FINAL

SAMPLE STRATEGY PLAN

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY PROJECT PLANS

OPERABLE UNIT NO. 8 (SITE 16)
OPERABLE UNIT NO. 11 (SITES 7 AND 80)
OPERABLE UNIT NO. 12 (SITE 3)

MARINE CORPS BASE,
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0233

Prepared for:

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

Under the:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

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Coraopolis, Pennsylvania

MARCH 21, 1994

INTRODUCTION

This Final Sample Strategy Plan presents an overview of the remedial investigation (RI) scope of work for Site 3 (Old Creosote Site), Site 7 (Tarawa Terrace Dump), Site 16 (Montford Point Burn Dump), and Site 80 (Paradise Point Golf Course) at Marine Corps Base (MCB), Camp Lejeune, North Carolina. Figure 1 shows the overall locations of these sites.

The purpose of the Final Sample Strategy Plan is to provide the EPA Region IV, the North Carolina Department of the Environment, Health, and Natural Resources (DEHNR), and members of the technical review committee (TRC) with a summary of the proposed field investigations that will be presented by LANTDIV at an upcoming RI/FS scoping meeting. This document is meant to be used as a supplement to the scoping meeting, and is not intended for formal comment. Questions or comments on the proposed RI field investigations will be addressed by LANTDIV at the upcoming meeting.

The format of the Final Sample Strategy Plan is as follows. Each site is addressed separately in this document. A brief description of the site location and setting, site history, and a summary of previous investigations are provided. Previously-obtained analytical results are also presented in table format in order to familiarize the reader with the level and types of contamination at the site. The proposed field investigations are described, including the objectives and sampling rationale. Figures depicting the sampling stations are also included.

Format idea:

for RI/FS Project plans - group all info together for a site. That way won't need to flip back & forth to gather all info.

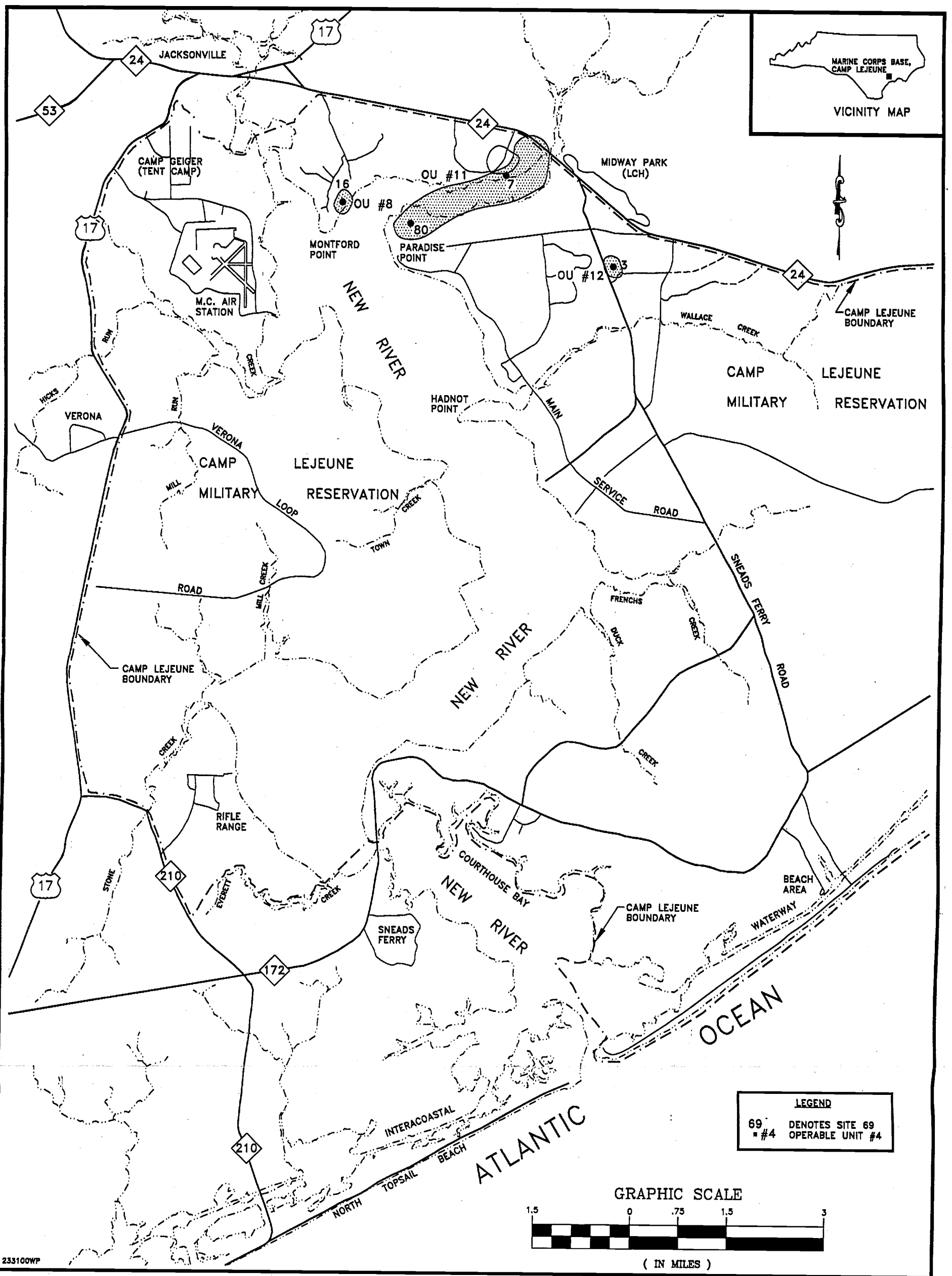


FIGURE 1
OPERABLE UNITS AND SITE LOCATIONS AT MARINE CORPS BASE CAMP LEJEUNE

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00221M012

OPERABLE UNIT NO. 8
SITE 16, MONTFORD POINT BURN DUMP AREA

1.0 SITE LOCATION AND SETTING

The former Montford Point burn dump area is located southwest of the intersection of Montford Landing Road and Wilson Drive in the Montford Point area of Camp Lejeune. The study area for this site is estimated at 4 acres in size. It is relatively flat, with a slight slope to the southeast. The Northeast Creek is approximately 400 feet southeast from the southeast boundary of the burn dump. The remainder of the study area is bordered by trees/woods. The general site location is shown on Figure 1.

2.0 SITE HISTORY

Limited information is available concerning operations of the burn dump. Practices at other burn dumps at Camp Lejeune indicate that the Montford Point burn dump accepted municipal waste/trash from the surrounding area housing and activities buildings. Records also indicate that liquids (waste oils) were also disposed of at this site. Typically, the debris was burned, then graded to the perimeter so that more debris could be dumped and burned.

3.0 PREVIOUS INVESTIGATIONS

This site was identified in the Initial Assessment Study (April 1983) as requiring further study. No previous field investigations have been performed at this site.

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc. March 1994)

The Montford Point burn dump is a cleared area surrounded by woods on all four sides. There is a opening in the trees in the southeast corner of the burn dump that leads to Northeast Creek. An apparent storm sewer line, located to the southeast of the burn dump, runs in a northeast-southwest direction. There is also a storm sewer line that runs from the intersection of Coolidge Road and Harding Road, and connects to the storm line southeast of the site. Currently, the site is being used for storing vehicles used in training, and for training exercises. In the center of the former burn dump is a mock-up jet aircraft. This aircraft is used in refueling exercises by tanker truck operators. During these exercises, however, no fuel is used. A four-foot wide ditch, believed to be a fire break, was noticed coming off of the storm sewer line to the southwest of the site and extending around the western side of the former burn dump. There are no permanent structures at this site. Figure 2 shows existing structures/features of the site.

5.0 PROPOSED FIELD INVESTIGATION

The objectives of the proposed field investigation for Site 16 are to define the types and extent of potential contamination within the soil and groundwater at the site and south towards Northeast Creek. The field program will also investigate potential contamination in Northeast Creek. The activities associated with this investigation are as follows.

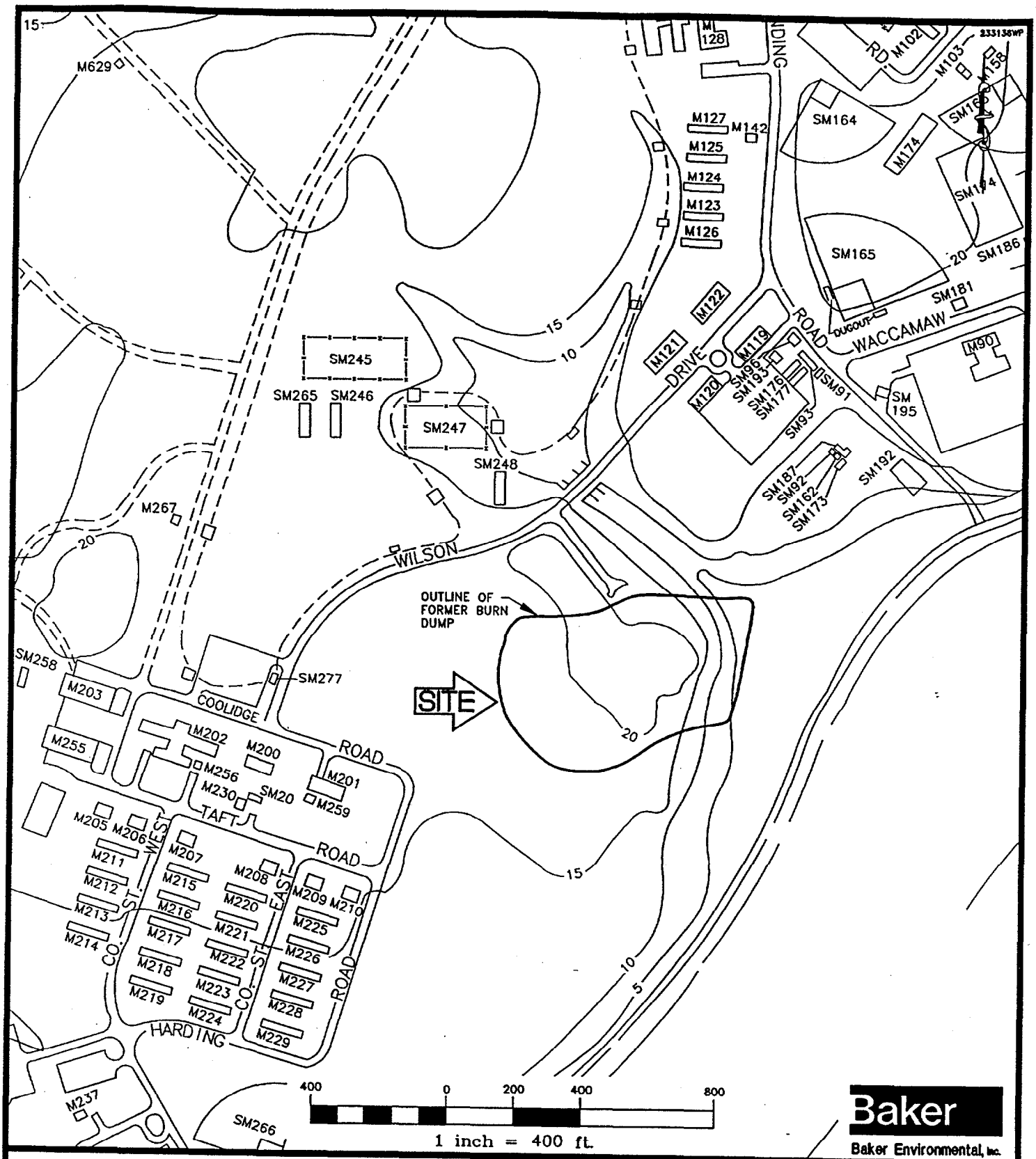


FIGURE 1
LOCATION MAP
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV., FEB. 1992

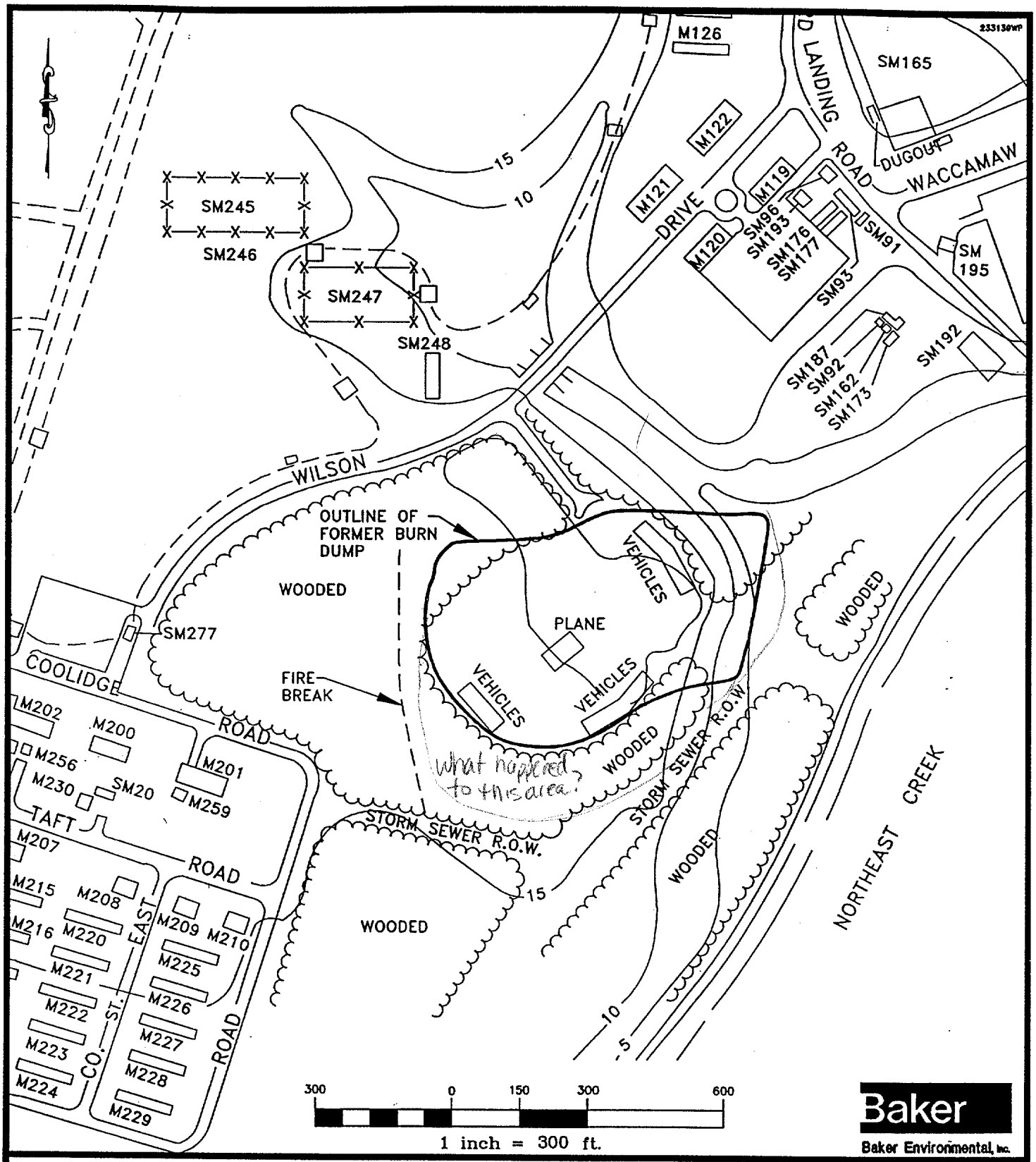


FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJUENE
NORTH CAROLINA

SOURCE: LANTDIV, FEB., 1992

Trenches would follow soil investigation to use soil as a screening.

5.1 Soil Investigation

Four trenches will be excavated within the boundary of the former burn dump to investigate the existence of any remaining trash or debris. These trenches will be approximately twenty (20) feet in length with a depth of approximately six (6) feet. No soil samples will be collected from the trenches for laboratory analyses. The locations of the trenches are shown on Figure 3.
↳ unless determined appropriate by field team.

