABLE 3-6 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SURFACE WATER (DRAINAGE DITCH)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-DD-SW01	41-DD-SW02
DATE SAMPLED	03/21/96	03/21/96
TOTAL METALS (ug/L)		
ALUMINUM	63	199
ARSENIC	2.2 U	2.9
BARIUM	47.1	60.9
CALCIUM	52500	66100
COPPER	3 U	3.3
IRON	3560	7040
MAGNESIUM	5170	7910
MANGANESE	46.6	360
POTASSIUM	4120	6320
SODIUM	11000	19800
VANADIUM	12.4	14.8
ZINC	28.2	24.6

TABLE 3-7

SUMMARY OF SURFACE WATER DATA, SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Criteria (µg/L)		Frequency	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Exceedences (µg/L)	
	Federal AWQC	NCWQS				Federal AWQC	NCWQS
Volatiles (µg/L)							
Chlorobenzene	680	488	2/8	1J - 2J	41-DD-SW02	0	0
Semivolatiles (µg/L)							
1,4-Dichlorobenzene	--	--	1/8	2	41-DD-SW-01	NA	NA
Total Metals (µg/L)							
Aluminum	--	--	8/8	63 - 465	41-TC-SW11	NA	NA
Arsenic	0.0022	--	3/8	2.3 - 2.9	41-DD-SW02	3	NA
Barium	1,000	1,000	8/8	19.4 - 60.9	41-DD-SW02	0	0
Cadmium	10	--	1/8	6.7 - 6.7	41-TC-SW10	0	NA
Calcium	--	--	8/8	18,700 - 66,100	41-DD-SW02	NA	NA
Copper	300	--	5/8	3.3 - 7.1	41-TC-SW11	0	NA
Iron	300	--	8/8	759 - 7,040	41-DD-SW02	8	NA
Magnesium	--	--	8/8	1,660 - 7,910	41-DD-SW02	NA	NA
Manganese	50	50	8/8	19.3 - 360	41-DD-SW02	2	3
Potassium	--	--	8/8	1,130 - 6,320	41-DD-SW02	NA	NA
Selenium	--	--	2/8	2.3 - 2.7	41-TC-SW12	NA	NA
Sodium	--	--	8/8	11,000 - 19,800	41-DD-SW02	NA	NA
Vanadium	--	--	8/8	6 - 14.8	41-DD-SW02	NA	NA
Zinc	--	--	8/8	15.1 - 37	41-UT-SW02	NA	NA

Notes:

-- = Not established
AWQC = Ambient Water Quality Standard
NCWQS = North Carolina Water Quality Standard
µg/L = microgram per liter
NA = Not Applicable

TABLE 3-8
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SEDIMENT (UNNAMED CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-UT-SD01	41-UT-SD02	41-UT-SD03
DATE SAMPLED	03/21/96	03/21/96	03/21/96
VOLATILES (ug/kg)			
SEMIVOLATILES (ug/kg)			
PESTICIDE/PCBs (ug/kg)	No Detects		

TABLE 3-8 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SEDIMENT (UNNAMED CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-UT-SD01	41-UT-SD02	41-UT-SD03
DATE SAMPLED	03/21/96	03/21/96	03/21/96
TOTAL METALS (mg/kg)			
ALUMINUM	1090	510	470
ARSENIC	0.83	0.56 U	0.58 U
BARIUM	3.9	4.4	2.3
CALCIUM	24900	302	252
CHROMIUM	2.6	1.8	1.6
COPPER	1.4	0.75 U	0.77 U
IRON	915	337	330
LEAD	3.8	2.6	1.7
MAGNESIUM	353	16.5 U	18.1 U
MANGANESE	9.2	2.2	3.5
NICKEL	3.3	2 U	2.1 U
POTASSIUM	135	128 U	132 U
SODIUM	54.1	24.1	30.3
THALLIUM	1.7	0.92 U	0.95 U
ZINC	9.5	6.7	9.5

TABLE 3-9
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SEDIMENT (TANK CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-TC-SD10	41-TC-SD11	41-TC-SD12
DATE SAMPLED	03/21/96	03/21/96	03/21/96
SEMIVOLATILES (ug/kg)			
DI-N-BUTYL PHTHALATE	460 U	430 U	430 J
BIS(2-ETHYLHEXYL) PHTHALATE	460 U	430 U	83 J

TABLE 3-9 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SEDIMENT (TANK CREEK)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-TC-SD10	41-TC-SD11	41-TC-SD12
DATE SAMPLED	03/21/96	03/21/96	03/21/96
TOTAL METALS (mg/kg)			
ALUMINUM	2610	529	1130
ARSENIC	0.85	0.57 U	0.63 U
BARIUM	11.4	5.1	10.6
CALCIUM	340	173	378
CHROMIUM	4.9	1.3	2.9
COPPER	0.94	0.77 U	0.88
IRON	1890	861	1070
LEAD	5.4	1.3	3.6
MAGNESIUM	90.1	16 U	41.8
MANGANESE	5.9	2	4.7
NICKEL	2.7	2.5	2.3 U
POTASSIUM	185	132 U	144 U
SELENIUM	0.77	0.48 U	0.87
SODIUM	36.1	25.7	42.2
ZINC	8.3	0.04 U	11.4

TABLE 3-10
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SEDIMENT (DRAINAGE DITCHES)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-DD-SD01	41-DD-SD02
DATE SAMPLED	03/21/96	03/21/96
VOLATILES (ug/kg)		
SEMIVOLATILES (ug/kg)		
PESTICIDE/PCBs (ug/kg)	No Detects	

TABLE 3-10 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 41)
SEDIMENT (DRAINAGE DITCHES)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	41-DD-SD01	41-DD-SD02
DATE SAMPLED	03/21/96	03/21/96
TOTAL METALS (mg/kg)		
ALUMINUM	1060	4200
ARSENIC	0.92	3.6
BARIUM	3.9	56.4
CALCIUM	423	4390
CHROMIUM	3.2	2.7
COBALT	3.4 U	14.4
COPPER	0.92	6.5
IRON	1690	58700
LEAD	3.3	11.4
MAGNESIUM	37.9	308
MANGANESE	3.7	430
POTASSIUM	140	193
SELENIUM	0.54	0.66 U
SODIUM	27.1	93.9
ZINC	6.1	56.6

TABLE 3-11

SUMMARY OF SEDIMENT DATA, SITE 41
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Criteria (mg/kg)		Frequency	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Exceedences (mg/kg)	
	NOAA ER-L	NOAA ER-M				NOAA ER-L	NOAA ER-M
Semivolatiles (µg/kg)							
Di-n-butyl phthalate	--	--	1/8	430J	41-TC-SD12	NA	NA
bis(2-ethylhexyl)phthalate	--	--	1/8	83J	41-TC-SD12	NA	NA
Total Metals (mg/kg)							
Aluminum	--	--	8/8	470 - 4,200	41-DD-SD02	NA	JNA
Arsenic	33	85	4/8	0.83 - 3.6	41-DD-SD02	0	0
Barium	--	--	8/8	2.3 - 56.4	41-DD-SD02	NA	NA
Calcium	--	--	8/8	173 - 24,900	41-UT-SD01	NA	NA
Chromium	80	145	8/8	1.3 - 4.9	41-TC-SD10	0	0
Cobalt	--	--	1/8	14.4	41-DD-SD02	NA	NA
Copper	70	390	5/8	0.88 - 6.5	41-DD-SD02	0	0
Iron	--	--	8/8	330 - 58,700	41-DD-SD02	NA	NA
Lead	35	110	8/8	1.3 - 11.4	41-DD-SD02	0	0
Magnesium	--	--	5/8	37.9 - 353	41-UT-SD01	NA	NA
Manganese	--	--	8/8	2 - 430	41-DD-SD02	NA	NA
Nickel	30	50	3/8	12.5 - 3.3	41-UT-SD01	0	0
Potassium	--	--	4/8	13.5 - 193	41-DD-SD02	NA	NA
Selenium	--	--	4/8	0.53 - 0.87	41-TC-SD12	NA	NA
Sodium	--	--	8/8	24.1 - 54.1	41-UT-SD01	NA	NA
Thallium	--	--	1/8	1.7	41-UT-SD01	NA	NA
Zinc	120	270	7/8	6.1 - 56.6	41-DD-SD02	0	0

Notes:

-- = Not established
µg/kg = microgram per kilogram
NA = Not Applicable
NOAA = National Oceanic and Atmospheric Association
ER-L = Effects Range - Low
ER-M = Effects Range - Medium