A series of soil borings will be performed within the boundary of the former burn dump. A 150 foot by 100 foot sampling grid will be established within the former burn dump. A total of twenty-two (22) borings will be drilled to a depth of approximately 10 feet (or to the top of the groundwater table) to determine the shallow stratigraphy at the site and to collect samples for laboratory analysis. Two (2) soil samples from each soil boring will be submitted for chemical analysis. These samples will be collected from the surface and just above the groundwater table for analysis of full TCL organics and TAL metals. Four (4) hand auger locations will be drilled and sampled southeast of the site. One location is where there is a break in the trees at the southeast corner of the former burn dump and a second location is to the southeast where there is evidence of surface drainage wash. The remaining two hand auger locations will be drilled south of the storm sewer right-of-way leading towards Northeast Creek. Two soil samples will also be collected from each of these locations for the same laboratory analyses as the soil borings. The locations of the soil sampling points are shown on Figure 4.

A minimum of two soil samples will be collected from each of the proposed groundwater monitoring well locations and submitted for laboratory analysis. The samples will be collected from the surface and just above the groundwater table.

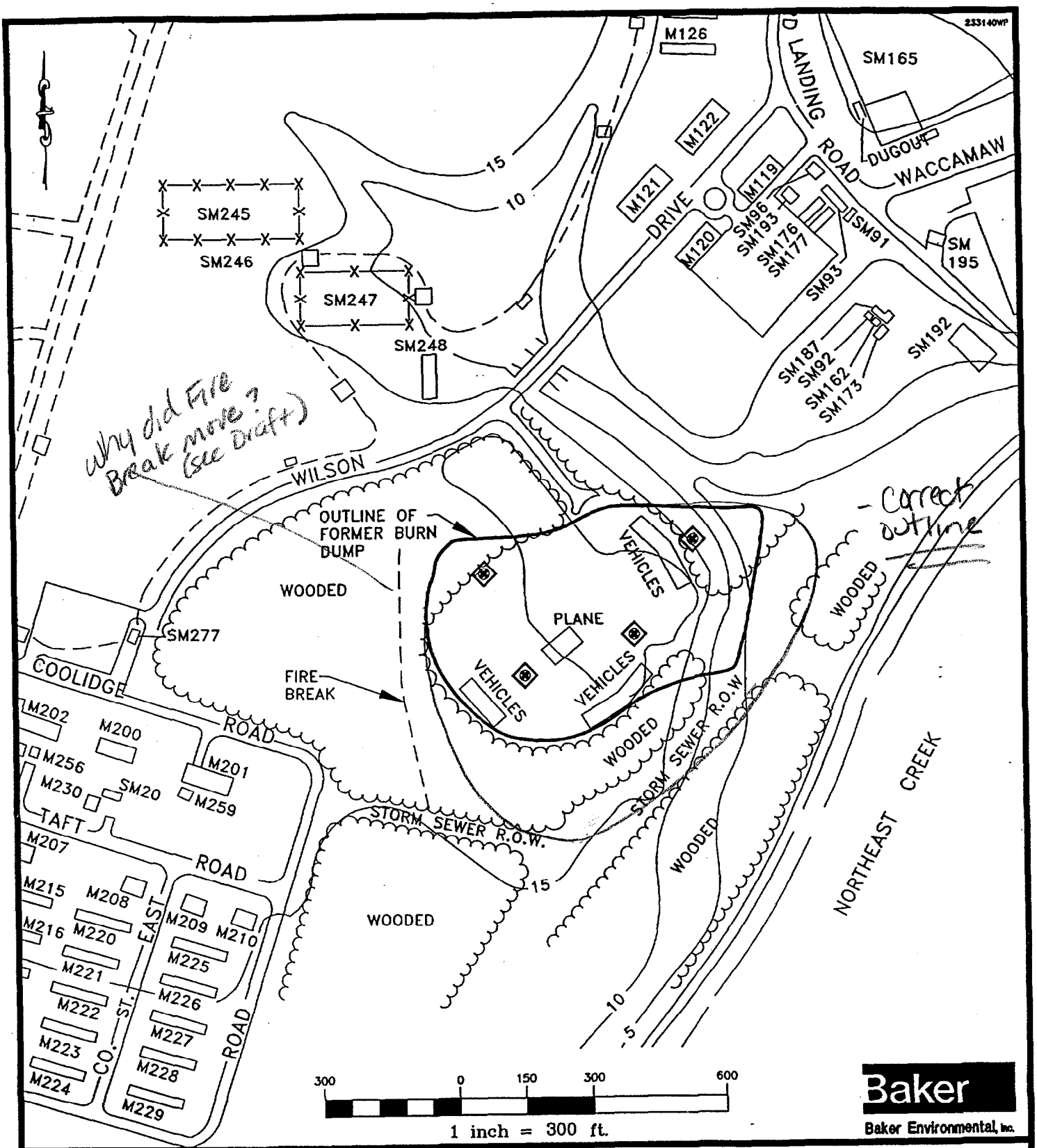
5.2 Surface Water/Sediment Investigation

Five surface water and sediment sampling stations are proposed along Northeast Creek. Three of the sampling stations will be spaced approximately every 400 feet along the creek south of the former burn dump. One surface water and sediment sampling point will be located one-quarter mile upstream from the burn dump and the remaining sampling location will be one-quarter mile downstream from the burn dump. Sediment samples will be collected from depths of 0 to 6 inches and 6 to 12 inches, and submitted for laboratory analysis. Analysis will be for full TCL organics and TAL metals. The proposed locations of the surface water and sediment sampling stations are shown on Figure 4.

5.3 Groundwater Investigation

Four (4) → 5 shallow groundwater monitoring wells are proposed for this investigation to determine if the former disposal/burning activities have affected groundwater. One well will serve as an upgradient, background well. Three shallow wells will be installed downgradient of the site to assess off-site groundwater quality. These wells will be approximately 20 to 25 feet deep. The proposed locations for the monitoring wells are shown on Figure 5. A fifth well will be installed within the boundary of the former burn dump, based on visual field observations, to assess the groundwater quality within the burn dump. Based on elevated HNU readings and visual observations of contaminants in the field, a sixth shallow monitoring well may be installed within the former burn dump.

Two rounds of groundwater samples will be collected from the newly installed monitoring wells. The first round of samples will be collected approximately one week following the development of the wells. The second round will be collected approximately three weeks following the first sampling round. All groundwater samples will be analyzed for full TCL organics and TAL metals (total and dissolved).



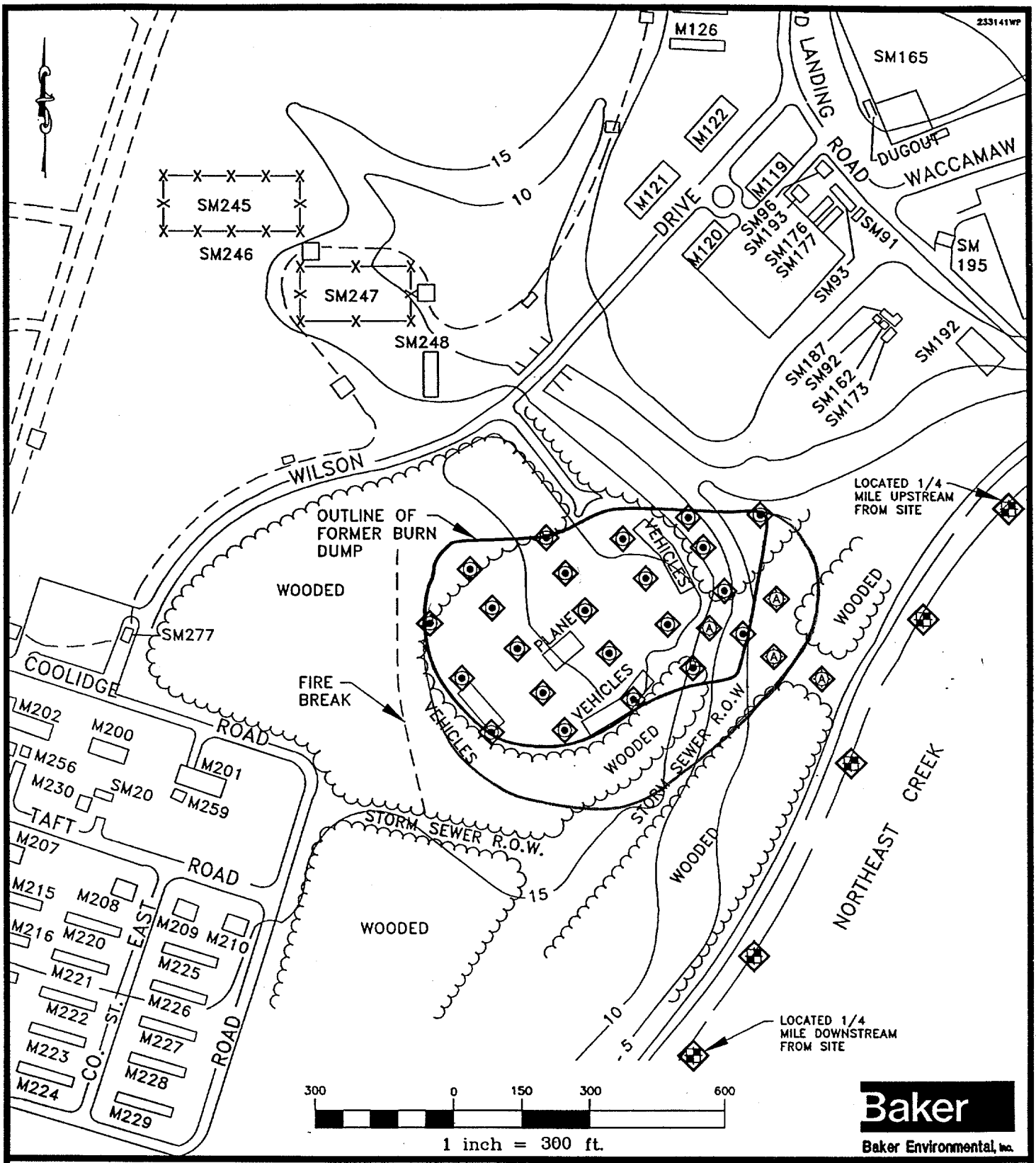
LEGEND

◈ PROPOSED TRENCH LOCATION

SOURCE: LANTDIV, FEB., 1992

FIGURE 3
PROPOSED TRENCH INVESTIGATION
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



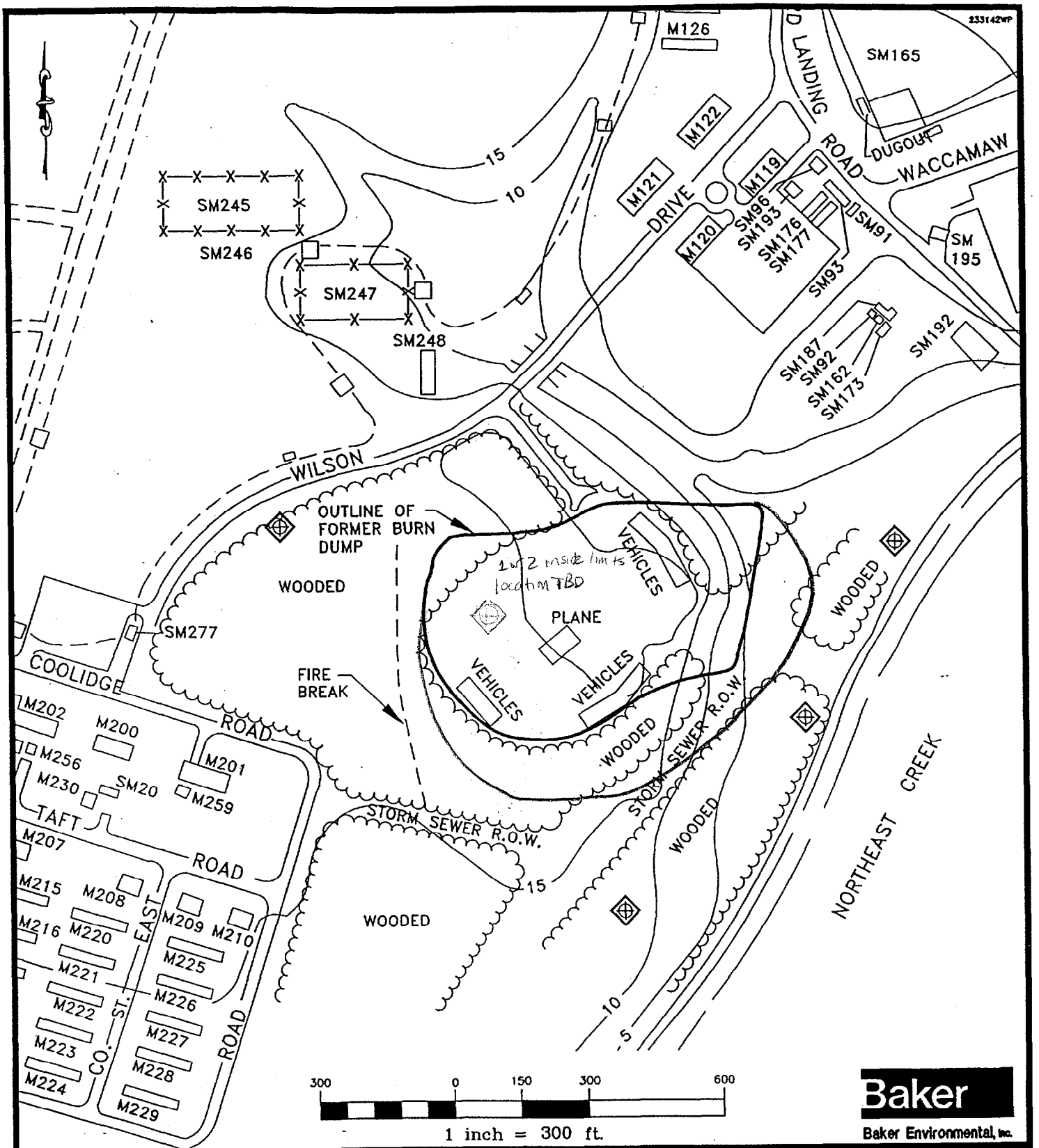
LEGEND

- PROPOSED HAND AUGER SAMPLE LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION

SOURCE: LANTDIV, FEB., 1992

FIGURE 4
PROPOSED SOIL INVESTIGATION
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJUENE
NORTH CAROLINA



LEGEND

◈ PROPOSED SHALLOW MONITORING WELL LOCATION

SOURCE: LANTDIV, FEB., 1992

FIGURE 5
PROPOSED GROUNDWATER INVESTIGATION
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJUENE
NORTH CAROLINA

OPERABLE UNIT NO. 11
SITE 7, TARAWA TERRACE DUMP

1.0 SITE LOCATION AND SETTING

Site 7 is located north and east of the water treatment plant, south of the Community Center, and is bordered to the north and south by Tarawa Boulevard and Northeast Creek, respectively. The study area is approximately 5 acres, and access is not restricted. A marsh area is encountered in the southern portion of the study area in the vicinity of Northeast Creek. The entire study area is dense with wooded areas and ground cover. Northeast Creek flows to the west in the direction of the New River. The general site location is shown on Figure 1.

2.0 SITE HISTORY

Tarawa Terrace Dump is a former dump, but the precise years of operation are unknown. It was used during the construction of the base housing located in Tarawa Terrace. The dump was closed in 1972. Past history does not indicate that hazardous materials were disposed of at this facility. Only construction debris, water treatment plant filter media, and household trash are known to have been disposed. The general arrangement of the site is shown on Figure 2.

3.0 PREVIOUS INVESTIGATIONS

- A Site Inspection was conducted in 1991 by Halliburton/NUS.
- Preliminary Draft Site Inspection Report (Halliburton/NUS, November 1991).
- Site Inspection sampling locations are presented on Figure 3.

3.1 Groundwater Investigation

Three shallow monitoring wells were installed and one round of groundwater samples were analyzed for full TCL organics and TAL total metals and cyanide. Analytical findings are summarized on Table 1.

Two pesticides, dieldrin and endrin ketone, were reported at low levels in one sample. Total metals were reported in all groundwater samples. Compare to base-wide background levels.

3.2 Soil Investigation

Eight surface soil samples (0 to 2 feet) and five subsurface soil samples (3 to 12 feet) were collected. All samples were analyzed for full TCL organics and TAL metals and cyanide. Analytical findings are summarized on Table 2.

Soil sample location MW02 exhibited elevated levels of PCBs and pesticides. Pesticides and PCBs were also reported in soil samples SB01 and SB02. The highest level of PCBs were detected in the subsurface soil (7.5 to 9.5 feet) at location MW02.

3.3 Surface Water/Sediment Investigation

Not conducted as part of the Site Inspection.

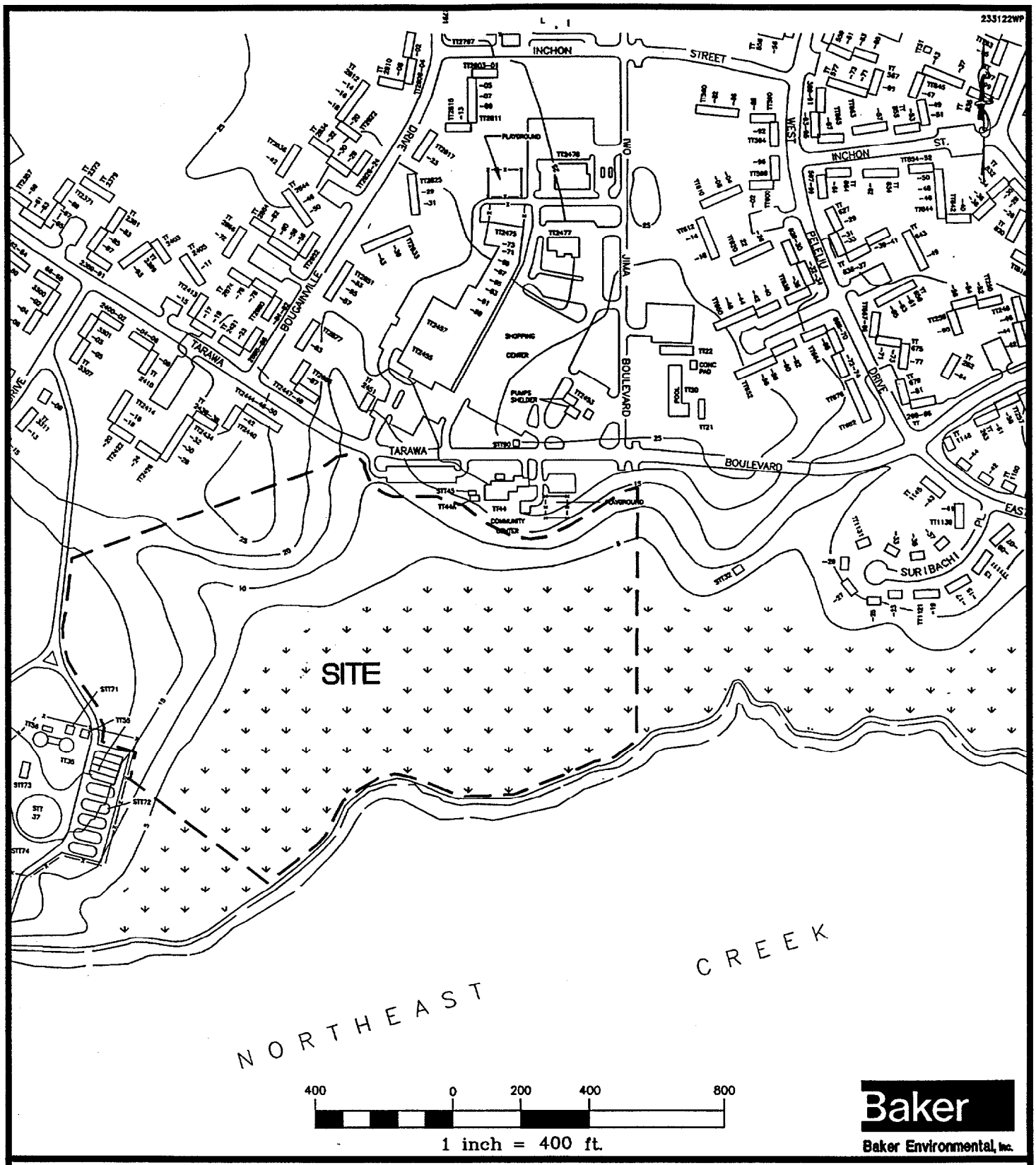
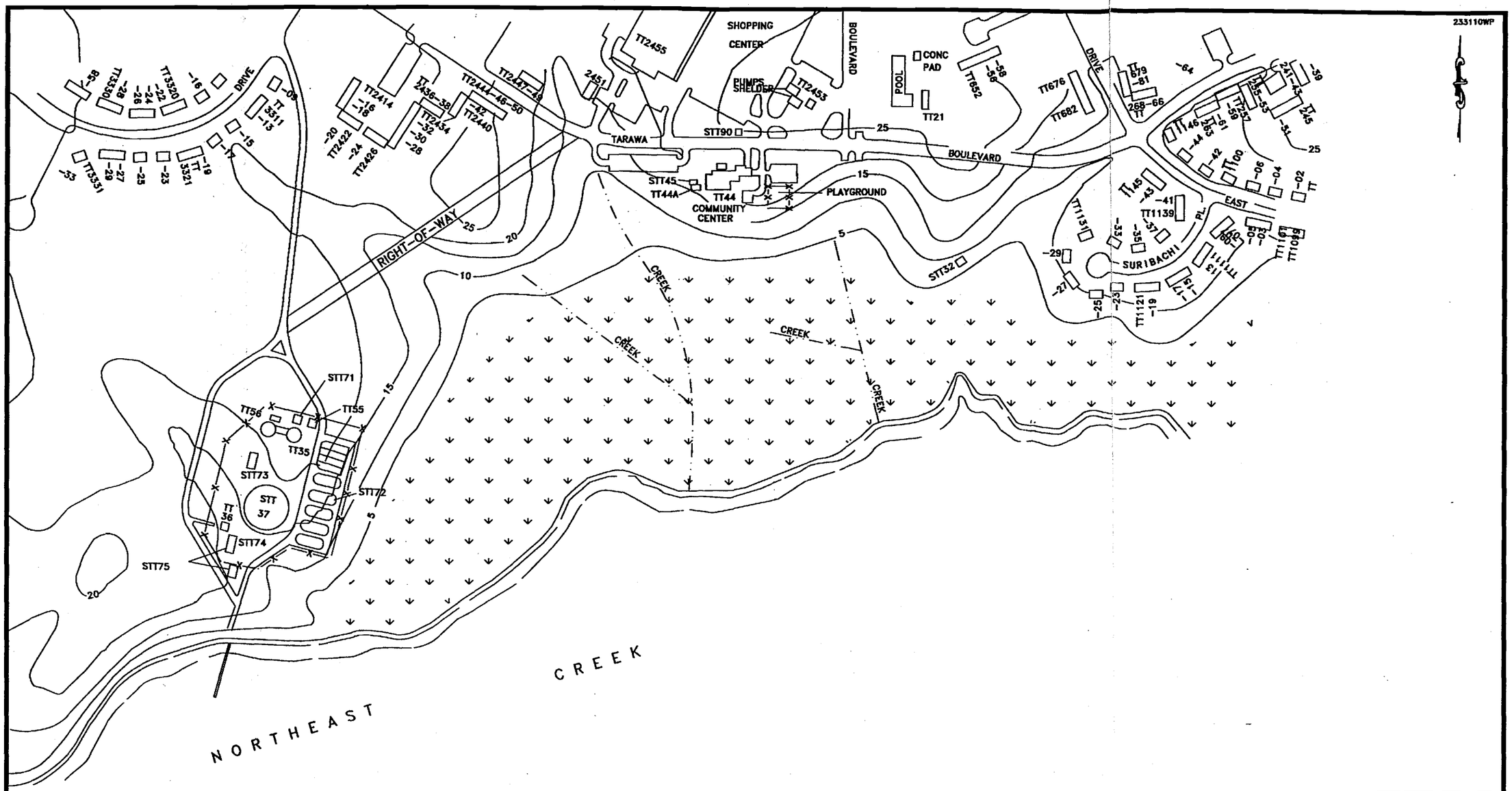


FIGURE 1
LOCATION MAP
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV., FEB. 1992



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Baker Environmental, Inc.

LEGEND

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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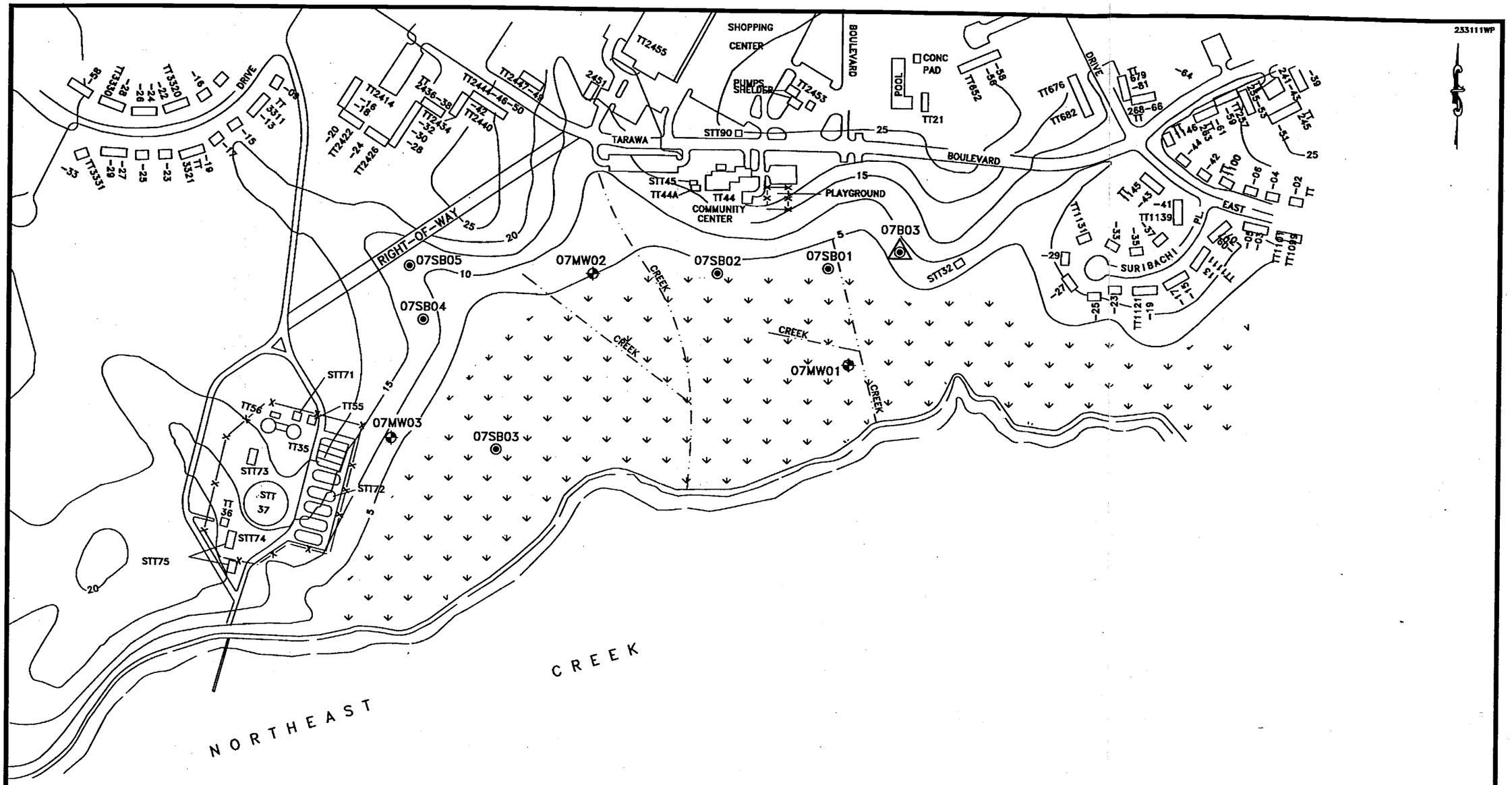

LEGEND

07MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07B03 EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

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FIGURE 3
PREVIOUS INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00221M032

TABLE 1

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION
OU NO. 11 (SITE 7)
TARAWA TERRACE DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	North Carolina Standards	EPA MCLs	No. of Positive Detections/ No. of Samples	Range of Positive Detections (μg/L)	Location of Maximum Concentration
Benzoic Acid	--	--	2/3	9-12	MW03
Dieldrin	--	--	1/3	0.63	MW02
Endrin Ketone	0.0002	0.002	1/3	0.09	MW02
Aluminum	--	--	3/3	29,000-137,000	MW02
Antimony	--	0.006	1/3	4.75	MW02
Barium	1.00	2	3/3	427-706	MW02
Beryllium	--	0.004	2/3	**3.1-9.4**	MW02
Chromium (III)	--	0.1	3/3	**47.8-251**	MW02
Cobalt	1.00	1.3 MCLG	2/3	9.6-21.7	MW01
Copper	--	--	3/3	17.7-41.6	MW02
Iron	0.3	0.3 SMCL	3/3	**26,400-228,000**	MW02
Lead	0.05	--	3/3	30.3-37.3	MW01
Magnesium	--	--	1/3	13,500	MW01
Manganese	0.05	--	3/3	**56.9-220**	MW01
Mercury	0.0011	0.002	2/3	0.24-0.36	MW03
Potassium	--	--	1/3	5,240	MW02
Selenium	0.01	0.05	1/3	3.4	MW01
Sodium	--	--	1/3	156,000	MW01
Vanadium	--	--	3/3	37.8-442	MW02
Zinc	5	--	3/3	83.6-151	MW02

μg/L - microgram per liter
Reference: Halliburton NUS, 1991

TABLE 2

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 11 (SITE 7)
TARAWA TERRACE DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)	
	No. of positive Detections/ No. of Samples	Range of Positive Detections	No. of positive Detections/ No. of Samples	Range of Positive Detections
Organics [1]				
Bis(2-ethylhexyl)phthalate	1/8	1,000	0/5	ND
Fluoranthene	2/8	220-290	0/5	ND
Benzoic acid	2/8	6,300-15,000	1/5	7,900
Aldrin	1/8	4.3	0/5	ND
4,4'-DDD	3/8	12-20	2/5	58-190
4,4'-DDE	1/8	240	0/5	ND
Dieldrin	3/8	12-540	3/5	400-2,500
Endosulfan II	3/8	7.6-1,400	3/5	73-2,000
Endrin	2/8	91-140	4/5	14-1,300
Aroclor-1260 PCB	3/8	108-12,000	4/5	660-25,000
Inorganics [2]				
Aluminum	8/8	3,690-9,700	5/5	1,030-5,030
Arsenic	3/8	1.1-1.7	3/5	1.1-1.5
Barium	8/8	9.1-223	5/5	6.6-72.8
Beryllium	4/8	0.26-2.1	3/5	0.29-3.6
Cadmium	8/8	1.1-5.0	5/5	1.2-4.5
Calcium	7/8	190-58,200	3/5	3,660-9,990
Chromium (III)	8/8	4.2-10.6	5/5	5.2-12.5
Cobalt	8/8	1.7-8.1	5/5	1.9-10.2
Iron	8/8	876-5,330	5/5	981-5,490
Lead	8/8	3.0-114	5/5	2.4-17.0
Magnesium	8/8	104-1,150	4/5	99.9-541

TABLE 2 (Continued)

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 11 (SITE 7)
TARAWA TERRACE DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)	
	No. of positive Detections/ No. of Samples	Range of Positive Detections	No. of positive Detections/ No. of Samples	Range of Positive Detections
Nickel	8/8	2.8-13.1	5/5	3.1-11.7
Potassium	6/8	110-507	4/5	120-452
Selenium	1/8	0.54	0/5	ND
Silver	8/8	0.66-3.0	5/5	0.72-2.7
Sodium	1/8	754	1/5	1,020
Thallium	8/8	0.44-2.0	5/5	0.47-1.8
Vanadium	8/8	4.5-18.1	5/5	4.5-9.8
Zinc	2/8	1.1-44.5	3/5	1.2-4.5
Cyanide	8/8	0.54-2.5	5/5	0.60-2.3

(1) - Organic concentrations expressed in µg/kg (microgram per kilogram).
(2) - Inorganic concentrations expressed mg/kg (milligram per kilogram).
ND - Not detected.
Reference: Halliburton NUS, 1991

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc., March 1994)

Two surface water bodies were located during the site reconnaissance. The larger of the two surface water bodies flows in a southern direction to Northeast Creek. The other surface water body flows in a southeastern direction feeding the larger surface water body. Based on visual observations, it is believed that these surface water bodies are formed due to groundwater seepage and stormwater runoff.

Two main areas of concern were apparent during the site visit, from a review of the Preliminary Draft Site Inspection Report (Halliburton/NUS, 1991) and from a review of historical photographs. Aerial photos from 1973 and 1978 showed a potential dump area east of the utility right-of-way. Additionally, a smaller cleared area was shown on the western side of the utility right-of-way. The area south of the community center is of concern because of the elevated levels of pesticides/PCBs detected in borings 07SB01 and 07SB02.