TABLE 3-12
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
GROUNDWATER (SHALLOW)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	74-GW01-02	74-GW02-02	74-GW03A-02	74-GW07-02
DATE SAMPLED	03/18/96	03/18/96	03/18/96	03/19/96
VOLATILES (ug/L)				
SEMIVOLATILES (ug/L)				
PESTICIDE/PCBs (ug/L)	No Detects			

TABLE 3-12 (continued)
POSITIVE DETECTION SUMMARY
OPERABLE UNIT NO. 4 (SITE 74)
GROUNDWATER (SHALLOW)
BASELINE LONG-TERM MONITORING STUDY - CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

LOCATION	74-GW01-02	74-GW02-02	74-GW03A-02	74-GW07-02
DATE SAMPLED	03/18/96	03/18/96	03/18/96	03/19/96
TOTAL METALS (ug/L)				
ALUMINUM	460	418	2320	342
ARSENIC	2.2 U	2.2 U	2.8	2.4
BARIUM	31.5	38.7	32.8	98
CALCIUM	697	8160	256	441
COPPER	3 U	3 U	3.8	5.1
IRON	6 UJ	6 UJ	377	1230
LEAD	0.88 U	0.88 U	0.88 U	1.2
MAGNESIUM	1020	1210	435	2190
MANGANESE	4.8	2.2	10.4	5.4
POTASSIUM	513 U	513 U	513 U	549
SELENIUM	2	2	2	1.8 U
SODIUM	4770	2310	4390	8130
THALLIUM	10.6	3.9	3.7 U	3.7
VANADIUM	3.6 U	8.4	8	6.4
ZINC	3.6	3.6	12.5	5.9

TABLE 3-13

SUMMARY OF GROUNDWATER DATA, SITE 74
BASELINE LONG-TERM MONITORING STUDY, CTO-0352
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Criteria		Frequency	Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Exceedences	
	Federal MCL	NCWQS				MCL	NCWQS
Total Metals (µg/L)							
Aluminum	--	--	4/4	342 - 2,320	74MW03A-02	NA	NA
Arsenic	50	--	2/4	2.4 - 2.8	74MW03A-02	0	NA
Barium	2,000	2,000	4/4	31.5 - 98	74-MW07-02	0	0
Calcium	--	--	4/4	256 - 8,160	74-MW02-02	NA	NA
Copper	1,300	1,000	2/4	3.8 - 5.1	74-MW07-02	0	0
Iron	300	300	2/4	377 - 1,230	74-MW07-02	3	2
Lead	15	15	1/4	1.2 - 1.2	74-MW07-02	0	0
Magnesium	--	--	4/4	435 - 2,190	74-MW07-02	NA	NA
Manganese	50	50	4/4	2.2 - 10.4	74-MW03A-02	0	0
Potassium	--	--	1/4	549 - 549	74-MW07-02	NA	NA
Selenium	50	50	3/4	2 - 2	74-MW03A-02	0	0
Sodium	--	--	4/4	2,310 - 8,130	74-MW07-02	NA	NA
Thallium	--	--	3/4	3.7 - 10.6	74-MW01-02	NA	NA
Vanadium	--	--	3/4	6.4 - 8.4	74-MW02-02	NA	NA
Zinc	--	2,100	4/4	3.6 - 12.5	74-MW03A-02	NA	0

Notes:

-- = Not established
MCL = Maximum Contaminant Level
NCWQS = North Carolina Water Quality Standard
µg/L = microgram per liter
NA = Not Applicable

SECTION 4

4.0 CONCLUSIONS

4.1 Site 41 - Groundwater

The following provides a discussion and comparison of groundwater contamination from Rounds 1 and 2, collected during the RI, and Round 3 collected during the baseline long-term monitoring study. The wells sampled during Round 3 were selected based on analytical findings from Rounds 1 and 2.

4.1.1 Shallow

Volatiles

Benzene and chlorobenzene were detected in the shallow groundwater in Rounds 1, 2, and 3. The detected concentration in Round 3 was higher than in the first two rounds. The three benzene concentrations exceeded the NCWQS criteria; however, none of the chlorobenzene detections exceeded the Federal or State criteria.

Acetone was only detected in Round 2 at a concentration of 2 µg/L in monitoring well 41-MW11.

Semivolatiles

Aside from common laboratory contaminants, naphthalene and 1,4-dichlorobenzene were the only semivolatiles detected in the shallow groundwater. Naphthalene was detected during Rounds 1 and 3 sampling at a concentration of 3 J µg/L. There are no Federal or State standards established for naphthalene. 1,4-dichlorobenzene was detected in monitoring well 41-MW11 during Round 3 only.

Pesticide/PCBs

During Round 1, beta-BHC (0.04 J µg/L) and 4,4'-DDD (0.01 NJ µg/L) were detected at concentrations in 41-MW02 and 41-MW11, respectively. These contaminants were not detected in the shallow wells at Site 41 during the Round 2 or 3 sampling activities.

Total Metals

Generally, the concentrations of metals in the shallow groundwater samples decreased from Round 1 to Round 3. The concentrations of ten of the metals (aluminum, barium, calcium, iron, magnesium, manganese, potassium, sodium, vanadium, and zinc) decreased. Eight metals (antimony, beryllium, cadmium, chromium, cobalt, mercury, nickel, and silver) that were detected in Rounds 1 and 2 were not detected in the Round 3 sampling event. The concentrations of arsenic, copper, lead, and selenium in a portion of the groundwater wells either significantly decreased in concentration from Round 1 to Round 3 or were not detected in the Round 3 samples. Thallium was the only contaminant that was not detected in Rounds 1 and/or 2 but was detected in the Round 3. In Round 3, arsenic, iron, and manganese were the only three contaminants that exceeded the Federal MCL criteria, where iron and manganese also exceeded the NCWQS.

4.1.2 Castle Hayne Aquifer

41-MW11DW-03 was the only deep well that was evaluated in the Round 3 sampling event.

Volatiles

In Rounds 1 and 3, total 1,2-dichloroethene was detected in the groundwater at a concentration of 1.22 J µg/L and 1.0 J µg/L, respectively. Neither concentration exceeded the Federal MCL criteria. A state standard has not been established for this contaminant. 1,1,1-trichloroethane was detected in the Round 2 sampling at a concentration that did not exceed the Federal or State criteria.

Three additional VOCs (vinyl chloride, 1,2-dichloropropane, and benzene) were detected during the Round 3 sampling event. Vinyl chloride (1J µg/L) and 1,2-dichloropropane (1J µg/L) exceeded the established state standard of 0.015 µg/L and 0.56 µg/L, respectively.

Semivolatiles

SVOCs were not detected in the Round 1 or 2 sampling events. Contaminants that are considered common laboratory contaminants were detected in the Round 3 sampling event.

Pesticides/PCBs

Pesticides and PCBs were not detected in the groundwater sampled during the Round 1 or 2 sampling events. However, in Round 3, alpha- and gamma- chlordane were detected at concentrations that exceeded the NCWQS criteria.

Total Metals

In general, the metal contaminant concentrations in the Round 2 sampling effort were elevated compared to the Round 1 and Round 3 sample data. Five metals (arsenic, cadmium, chromium, copper, and nickel) were detected exclusively in the Round 2 sampling data. Lead was the only contaminant that was detected in the groundwater during the Round 1 and 2 sampling events, but not in the Round 3 sampling event.

From the Round 3 sampling data, iron and magnesium were the only contaminants in the groundwater that exceeded both the Federal and State water quality criteria. Additionally, arsenic exceeded the NCWQS criteria.

4.2 Site 41 - Surface Water

Surface water data was collected during the RI field investigation in two rounds. Since the same sampling stations were not sampled in each round, the entire RI surface water sampling effort will be referred to as Round 1 in the following text. Additional surface water sampling was conducted as part of the baseline study and will be referred to as Round 2 data. The Round 2 surface water samples were collected in the vicinity of Round 1 surface water stations that exhibited elevated contaminant concentrations.

The surface water bodies that were sampled during Round 2 and are included in this analysis are the unnamed creek, Tank Creek, and two drainage seeps.

Volatiles

VOCs were not detected in the Tank Creek or unnamed creek surface water samples. Chlorobenzene was detected in the drainage seep area in both Round 1 and 2 surface water samples. None of the sample concentrations exceeded the Federal or State surface water quality criteria.

Semivolatiles

1,4-dichlorobenzene was detected at a concentration of 2 µg/L in the drainage seep area (41-DD-SD01) during the Round 2 surface water sampling effort. This was the only SVOC detection in the surface water samples.

Pesticide/PCBs

Gamma-BHC and 4,4'-DDD were detected during Round 1 of the surface water sampling near the 41-UT-SW02 sampling station. PCBs were not detected in the surface water during Round 1. These contaminants and other pesticides or PCBs were not detected in the surface water during Round 2 sampling activities.