Additionally, visual debris (i.e., paint cans, motor oil cans, other unknown rusted cans) were present in one area, due east of the Water Treatment Plant. What appeared to be a cleared area, where past dumping may have occurred was also observed in a southwest direction from the smaller surface water body.

5.0 PROPOSED FIELD INVESTIGATION

In order to define the extent of potential contamination due to reported dumping practices the following activities will be conducted:

- Soil Investigation
- Groundwater Investigation
- Surface Water/Sediment Investigation

5.1 Support Activities

Collection of at least one round of water level measurements from existing and newly installed monitoring wells.

Placement of staff gauges in the two surface water bodies within the boundaries of this site.

5.2 Soil Investigation

Soil characterization during the RI will comprise of sampling surface and subsurface soil. The soil investigation will be conducted throughout the study area. The following investigations will be conducted in the study area.

Soil characterization to be conducted in the southwest corner of the study area, where surficial debris was noted, will comprise of excavating up to 5 trenches/pits, and sampling the surface (0 to 12 inches) and subsurface soil. The subsurface soil sample will be a composite sample representative of the excavation. Additionally, five sampling locations will be drilled with a hand auger to collect samples for analysis. Samples will be submitted from the surface and just above the groundwater table.

All soil samples will be analyzed for full TCL organics and TAL metals. Composite trench samples should be analyzed for full TCLP & RCRA haz waste char., not full scan

A 300 by 300-foot sampling grid will be established along the northwestern boundary of the study area along the slope of the former dump. Within the two potential areas of concern (i.e., the "cleared area"

and south of the community center) a 150 by 150-foot sampling grid will be established. Twelve sampling locations in the area of the right-of-way will be performed using a drill rig. The remaining eleven (11) locations are not as accessible and will be sampled using a hand auger. Soil characterization within these grid areas will comprise of one surface soil and one subsurface soil sample per grid location. Surface soil characterization will be comprised of sampling soils to a depth not to exceed twelve inches. The subsurface soil characterization will be comprised of sampling soils from a depth just above the water table. All surface and subsurface soil samples will be submitted for laboratory analysis including full TCL organics and TAL metals.

Soil samples will also be collected during the drilling of monitoring well test borings. Split-spoon samples will be collected at two-foot centers from the ground surface to 10 feet below the water table. Two samples will be collected for laboratory analysis of full TCL organics and TAL metals from each boring. These samples include a surficial soil sample (0 to 12 inches) and one from just above the water table. These soil borings will be converted into monitoring wells.

Test boring locations for the study area are shown on Figure 4.

5.3 Groundwater Investigation

The groundwater investigation will consist of installing two shallow monitoring wells and two temporary shallow monitoring wells in order to assess groundwater quality in the shallow (i.e., water table) aquifer.

One permanent shallow monitoring well will be installed in the southern portion of the study area to assess horizontal migration of contamination in the direction of Northeast Creek. Two temporary wells will be positioned in the southwestern portion of the study area, where access with a drilling rig is restricted due to the marshy conditions. The second permanent well will be installed north of the water treatment plant to assess background groundwater quality.

Two rounds of groundwater samples will be obtained from the three existing and two newly installed shallow monitoring wells. The first round of samples will be collected approximately one week following the development of the new wells. The second round will be collected approximately three months following the first round. One round of groundwater samples will be obtained from the two temporary shallow monitoring wells. All groundwater samples will be analyzed for full TCL organics and TAL metals (total and dissolved).

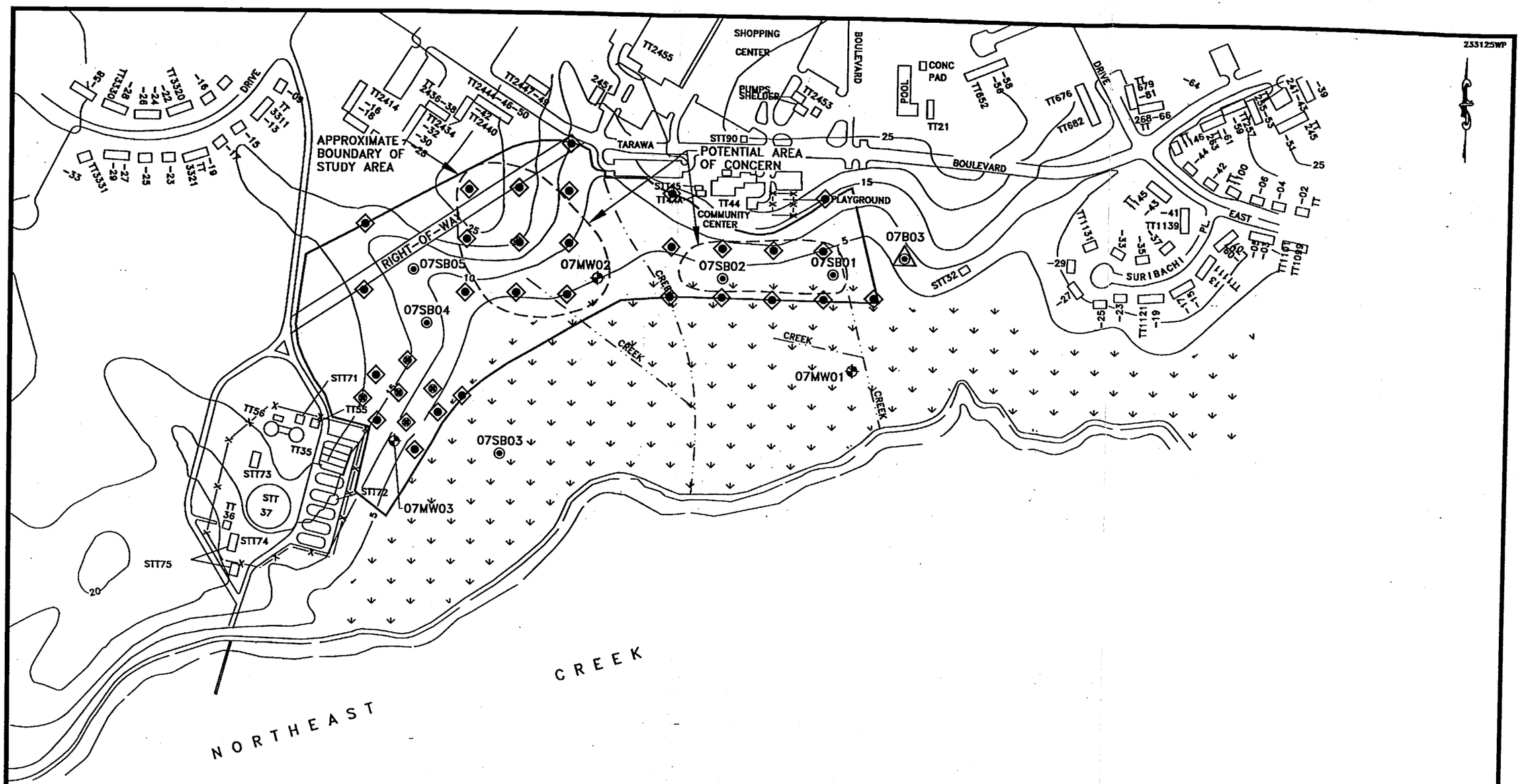
The proposed and existing shallow monitoring well locations are shown on Figure 5.

5.4 Surface Water/Sediment Investigation

Potential impacts to surface water/sediment has not been assessed. There are three surface water bodies within Site 7. A surface water/sediment investigation will be conducted on each of these surface water bodies. The proposed investigations will include; Northeast Creek, the west and east tributaries of Northeast Creek, and the drainage ditch.

Six sampling stations are proposed within Northeast Creek. At each sampling station, one surface water and two sediment samples, a surface (0 to 6 inches) and subsurface (6 to 12) inches will be collected.

A surface water/sediment investigation will be conducted in the western and eastern tributaries to Northeast Creek. Samples will be collected from three sampling stations in the west tributary and from two sampling stations in the east tributary. At each sampling station, one surface water and one surface sediment (0 to 6 inches) will be collected.



LEGEND

- 07MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07B03 EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SOIL SAMPLE LOCATION
- PROPOSED TRENCH LOCATION

SOURCE: LANTDIV, FEB. 1992

make symbol match diagram.

300 0 150 300 600

1 inch = 300 ft.

Baker

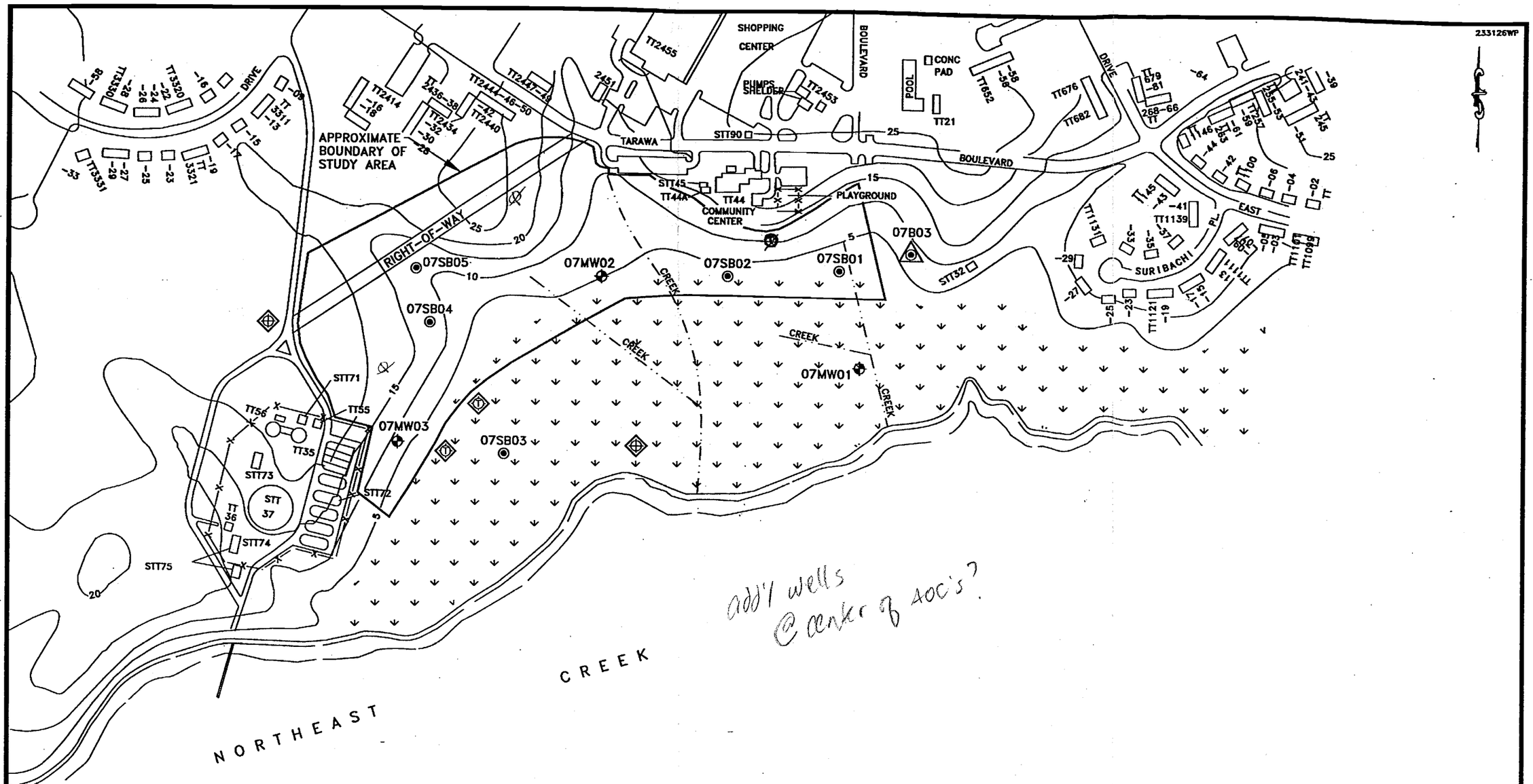
Baker Environmental, Inc.

FIGURE 4
PROPOSED SOIL INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

233125WP

9 0021-M043



LEGEND

07MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07B03 EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

PROPOSED SHALLOW MONITORING WELL LOCATION

PROPOSED TEMPORARY WELL LOCATION

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

Baker

Baker Environmental, Inc.

FIGURE 5
PROPOSED GROUNDWATER INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00221M052

Two surface water and sediment stations are proposed for the drainage ditch which feeds the western tributary to Northeast Creek. One surface water and one surface sediment (0 to 6 inches) will be collected at each station.

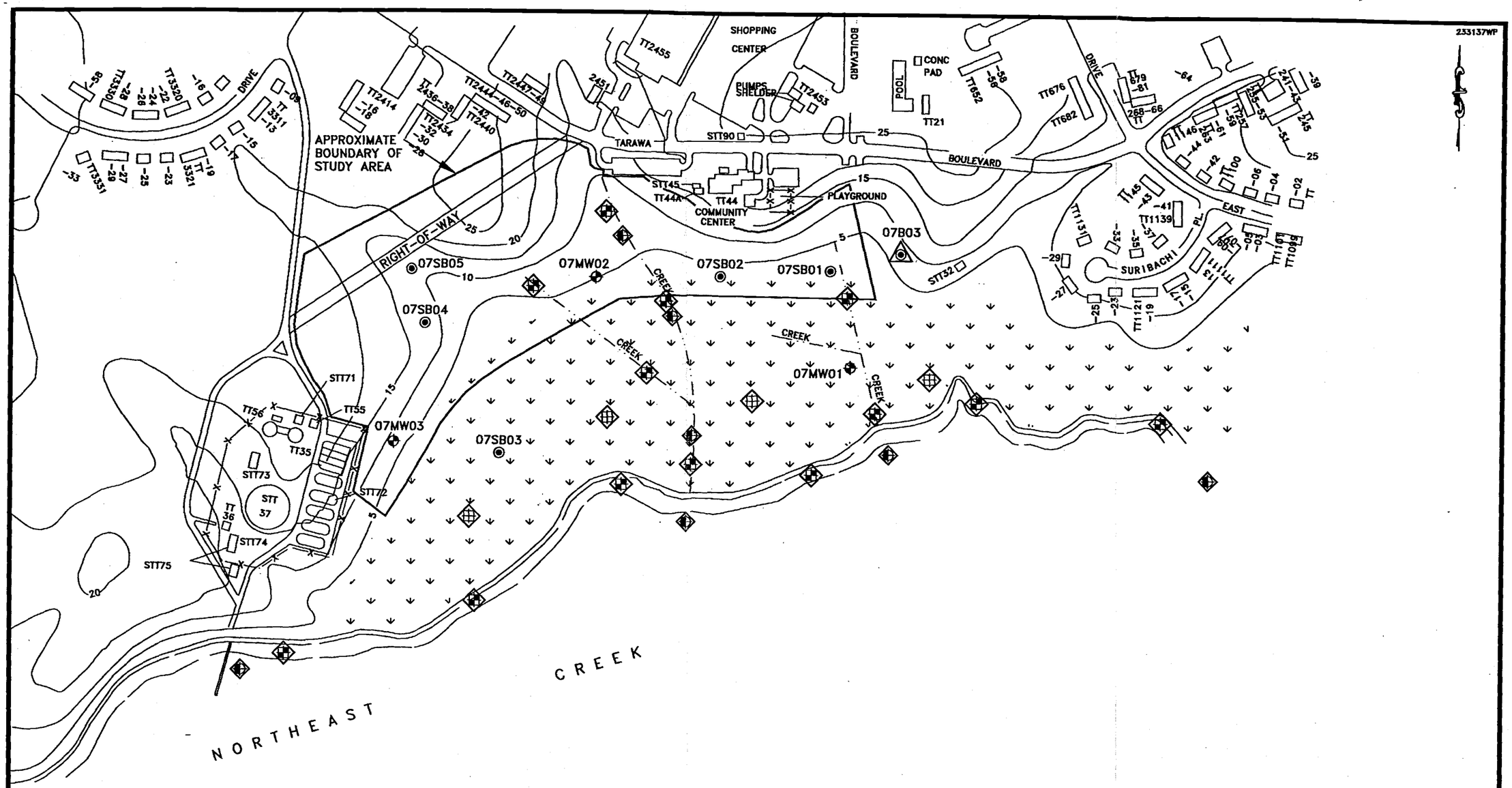
A sediment investigation will be conducted in the marsh area in the southern portion of the study area. Two sediment samples will be collected from four sample stations. Sediment samples will be collected from the surface (0 to 6 inches) and the subsurface (6 to 12 inches) at each station.

All surface water and sediment samples will be analyzed for full TCL organics and TAL metals.

In addition to the surface water/sediment investigation, benthic samples will be collected in Northeast Creek and the western tributary to Northeast Creek. Samples will be collected from three stations in the tributary and four stations in Northeast Creek.

A gill net will be positioned where the west tributary feeds Northeast Creek in order to determine whether this tributary is a significant ecological area. If appropriate, fish samples may be collected for analysis.

Figure 6 presents the proposed sample stations for the surface water/sediment and benthic investigation.



LEGEND

- 07MW01 — EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07SB01 — EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07B03 — EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION
- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED BENTHIC SAMPLE LOCATION

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

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Baker Environmental, Inc.

FIGURE 6
PROPOSED ECOLOGICAL INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 11
SITE 80, PARADISE POINT GOLF COURSE MAINTENANCE AREA

1.0 SITE LOCATION AND SETTING

The study area is located northwest of Brewster Boulevard within the Paradise Point Golf Course. A general site location of this study area is shown on Figure 1. Site 80 consists of a 1-acre area located in the rear of the machine shop (Building 1916) and a maintenance wash area consisting of a concrete wash pad and a sump. The sump is used to collect water and oil runoff generated from the spraying of the maintenance equipment. The sump has been known to overflow during periods of heavy rain. Pesticide mixing and handling was once performed in this area. The wash rack was reportedly constructed over the former mixing area. A drainage ditch is located to the southeast of the wash area. Figure 2 depicts the current site structures. Behind the machine shop are mounds of soil and an "open" area where tree cuttings and other debris are in piles. The mounds of dirt are overgrown with young pines (5 to 7 years old).

2.0 SITE HISTORY

Site 80 is used for maintenance and cleaning of equipment used at the golf course. This area is currently used to house and mix pesticides and herbicides used in the golf course maintenance. Prior to the construction of the existing concrete wash pad, chemical mixing was conducted on a concrete pad with no apparent containment controls. The soil mounds behind Building 1916 are excavated soils generated during the construction of a pond along one of the fairways in 1987 or 1988. It was reported that wastes were disposed of behind Building 600. Employees of the maintenance garage were instructed not to use the soil for fill material.

3.0 PREVIOUS INVESTIGATIONS

- A Site Inspection was conducted in 1991 by Halliburton/NUS.
- Preliminary Draft Site Inspection Report (Halliburton/NUS, November 1991).
- Site Inspection sampling locations are presented on Figure 3.

3.1 Groundwater Investigation

Three shallow monitoring wells were installed and one round of groundwater samples were analyzed for TCL volatile organics, pesticides/PCBs, and chlorinated herbicides. Analytical findings are summarized on Table 1.

Low levels of toluene, ethylbenzene, and xylenes were reported in 80MW03.

3.2 Soil Investigation

Three surface soils (0 to 6 inches), seven surface soil samples (0 to 2 feet), and seven subsurface soil samples (3 to 17 feet) were collected. All samples were analyzed for TCL volatile organics, pesticides/PCBs, and chlorinated herbicides. Analytical findings are presented on Table 2.

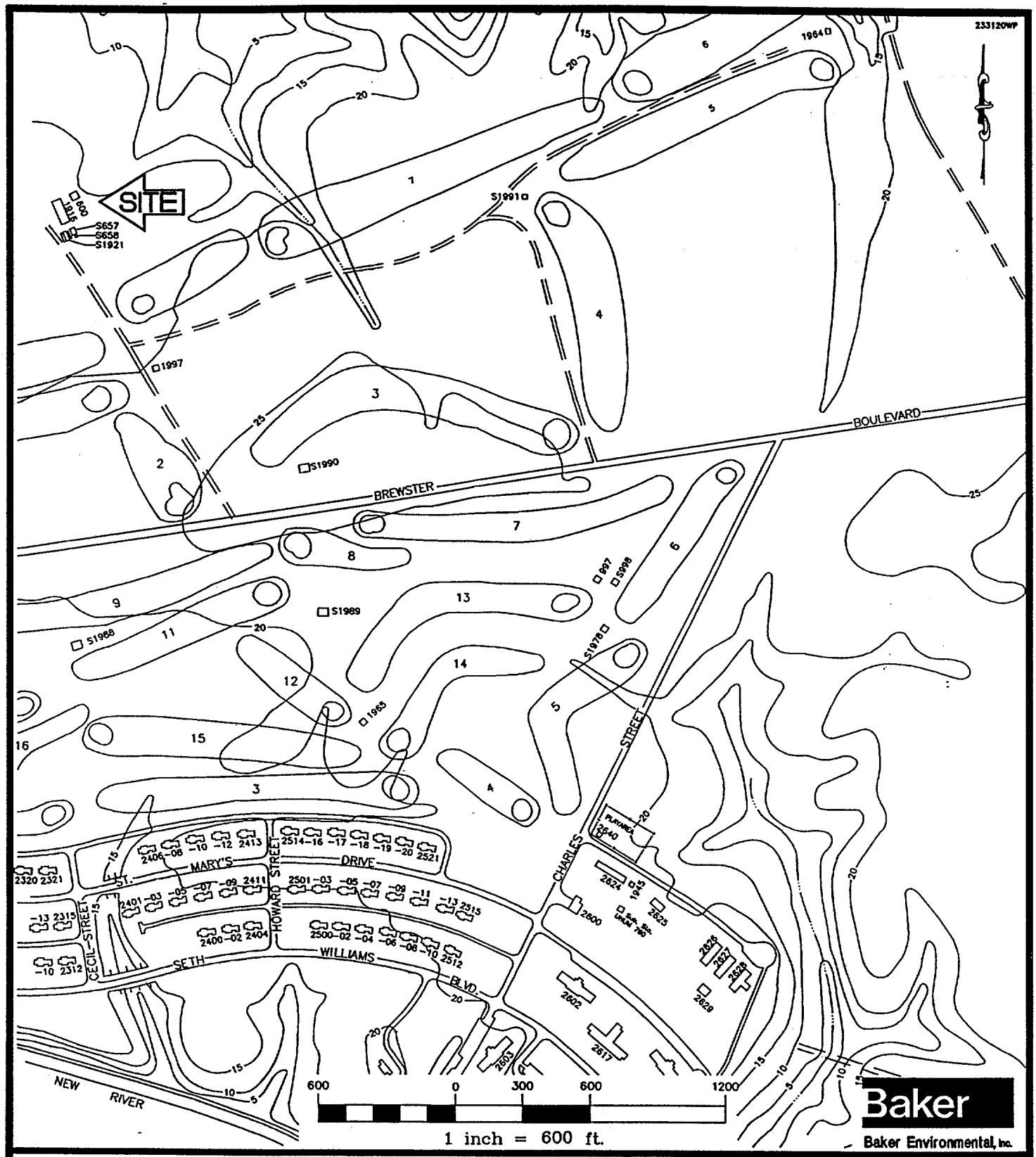


FIGURE 1
LOCATION MAP
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV, FEB. 1992

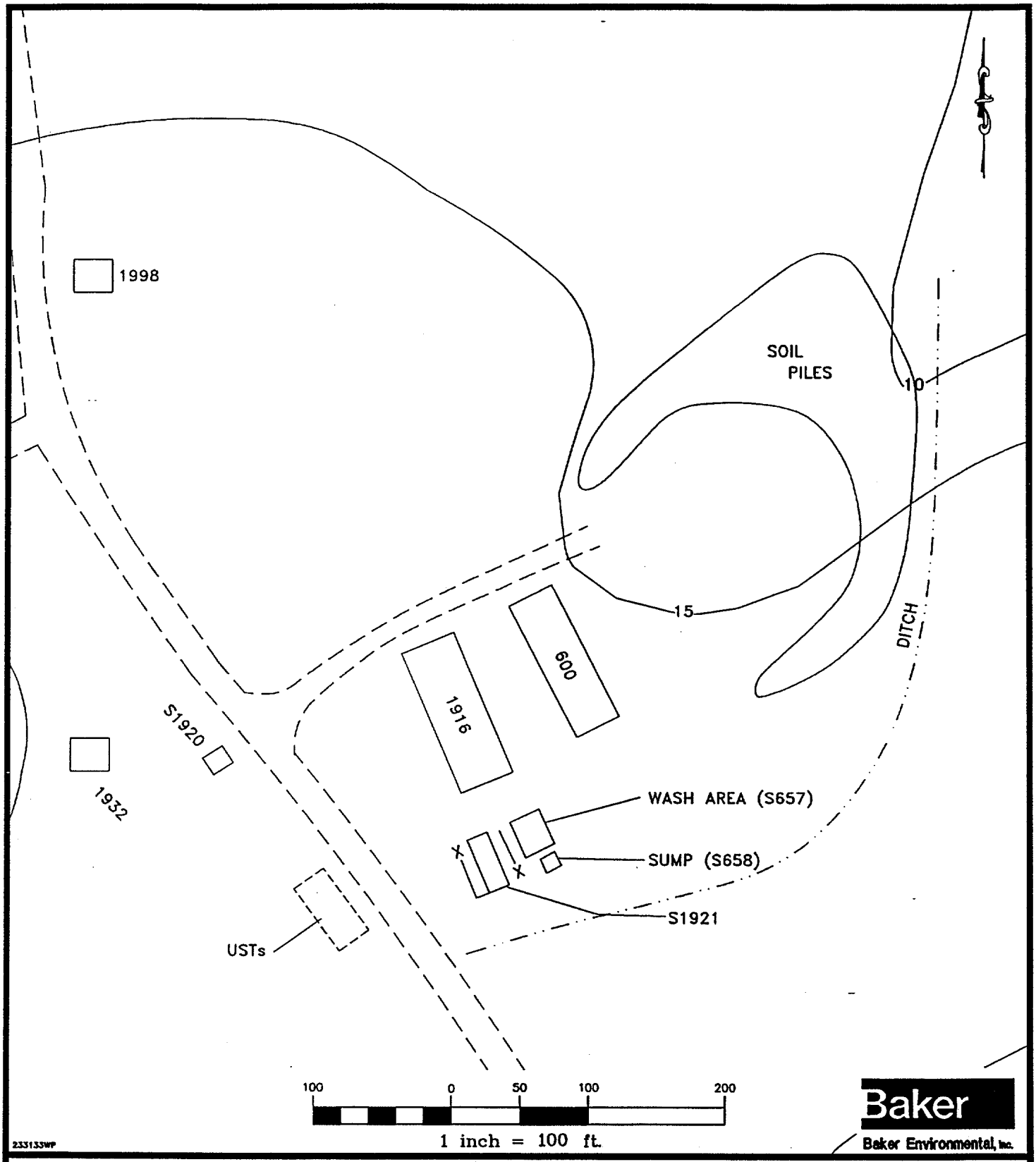
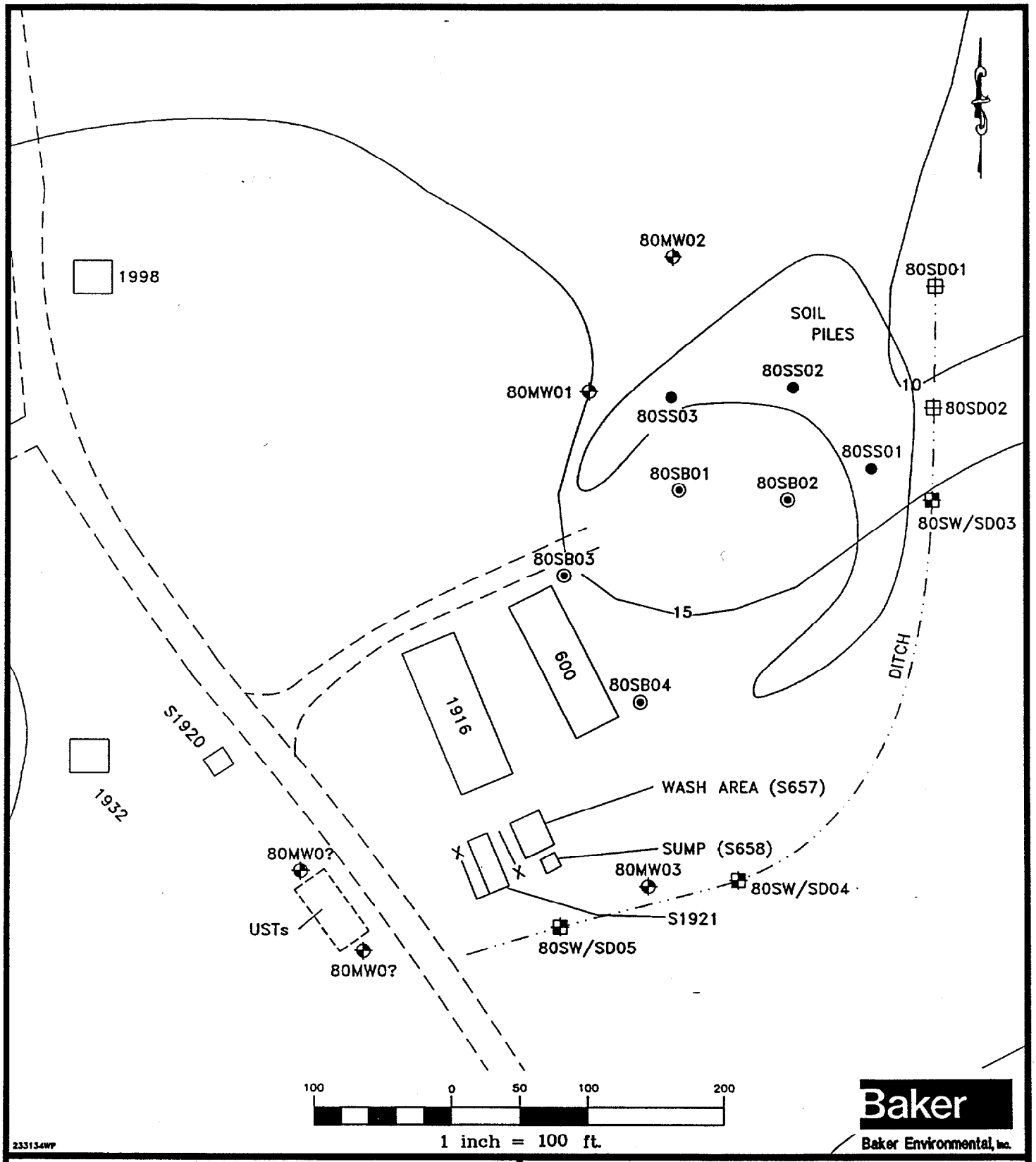


FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV, FEB. 1992



LEGEND

80MW01	EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SB01	EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SD01	EXISTING SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SW/SD03	EXISTING SURFACE WATER/SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SS01	EXISTING SURFACE SOIL SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: LANTDIV, FEB. 1992

FIGURE 3
PREVIOUS INVESTIGATIONS
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TABLE 1

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION
OU NO. 11 (SITE 80)
PARADISE POINT GOLF COURSE
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	North Carolina Standards	EPA MCLs	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/L)	Location of Maximum Concentration
Toluene	1	1	1/3	180	MW03
Ethylbenzene	0.029	0.1	1/3	5	MW03
Xylenes	0.4	10	1/3	21	MW03
Carbon Disulfide	--	--	1/3	25	MW03

µg/L - microgram per liter
Reference: Halliburton NUS, 1991

TABLE 2

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 11 (SITE 80)
PARADISE POINT GOLF COURSE
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)		Subsurface Soil (>12 feet)	
	No. of Positive Detections/No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/No. of Samples	Range of Positive Detections (µg/kg)
Methylene Chloride	1/10	7	0/6	ND	0/1	ND
Aldrin	2/10	6.8-220	0/6	ND	0/1	ND
alpha-Chlordane	1/10	60	0/6	ND	0/1	ND
4,4'-DDD	4/10	18-700	0/6	ND	0/1	ND
4,4'-DDE	5/10	16-210	0/6	ND	0/1	ND
4,4'-DDT	4/10	14-290	0/6	ND	0/1	ND
Dieldrin	4/10	16-440	0/6	ND	0/1	ND
Aroclor	2/10	830-1,500	0/6	ND	0/1	ND

µg/kg - microgram per kilogram
ND - Not detected.
Reference: Halliburton NUS, 1991

Several pesticides were detected in these samples, such as aldrin, chlordane, 4,4'-DDT, and its metabolites, and dieldrin. 4,4'-DDD was the pesticide reported at the greatest concentration (700 μg/kg in sample SB02-0002). Aroclor-1254 was detected in two discrete samples (SB02 and MW03) at concentrations of 830 μg/kg and 1,500 μg/kg, respectively.