Total Metals

Tank Creek

The Round 2 surface water samples were compared to Round 1 surface water samples that were located in the approximate area. The following lists the surface water samples that were included in the Tank Creek analysis:

Round 1	Round 2
41-TC-SW07	41-TC-SW10
41-TC-SW08	41-TC-SW11
	41-TC-SW12

Nine metals (aluminum, barium, calcium, iron, magnesium, manganese, potassium, sodium, and zinc) were detected in both the Round 1 and Round 2 surface water samples at concentrations that were within a similar range of concentration between sampling stations. Arsenic, cadmium, chromium, and selenium were each detected in one surface water sample collected during the Round 2 sampling event. Copper and vanadium were detected in all of the surface water samples collected during Round 2; however, they were not detected in the Round 1 surface water samples. Lead was detected in the Round 1 surface water samples but not in either of the Round 2 samples.

Arsenic, iron, and manganese were the only metals that exceeded the Federal MCL criteria. Manganese also exceeded the NCWQS.

Unnamed Creek

The Round 2 surface water samples were compared to Round 1 surface water samples that were located in the approximate area. The following lists the surface water samples that were included in the unnamed creek analysis:

Round 1	Round 2
41-UT-SW01	41-UT-SW01
41-UT-SW04	41-UT-SW02
41-UT-SW10	41-UT-SW03

Eight metals (aluminum, barium, calcium, iron, magnesium, manganese, potassium, and sodium) were detected in both the Round 1 and Round 2 surface water samples at concentrations that were within a similar range of concentration between sampling stations. Arsenic, copper, and selenium were each detected in one surface water sample collected during the Round 2 sampling event. Vanadium was detected in all of the surface water samples collected during Round 2; however, they were not detected in the Round 1 surface water samples. Lead was detected in the Round 1 surface water samples but not in any of the Round 2 samples. Concentrations of zinc were detected in the the three Round 2 surface water samples and one of the Round 1 surface water samples.

Arsenic and iron from both Rounds 1 and 2 were the only metals that exceeded the Federal MCL criteria. None of the metals exceeded the State water quality criteria.

Drainage Seep

The Round 2 surface water samples collected from the drainage seep were compared to Round 1 surface water samples that were located in the same approximate area. The following lists the surface water samples that were included in the drainage seep analysis:

Round 1	Round 2
41-UT-SW03	41-DD-SW01
41-UT-SW12	41-DD-SW02
41-UT-SW18	
41-UT-SW20	
41-UT-SW25	
41-UT-SW26	

Barium, calcium, iron, magnesium, potassium, and sodium were detected in all of the surface water samples included in this analysis in both Rounds 1 and 2. The ranges of detected concentrations are presented below.

Barium	18.4 µg/L - 327 µg/L
Calcium	30,000 µg/L - 121,000 µg/L
Iron	633 µg/L - 238,000 µg/L
Magnesium	17.5 µg/L - 1,200 µg/L
Potassium	1,700 µg/L - 4,450 µg/L
Sodium	7,490 µg/L - 52,600 µg/L

The minimum and maximum concentrations listed above were all detected in the surface water samples collected during the Round 1 sampling event. Therefore, all of the concentrations of metal detected in the Round 2 sampling event fell within the range of that particular metal. All of the maximum concentrations listed in the ranges were collected from 41-UT-SW25.

Cobalt, lead, and mercury were detected in a portion of the Round 1 surface water samples, but were not detected in any of the Round 2 surface water samples.

Concentrations of aluminum and zinc were detected in all of the surface water samples with the exception of one surface water sample from Round 1. Again, the maximum concentration was collected from 41-UT-SW25.

Arsenic, copper, and vanadium were detected in a limited number of surface water samples collected during both Rounds 1 and 2. Cobalt was detected in one Round 1 surface water sample (41-UT-SW25).

Arsenic, iron, and manganese from both Rounds 1 and 2 were the only metals that exceeded the Federal MCL criteria. Manganese also exceeded the State water quality criteria.

4.3 Site 41 - Sediment

Sediment data was collected during the RI field investigation in two rounds. Since the same sampling stations were not sampled in each round, the entire RI sediment sampling effort will be referred to as Round 1 in the following text. Additional sediment sampling was conducted as part of the baseline study and will be referred to as Round 2. The Round 2 sediment samples were collected in the vicinity of Round 1 sediment stations that exhibited elevated contaminant concentrations.

The surface water bodies where the sediments were collected during Round 2 and that are included in this analysis are the unnamed creek, Tank Creek, and two drainage seeps.

Volatiles

Methylene chloride was detected in three of the sediment samples and acetone was detected in two of the sediment samples collected during the Round 1 sampling event. One sediment sample in Tank Creek exhibited a low concentration of toluene. VOCs were not detected in the Tank Creek, unnamed creek, or drainage seep Round 2 surface water samples None of the sample concentrations exceeded the NOAA ER-L or ER-M.

Semivolatiles

With the exception of common laboratory contaminants, such as di-n-butyl phthalate and bis(2-ethylhexyl)phthalate, no other SVOCs were detected in the sediment samples collected from the unnamed creek, Tank Creek, or the drainage seep.

Pesticide/PCBs

Pesticides and PCBs were not detected in the sediment samples collected from any of the water bodies during the Round 2 sampling event. However, pesticides were detected in the sediments during Round 1 sampling.

4,4'-DDE, 4,4'-DDD, and methoxychlor were detected in one of the two sediment samples collected in Tank Creek during the Round 1 sampling event in concentrations that did not exceed the ER-L or ER-M. No PCBs were detected in either of the sediment samples.

In the unnamed creek, several pesticides were detected in the sediments. 4,4'-DDE, 4,4'-DDD, and alpha - and gamma-chlordane were detected in all three of the sediment samples included in this analysis. Two of the concentrations of 4,4'-DDE and all three of the concentrations of 4,4'-DDD exceeded the ER-L screening level. Dieldrin and endosulfan II were detected in two of the sediment samples. The concentrations of dieldrin both exceeded the ER-L. 4,4'-DDT and methoxychlor were detected in one sediment samples, where the concentration of 4,4'-DDT exceeded the ER-L and ER-M. PCBs were not detected in any of the sediment samples.

In the drainage seep sediments collected during Round 1, 4,4'-DDD was detected in two, 4,4'-DDE in four, and 4,4'-DDT in three of the sediment samples included in this analysis. The concentrations of 4,4'-DDD and 4,4'-DDT all exceeded the ER-L and one sediment sample exceeded the ER-M. The concentrations of 4,4'-DDE all exceeded the ER-L and two sediment samples exceeded the ER-M. Dieldrin, endosulfan II, methoxychlor, and alpha- and gamma-chlordane was detected in one of the sediment samples, where only dieldrin exceeded the ER-L screening criteria. PCBs were not detected in any of the sediment samples.

Total Metals

Tank Creek

The Round 2 sediment samples were compared to Round 1 sediment samples that were located in the approximate area. The following lists the surface water samples that were included in the Tank Creek analysis:

Round 1	Round 2
41-TC-SD07	41-TC-SD10
41-TC-SD08	41-TC-SD11
	41-TC-SD12

Five metals (aluminum, barium, calcium, iron, and lead) were detected in both the Round 1 and Round 2 sediment samples at concentrations that were within a similar range of concentration between sampling stations. Beryllium was detected in one sediment sample collected during the Round 1 sampling event and not during the Round 2. Arsenic, chromium, copper, nickel, potassium, sodium, and zinc were detected in the sediment samples collected during Round 2; however, they were not detected in the Round 1 sediment samples. Selenium, magnesium and manganese were detected in both Rounds 1 and 2, but not uniformly across the sampling stations.

None of the concentrations of metals detected in the sediments samples in Tank Creek exceeded the ER-L or ER-M screening criteria.

Unnamed Creek

The Round 2 sediment samples were compared to Round 1 sediment samples that were located in the same approximate area. The following lists the sediment samples that were included in the unnamed creek analysis:

Round 1	Round 2
41-UT-SD01	41-UT-SD01
41-UT-SD04	41-UT-SD02
41-UT-SD10	41-UT-SD03

Five metals (aluminum, calcium, iron, lead, and magnesium) were detected in all the sediment samples in both the Rounds 1 and 2 at concentrations that were within a similar range of concentration between sampling stations.

Beryllium and vanadium were detected in one sediment sample collected during the Round 1 sampling event and was not detected in any of the Round 2 samples. Arsenic, copper, potassium, and thallium were detected in the sediment samples collected during Round 2; however, they were not detected in the Round 1 sediment samples. Barium, chromium, magnesium, nickel, sodium, and zinc were detected in both Rounds 1 and 2, but not uniformly across the sampling stations.