3.3 Surface Water/Sediment Investigation

Three surface water samples and five sediment samples were collected from the drainage ditch and analyzed for TCL volatile organics, pesticides/PCBs, chlorinated herbicides, and total petroleum hydrocarbons.

Analytical findings are summarized on Table 3.

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc., March 1994)

The wash/mixing pad and sump are approximately five years old. During heavy rains, surface water was observed flowing in front of the concrete pad and in the direction of 80MW03 to the ditch.

Two flush mounted monitoring wells were located across the access road from the wash/mixing pad. These two wells were installed in connection with the underground storage tank.

Conversation with Mr. Gerald Latham, who has been employed at the golf course for the past forty years, indicated that many pesticides were mixed and applied on the golf course. Additionally, an old mixing pad, with no containment controls, was located in the area where the new pad was constructed. According to Mr. Latham, all past and current chemical mixing activities were conducted in the area where the current pad exists. Historically, a documented inventory of chemicals used at the golf course was maintained, however it could not be located at the time of the site visit. The current Greens Maintenance Supervisor is Mr. Gary Appleton.

The large soil mound, located to the northeast of Building 1916, was generated during the excavation of a golf course pond.

Two drums were noted to the left side of the access road leading to the mounded dirt area. Based on visual observations, one of the drum contents appears to be solidified and the other drum is approximately one quarter full of liquid. A petroleum odor was evident from the drum in which the liquid contents were observed. These drums will be characterized and removed under rapid response.

There is old maintenance equipment placed in the lawn and wooded areas around the machine shop (Building 1916). An oil collection system was located in the maintenance building (Building 600).

Three existing shallow monitoring, and two flush mounted monitoring wells were located within the site boundaries.

5.0 PROPOSED FIELD INVESTIGATIONS

The objectives of these investigations are to identify contaminants and media of potential concern; identify routes of exposure; delineate suspected areas where prior practices may have impacted the soil or groundwater.

TABLE 3

NATURE AND EXTENT OF SURFACE WATER CONTAMINATION
OU NO. 11 (SITE 80)
PARADISE POINT GOLF COURSE
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Near Site (SW03, SW04, SW05)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/L)
Acetone	3/3	11-190
Toluene	2/3	30-104
Carbon Disulfide	1/3	6
Total Petroleum Hydrocarbons (mg/L)	2/3	1.39-1.65

µg/L - microgram per liter
Reference: Halliburton NUS, 1991

5.1 Support Activities

Free product measurements will be conducted in the two flush mounted monitoring wells.

All newly installed monitoring wells will be surveyed.

All soil boring locations will be surveyed.

Static water level measurements will be collected from existing and newly installed monitoring wells.

5.2 Soil Investigation

The objectives of the soil investigation are to vertically and horizontally delineate contaminant levels in four potential areas of concern (lawn area around the sump and wash pad, the soil mounds located in northeast corner of the site, the "open area" near the soil mounds, and the soil where drums are now present).

The following investigations are proposed.

A soil investigation will be conducted in the lawn area adjacent to the collection sump and concrete wash pad. Seven test borings will be drilled to characterize soil in this area. One surface soil and one subsurface soil sample will be collected from each test boring. Surface soil characterization will comprise of sampling soils to a depth not to exceed twelve inches. Subsurface soil samples will be collected from a depth just above the water table, which is estimated at 8 to 20 feet bgs. All soil samples will be submitted for laboratory analysis including full TCL organics and TAL metals.

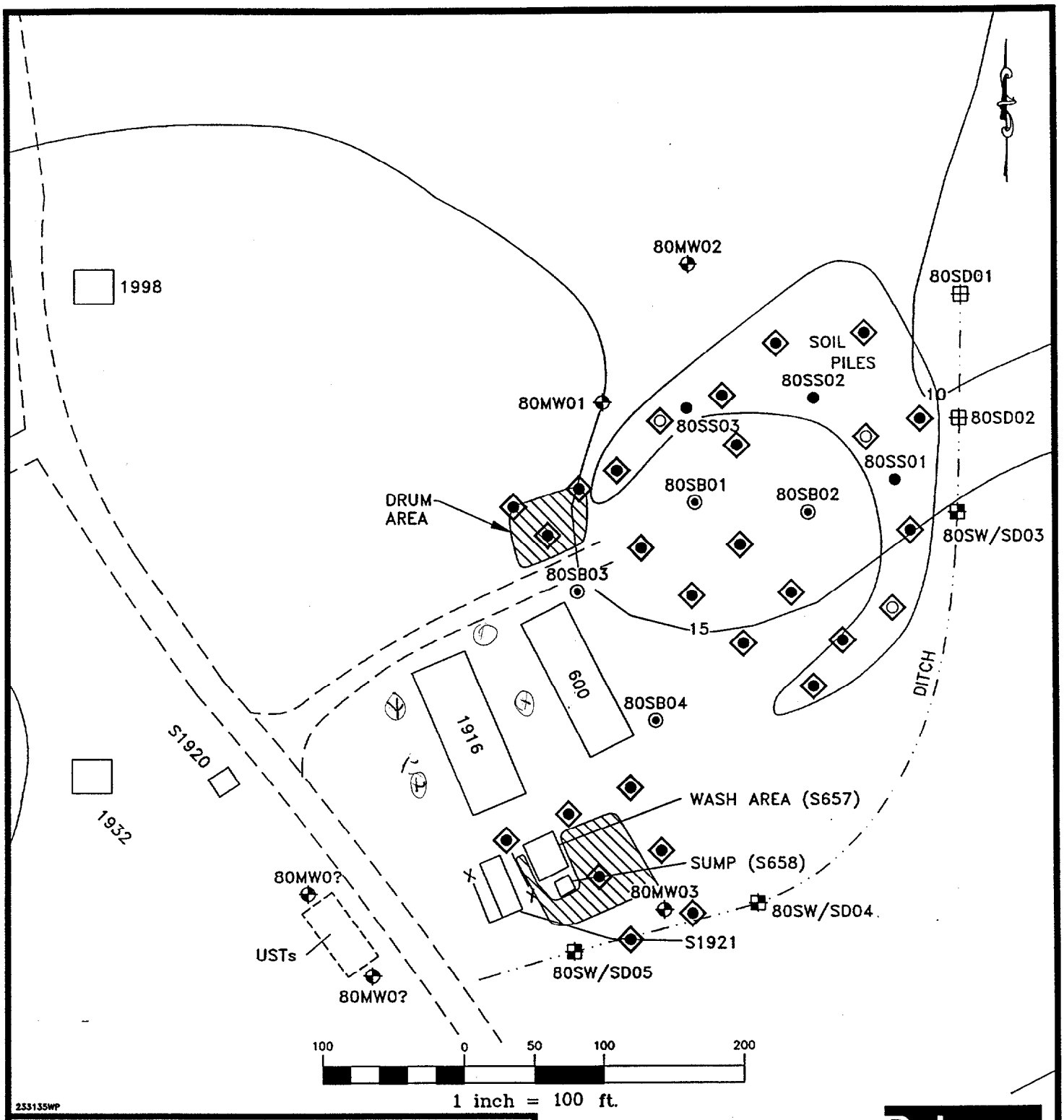
A soil investigation will be conducted within the level "open" area adjacent to the soil piles in the northeast corner of the study area. A total of seven test borings will be drilled in this area to investigate this reported disposal area. One surface soil and subsurface sample will be collected from each test boring. Surface soil samples will comprise of sampling soils to a depth not to exceed twelve inches. Subsurface soil samples will be collected from a depth just above the water table. The surface and subsurface soil samples will be submitted for laboratory analysis including full TCL organics and TAL metals.

A soil investigation will be conducted within the soil mounds in the northeast corner of the study area. This investigation will be conducted using hand augers. One surface soil sample will be collected from ten random areas. Surface soil samples will comprise of sampling soils to a depth not to exceed twelve inches. In addition, one subsurface soil sample will be collected from three areas within the mounds. Subsurface soil samples will be collected at a depth of eight feet, which is approximately the original ground surface. Due to access restrictions, a drill rig will not be used to collect the subsurface soil samples. Subsurface soil samples will be obtained via a power auger to drill to depth and using a hand auger to collect the analytical sample. The surface and subsurface soil samples will be submitted for laboratory analysis including full TCL organics and TAL metals.

A soil investigation will be conducted in the area where two drums were found north of the maintenance building. One surface soil sample will be collected from three locations using hand augers.

Soil samples will also be collected during the construction of monitoring wells. Split spoon samples will be collected at 2-foot intervals along 2-foot centers to a depth of 10 feet. Two soil samples will be collected per test boring. These samples include a surficial soil (0 to 12 inches) and one from just above the water table. Soil samples will be submitted for laboratory analysis of TCL organics and TAL metals.

Proposed soil sampling locations are presented on Figure 4.



LEGEND

80MW01	EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SB01	EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SD01	EXISTING SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SW/SD03	EXISTING SURFACE WATER/SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SS01	EXISTING SURFACE SOIL SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
	PROPOSED SOIL SAMPLING LOCATION
	PROPOSED DEEP SOIL SAMPLING LOCATION
	AREAS OF CONCERN

SOURCE: LANTDIV, FEB. 1992

Baker

Baker Environmental, Inc.

FIGURE 4
PROPOSED SOIL INVESTIGATION
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

5.3 Groundwater Investigation

The principal interest of the groundwater investigation will be the shallow water table. However, because low levels of BTEX contamination have been reported in one on-site well, deeper groundwater will also be investigated. In order to characterize the groundwater conditions, additional monitoring wells will be required.

The groundwater investigation will involve the following activities:

- Installation of four shallow monitoring wells throughout the study area. Two wells will serve as downgradient wells from the mixing pad area. One of the two downgradient wells will also help characterize groundwater quality in the area where the two drums were found. The third shallow well will be installed in the "open area" behind the maintenance garage. The fourth well will serve as a background well.

- One intermediate monitoring well (approximately 40-50 feet) will be installed next to existing monitoring well 80MW03.

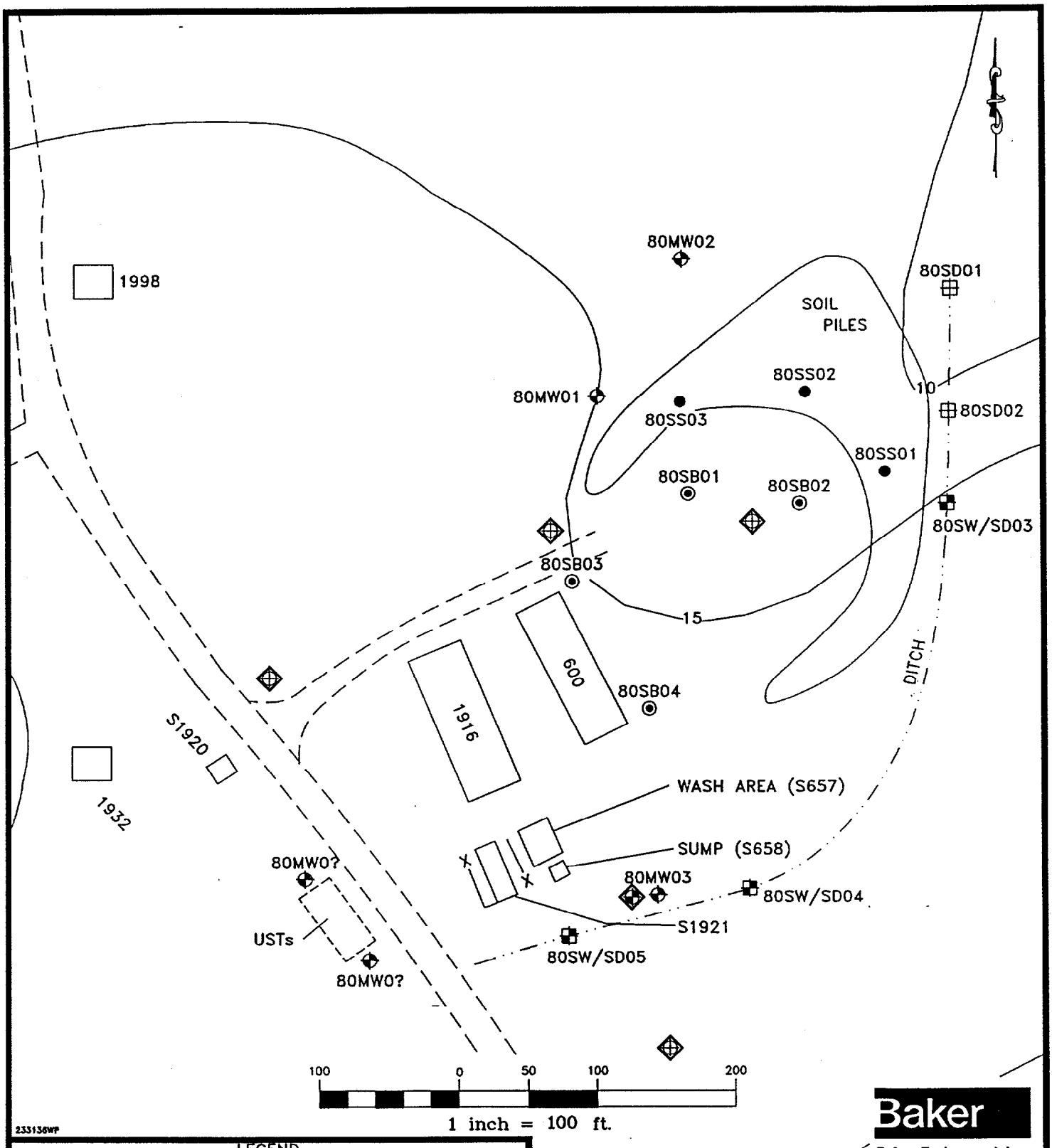
- The new and existing shallow wells will be used in assessing current groundwater conditions (i.e., groundwater flow direction).

- Two rounds of groundwater samples to be conducted on all existing and newly installed monitoring wells. Groundwater samples will be analyzed for full TCL organics and TAL metals (total and dissolved).

Proposed monitoring well locations are shown on Figure 5.

5.4 Surface Water/Sediment Investigation

The drainage ditch in this area is not a classifiable surface water body. Five surface water/sediment samples were obtained as part of the SI. Three samples were analyzed for full TCL organics and TAL inorganics (Level IV data quality). Therefore, a surface water/sediment investigation will not be conducted.



LEGEND

- 80MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SD01 EXISTING SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SW/SD03 EXISTING SURFACE WATER/SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SS01 EXISTING SURFACE SOIL SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SHALLOW MONITORING WELL LOCATION
- PROPOSED INTERMEDIATE MONITORING WELL LOCATION

SOURCE: LANTDIV, FEB. 1992

FIGURE 5
PROPOSED GROUNDWATER INVESTIGATION
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 12
SITE 3, OLD CREOSOTE PLANT

1.0 SITE LOCATION AND SETTING

The study area is located on the mainside of MCB Camp Lejeune approximately one quarter mile east of Holcomb Boulevard and one mile north of Wallace Creek (see Figure 1). Remnants of a creosote plant including concrete pads and train rails are present on the site. The site area encompasses approximately 5 acres, is generally flat and unpaved, and is intersected by a dirt access road. This study area can be directly accessed from Holcomb Boulevard. The Camp Lejeune Railroad lies approximately 200 feet to the west of the study area. The remainder of the area is surrounded by woods. The general site location of this area is shown on Figure 1.

2.0 SITE HISTORY

The old creosote plant reportedly operated from 1951 to 1952 to supply treated lumber during construction of the railroad on the base. Logs were cut into railroad ties at an on-site sawmill, then pressure treated with hot creosote stored in a railroad tank car. There is no indication of creosote disposal on site, and records show that creosote remaining in the pressure chamber at the end of a treatment cycle was stored for future use. Historical information indicates that the on-site sawmill was located in the area north of the dirt access road. The location of current site structures are shown on Figure 2.

3.0 PREVIOUS INVESTIGATIONS

- A Site Inspection was conducted in 1991 by Halliburton/NUS.
- Preliminary Draft Site Inspection Report (Halliburton/NUS, November 1991).
- Site Inspection sampling locations are presented on Figure 3.