None of the concentrations of metals detected in the sediments samples in the unnamed creek exceeded the ER-L or ER-M screening criteria.

Drainage Seep

The Round 2 sediment samples collected from the drainage seep were compared to Round 1 sediment samples that were located in the same approximate area. The following lists the sediment samples that were included in the drainage seep analysis:

Round 1	Round 2
41-UT-SW03	41-DD-SW01
41-UT-SW12	41-DD-SW02
41-UT-SW18	
41-UT-SW20	
41-UT-SW25	
41-UT-SW26	

Aluminum, barium, calcium, iron, lead, magnesium, and manganese were detected in all of the sediment samples included in this analysis in both Rounds 1 and 2. The ranges of detected concentrations are presented below.

Aluminum	596 mg/kg - 10,200 mg/kg
Barium	2.9 mg/kg - 161 mg/kg
Calcium	188 mg/kg - 8420 mg/kg
Iron	510 mg/kg - 104,000
Lead	1.13 mg/kg - 28.2 mg/kg
Magnesium	28.2 mg/kg - 321 mg/kg
Manganese	1.9 mg/kg - 430 mg/kg

The minimum and maximum concentrations listed above were all detected in the surface water samples collected during the Round 1 sampling event, with the exception of the maximum concentration of manganese which was collected during Round 2. Therefore, all of the

concentrations of metal detected in the Round 2 sampling event fell within the range of that particular metal. All of the maximum concentrations listed in the ranges were collected from 41-UT-SD25.

Mercury and vanadium were detected in a portion of the Round 1 sediment samples, but were not detected in any of the Round 2 sediment samples. Similarly, cobalt, potassium, and selenium were detected in a portion of the Round 2 sediment samples, but were not detected in any of the Round 1 sediment samples.

Arsenic, chromium, copper, sodium, and zinc were detected in a limited number of sediment samples collected during both Rounds 1 and 2.

Zinc was the only metal that was detected in the sediment samples that was detected in a concentration that exceeded the screening criteria. At sediment sampling station 41-UT-SD25, zinc exceeded the NOAA ER-L

4.4 Site 74 - Groundwater

The following provides a discussion and comparison of groundwater contamination from Rounds 1, collected during the RI, and Round 2 collected during the baseline long-term monitoring study. The wells sampled during Round 2 were selected based on analytical findings from Rounds 1.

4.4.1 Shallow

Volatiles

Acetone was detected at concentrations ranging from 2 J µg/L to 2.04 J µg/L in two of the Round 1 groundwater samples. The concentration of acetone did not exceed either the Federal or State water quality criteria. No VOCs were detected in the Round 2 groundwater samples.

Semivolatiles

SVOCs were not detected in either the Round 1 or Round 2 groundwater sampling events.

Pesticide/PCBs

During Round 1, Heptachlor was detected at a concentration of 0.01 µg/L in the groundwater collected from monitoring well 74-MW01 that exceeded the state groundwater quality standard (0.008 µg/L). It was not detected in any monitoring wells during the Round 2 sampling activities. The concentration of heptachlor exceeded the NCWQS of 0.008 µg/L. No other pesticides or PCBs were detected in the Site 74 groundwater samples.

Total Metals

Generally, the concentrations of metals in the shallow groundwater samples decreased from Round 1 to Round 2. The concentrations of five of the metals (arsenic, iron, lead, manganese, and potassium) decreased concentration from Round 1 to Round 2. Beryllium, chromium, and mercury were detected in Round 1 groundwater samples, but were not detected in Round 2 groundwater samples.

Copper and thallium were detected in the Round 2 groundwater samples but were not detected in the Round 1 groundwater samples. The concentration of sodium detected in the groundwater sample increased from Round 1 to Round 2.

The concentrations of aluminum, barium, calcium, magnesium, selenium, vanadium, and zinc varied per groundwater monitoring well between the Round 1 and Round 2 sampling events. In a portion of the wells, the concentrations increased from Round 1 to Round 2, but decreased from Round 1 to Round 2 in other groundwater samples.

Iron, lead, manganese, and selenium concentrations in the Round 1 groundwater samples exceeded the Federal MCL and NCWQS. Iron was the only contaminant that exceeded the Federal MCL criteria and NCWQS in the Round 2 sampling event.

SECTION 5

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