3.1 Groundwater Investigation

Three shallow monitoring wells were installed and one round of groundwater samples were analyzed for TCL semivolatile organics. Analytical findings are summarized on Table 1.

Well 03MW02 exhibited elevated levels of PAHs.

3.2 Soil Investigation

Eight surface soil samples (0 to 2 feet) and 8 subsurface soil samples (3 to 17 feet) were collected. All samples were analyzed for TCL semivolatile organics. Analytical findings are summarized on Table 2.

Two soil sample locations, 03MW02 and 03SB04, exhibited elevated levels of PAHs, which are contaminants normally associated with creosote operations. The highest levels were detected in subsurface soil near the former creosote treatment area (03MW02).

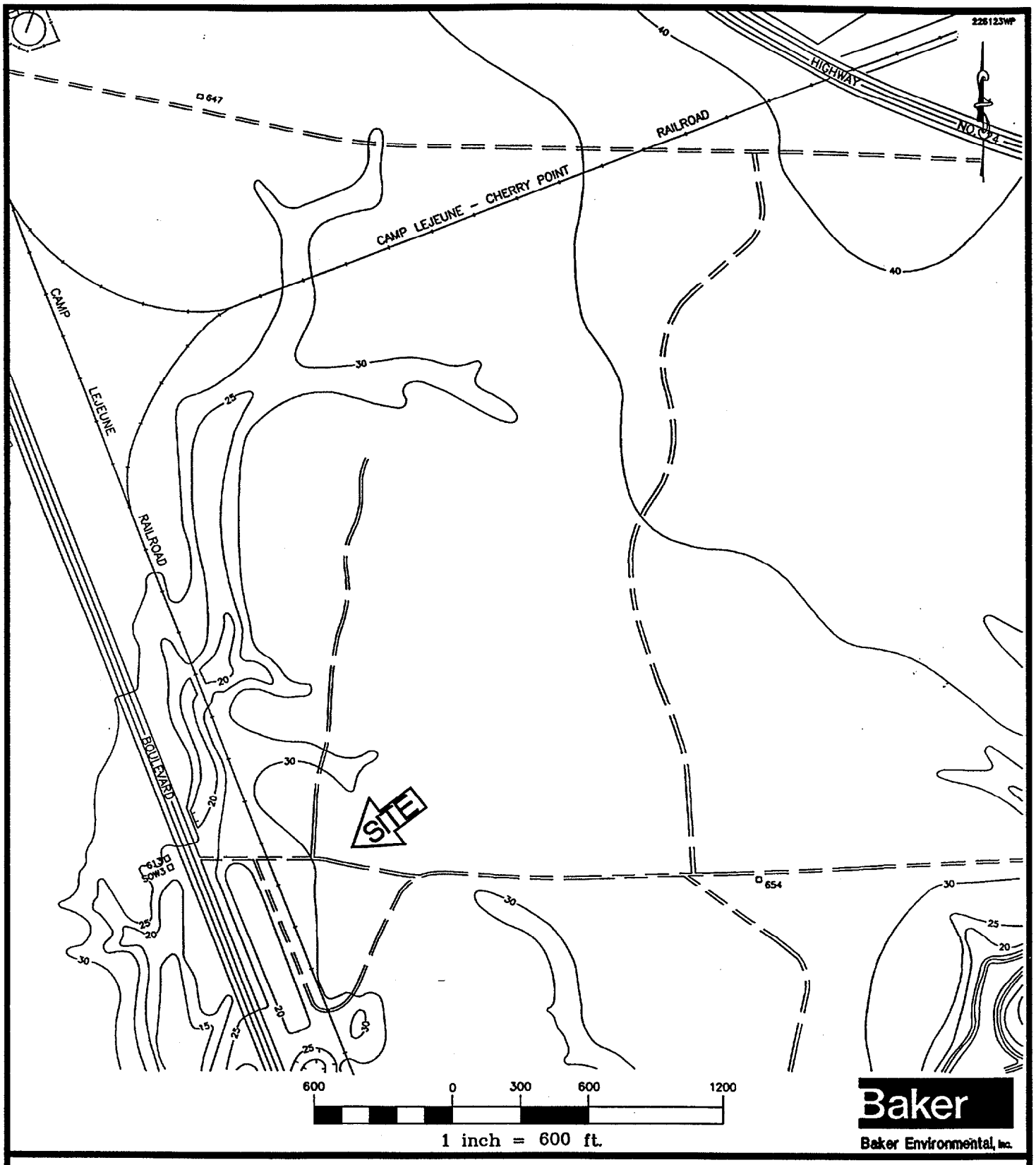


FIGURE 1
LOCATION MAP
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV., FEB. 1992

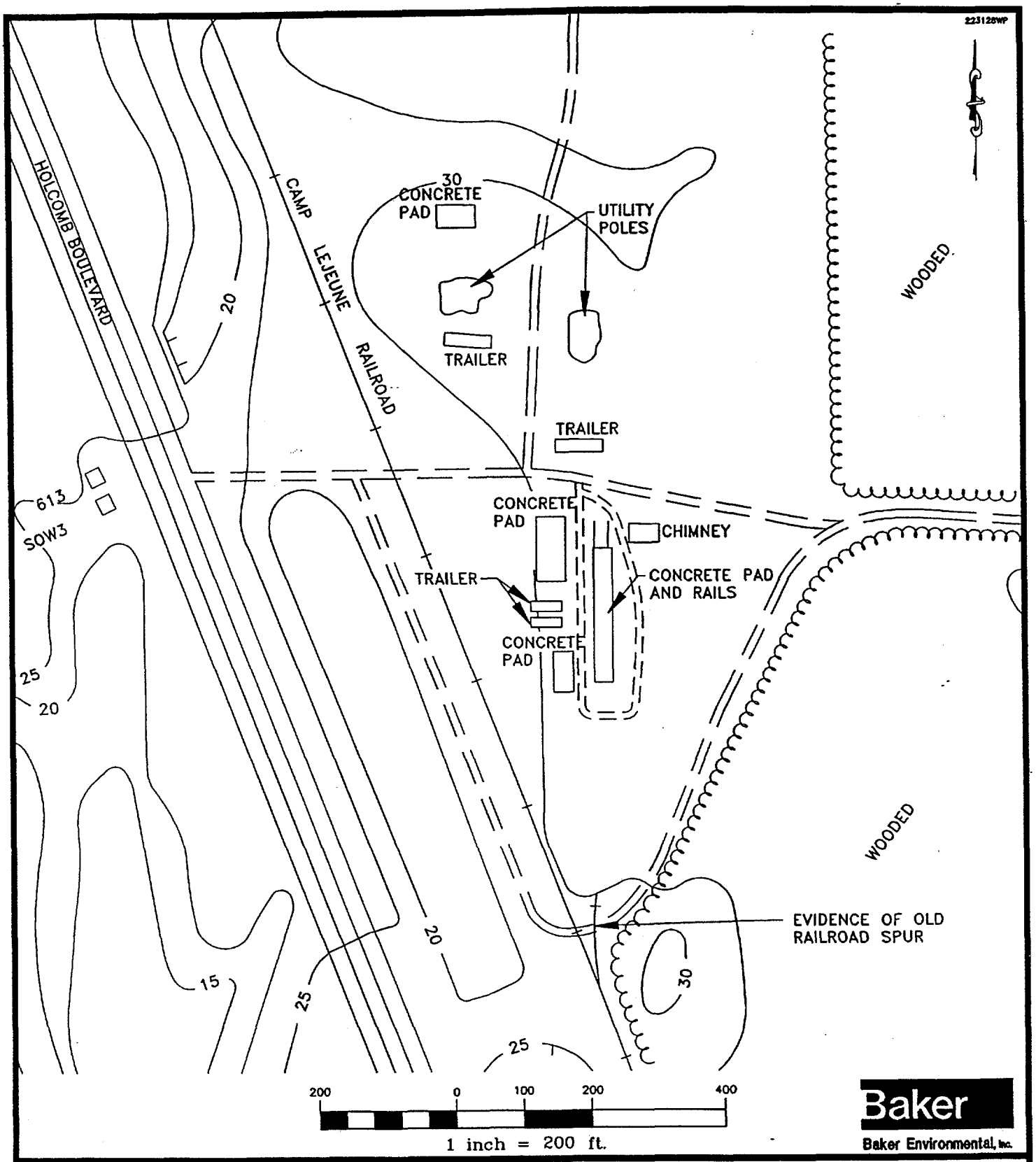
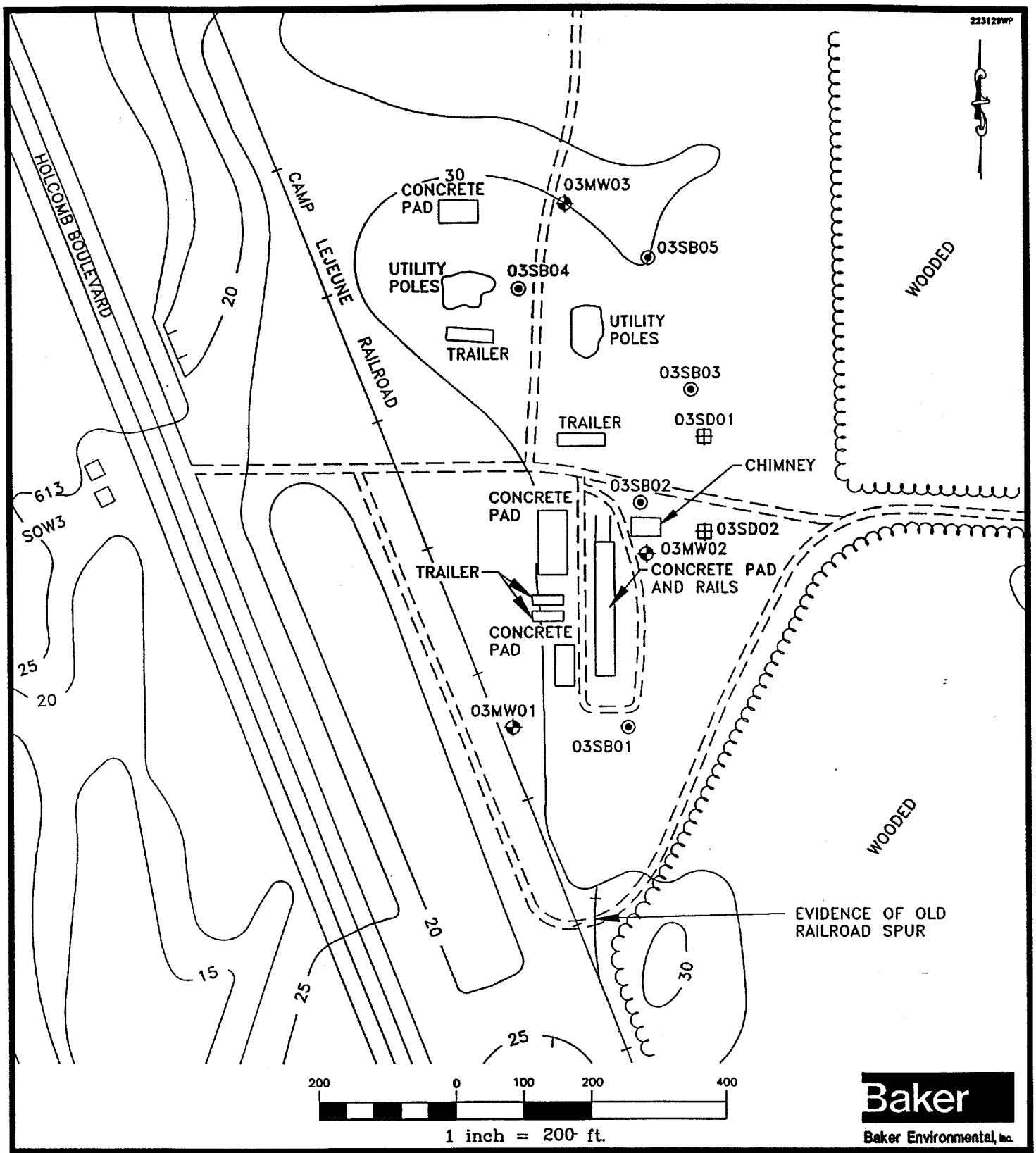


FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV, FEB. 1992



LEGEND

- 03MW01 ◆ MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 ◉ SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 ⊞ SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: LANTDIV, FEB. 1992

FIGURE 3
PREVIOUS INVESTIGATIONS
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TABLE 1

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION
OU NO. 12 (SITE 3)
OLD CREOSOTE PLANT
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	North Carolina Standards	EPA MCLs	No. of Positive Detections/ No. of Samples	Range of Positive Detection (µg/kg)	Location of Maximum Concentration
Acenaphthene	--	--	1/3	1,500	MW02
Anthracene	--	--	1/3	260	MW02
Chrysene	--	0.0002	1/3	**96**	MW02
Fluoranthene	--	--	1/3	640	MW02
Fluorene	--	--	1/3	890	MW02
2-Methylnaphthalene	--	--	1/3	1,500	MW02
Naphthalene	--	--	2/3	9-4,400	MW02
Phenanthrene	--	--	1/3	1,600	MW02
Pyrene	--	--	1/3	460	MW02
Dibenzofuran	--	--	1/3	1,100	MW02

µg/L - microgram per liter
Reference: Halliburton NUS, 1991

TABLE 2

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 12 (SITE 3)
OLD CREOSOTE PLANT
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)		Subsurface Soil (> 12 feet)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)
Acenaphthene	0/7	ND	0/5	ND	1/2	37,000
Antracene	1/7	1,900	0/5	ND	1/2	8,600
Benzo(a)anthracene	2/7	460-660	0/5	ND	1/2	5,600
Benzo(b)fluoranthene	2/7	520-2,200	0/5	ND	1/2	2,300
Benzo(k)fluoranthene	2/7	420-1,200	0/5	ND	1/2	2,100
Benzo(g,h,i)perylene	2/7	260-720	0/5	ND	0/2	ND
Benzo(a)pyrene	2/7	320-1,300	0/5	ND	0/2	ND
Chrysene	2/7	750-1,400	0/5	ND	1/2	5,900
Flouranthene	2/7	1,000-1,600	0/5	ND	1/2	35,000
Fluorene	0/7	ND	0/5	ND	1/2	35,000
Indeno(1,2,3-cd)pyrene	2/7	340-1,000	0/5	ND	0/2	ND
2-Methylnaphthalene	0/7	ND	0/5	ND	1/2	26,000
Napthalene	1/7	550	0/5	ND	1/2	52,000
Phenanthrene	1/7	310	0/5	ND	1/2	81,000
Pyrene	2/7	920-1,400	0/5	ND	1/2	27,000
Dibenzofuran	0/7	ND	0/5	ND	1/2	35,000

µg/kg - microgram per kilogram
Reference: Halliburton NUS, 1991

3.3 Sediment Investigation

Two sediment samples were collected from low lying areas of the site that collect water. Both samples were analyzed for TCL semivolatile organics. Analytical findings are presented on Table 3.

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc., March 1994)

Three concrete pads, not previously indicated on any figures or described in historical literature, were located. Two pads are located in the southern portion of the site where wood treating operations were probably performed. The third pad is located in the far northwest corner of the site. The historical use for these pads is unknown. Some staining is evident on the pad surface. The integrity of the concrete is very good, indicating that these pads may have been under cover, or the pads were recently constructed. During a period of heavy rain standing water was observed on the pads.

A large concrete slab, bordered by rail lines, was observed in the southern portion of the site, just southwest of the chimney structure. Some surface staining was evident on the concrete surface. This pad was likely associated with the creosote operations.

Two piles of utility poles are located in the northern portion of the site. These poles are new and belong to contractors who have used the area for staging supplies.

Evidence of the railroad spur that connected the creosote treatment area with the Lejeune railroad was found in the southwest corner of the site.

Historical aerial photos indicate that the access road which currently divides the site was not present. The access road around the southern portion of the site is currently overgrown with ground cover but still is accessible.

Free standing water was observed in the eastern portion of the site. This water was observed in depressed area that was probably created as a result of vehicle traffic.

5.0 PROPOSED FIELD INVESTIGATION

An investigation involving the collection and analysis of soil and groundwater media will be conducted. The objectives of this investigation are to delineate the site related contamination, predict contaminant migration potential, estimate human exposures and environmental impacts, and evaluate remediation options, if necessary. The following investigations and support activities will be conducted at Site 3.

5.1 Support Activities

All newly installed monitoring wells will be surveyed.

All soil sampling locations will be surveyed.

One round of static water level measurements will be collected from the existing and newly installed monitoring wells.

TABLE 3

NATURE AND EXTENT OF SEDIMENT CONTAMINATION
OU NO. 12 (SITE 3)
OLD CREOSOTE PLANT
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)
Bis(2-ethylhexyl)phthalate	1/2	750

µg/kg - microgram per kilogram
Reference: Halliburton NUS, 1991

5.2 Soil Investigation

Soil characterization during the RI will comprise sampling of surface and subsurface soil. The soil investigation will be conducted in the northern region of the site and the area believed to be where creosote treatment practices occurred (i.e., near the concrete pads). The following investigations are proposed.

A 200 by 200-foot sampling grid will be established in the northern portion of the study area. Soil characterization in this area will focus only on surficial soil since PAH compounds are relatively immobile. PAHs present in the surface soil would be an indication that creosote operations, including storage, may have taken place in this area. Soil samples will be collected using a decontaminated hand auger.

Test boring locations for the northern portion of the study area are shown on Figure 4.

A soil investigation will be conducted around the former creosote treatment area in the southern portion of the study area.

A 50 by 50-foot sampling grid will be established in this area. Soil characterization in this area will comprise of sampling soils via hand auguring to a depth not to exceed twelve inches.

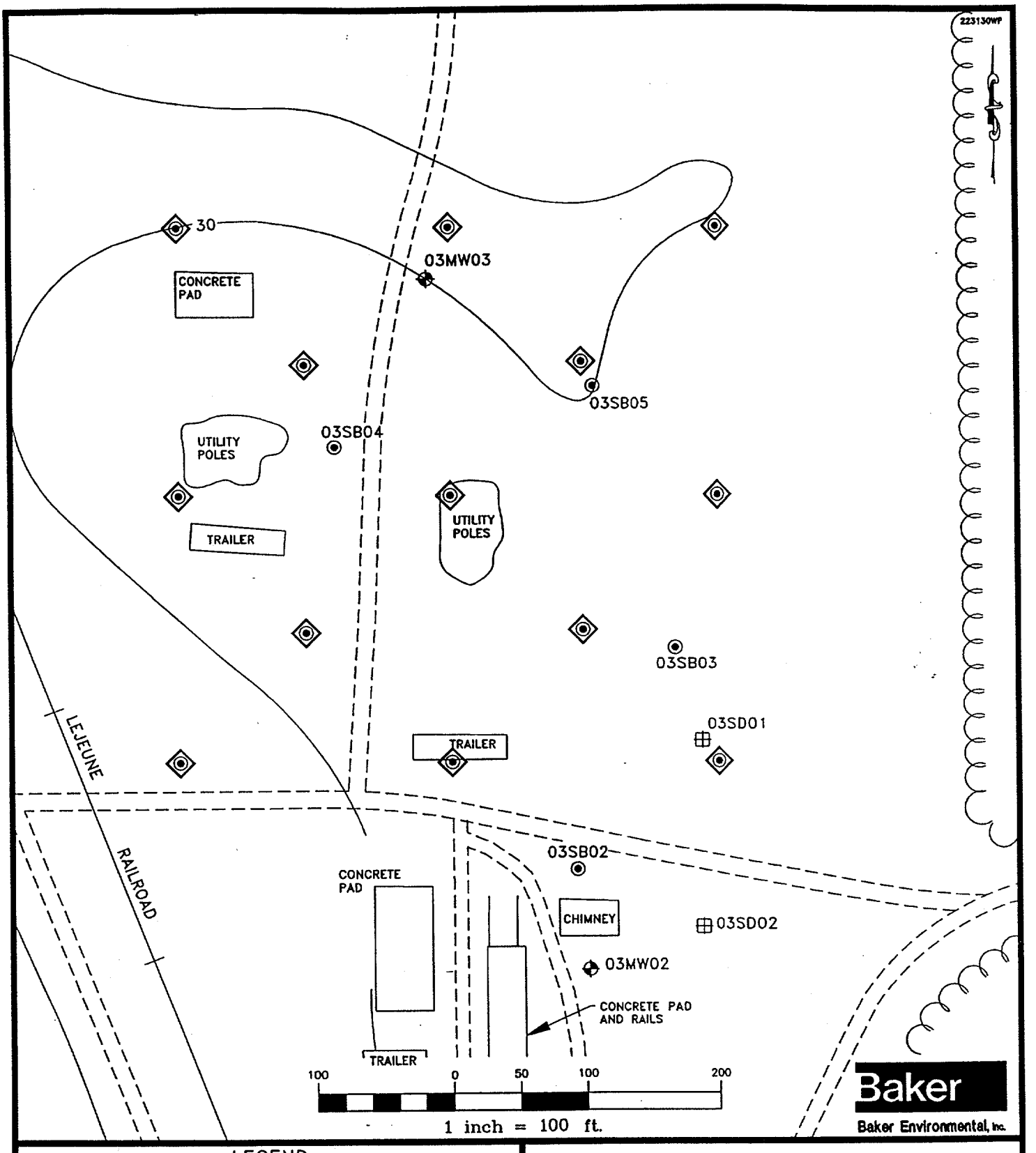
A soil investigation will be conducted around the two concrete pads located in the southern portion of the study area, near the former creosote operation. One soil sample will be collected from the midpoint of each of the four sides of the two concrete pads. Soil characterization will comprise of sampling soils to a depth not to exceed twelve inches.

One soil sample will be collected from two locations in the area where the railroad spur line was located. Soil characterization will comprise sampling soils via hand auguring to a depth not to exceed twelve inches.

All surface soil samples from both the north and south portions of the study area will be analyzed using ENSYS PAH Soil Sensitivity and ENSYS Petro Soil test kits to detect total PAHs and total creosote, respectively. Sample locations where levels of PAHs and/or creosote are above detection limits for the ENSYS test kits will be expanded to determine the horizontal extent of the constituents. Based on the findings of the quantitative findings of these immunoassay-based testing methods, positive results for total PAHs or total creosote will be submitted for confirmatory laboratory analysis. Soil borings may be drilled in areas identified by ENSYS tests with detected levels of PAHs and/or creosote. In addition, ten percent of soil samples reported as nondetect will be submitted for laboratory analysis.

A soil investigation will be conducted during the monitoring well installation. Monitoring well test borings will be augured and soil samples collected. Soil samples will be collected with a split spoon for 2-foot intervals along 2-foot centers to a depth of ten feet. A maximum of three soil samples will be submitted per test boring. These samples include a surficial soil (0 to 12 inches) and two subsurface soil samples, one from just above the water table and one at mid-depth. Soil samples will be submitted for analysis of TCL semivolatile organics only.

Test boring and monitoring well test boring locations for the south area are shown on Figure 5.



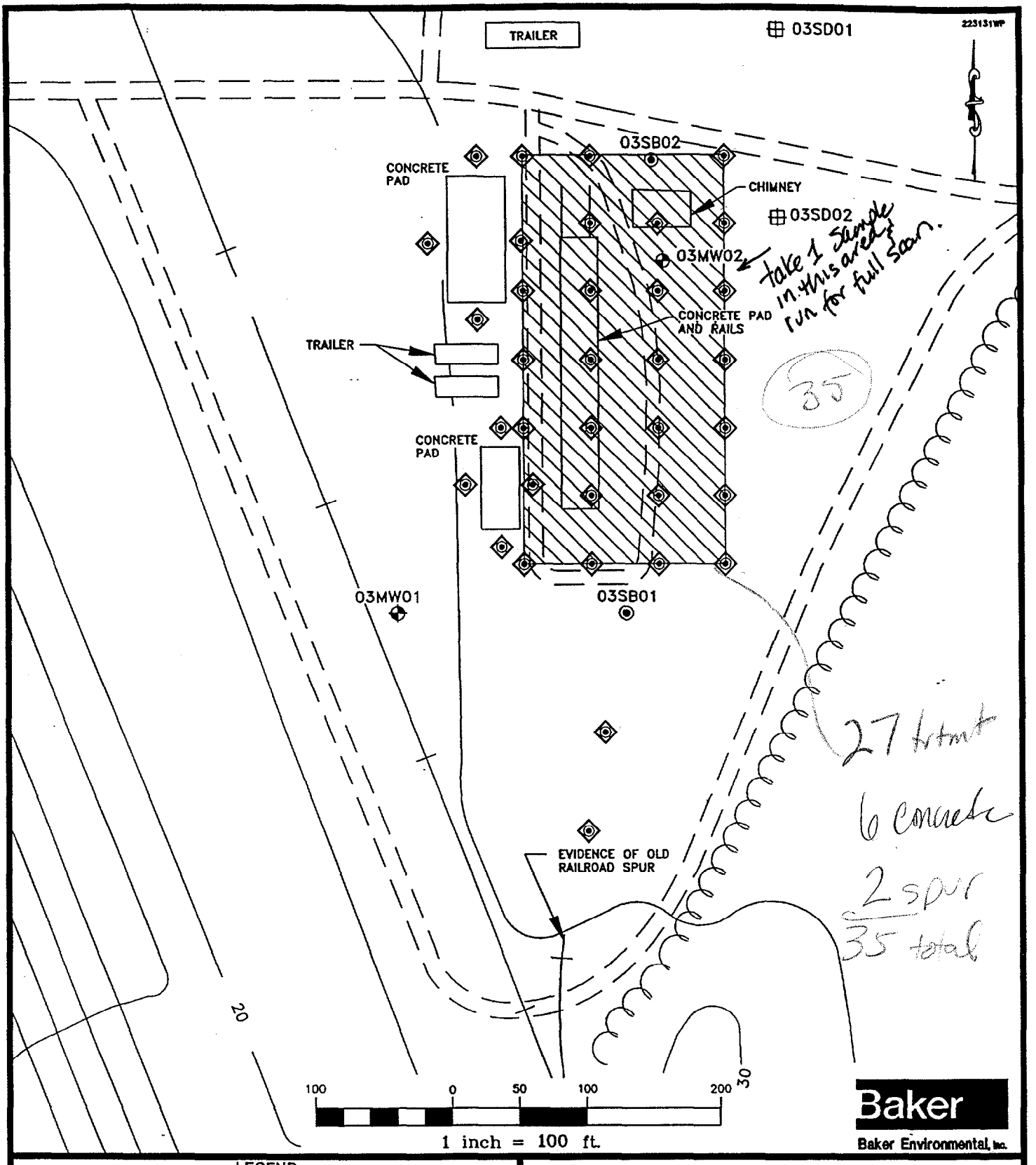
LEGEND

- 03MW01 — MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 — SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 — SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED ENSYS TESTING LOCATION

SOURCE: LANTDIV, FEB. 1992

FIGURE 4
PROPOSED SOIL INVESTIGATION
NORTH AREA – SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- 03MW01 — MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 — SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 — SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED ENSYS TESTING LOCATION
- AREA OF CONCERN

SOURCE: LANTDIV, FEB. 1992

FIGURE 5
PROPOSED SOIL INVESTIGATION
SOUTH AREA – SITE 3
OLD CREOSOTE PLANT

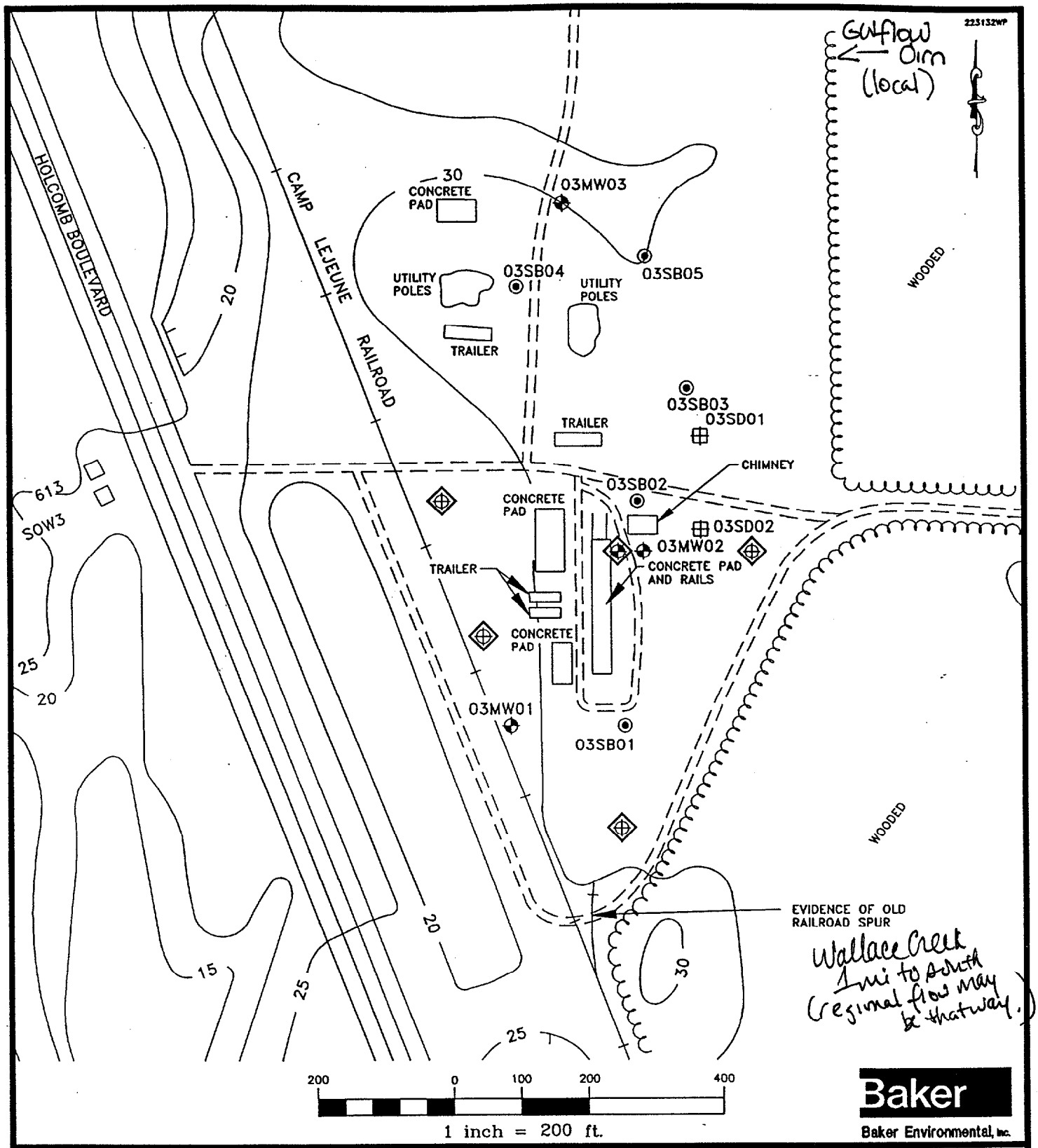
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

5.3 Groundwater Investigation

Four shallow monitoring wells will be constructed in a configuration to delineate the extent of PAH contaminated groundwater at well 03MW02, and to assess background groundwater quality. One intermediate depth monitoring well (40-50 feet) will be installed adjacent to existing shallow monitoring well 03MW02 in order to assess the potential vertical migration of PAHs. The proposed shallow wells are estimated to be installed to a depth of 20 feet.

One round of groundwater samples will be collected from 3 existing, 4 newly installed shallow monitoring wells, and 1 newly installed intermediate well. All groundwater samples will be analyzed for TCL volatile and semivolatile organics. Groundwater samples collected from newly-installed monitoring wells will be submitted for "quick-turn" analysis.

Existing and proposed monitoring well locations are shown on Figure 6.



LEGEND

- 03MW01 MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SHALLOW MONITORING WELL LOCATION
- PROPOSED INTERMEDIATE MONITORING WELL LOCATION

SOURCE: LANTDIV, FEB. 1992

FIGURE 6
PROPOSED GROUNDWATER INVESTIGATION
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

DRAFT

SAMPLE STRATEGY PLAN

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY PROJECT PLANS

OPERABLE UNIT NO. 8 (SITE 16)
OPERABLE UNIT NO. 11 (SITES 7 AND 80)
OPERABLE UNIT NO. 12 (SITE 3)

MARINE CORPS BASE,
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0233

Prepared for:

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

Under the:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

MARCH 11, 1994

INTRODUCTION

This Sample Strategy Plan presents an overview of the remedial investigation (RI) scope of work for Site 3 (Old Creosote Site), Site 7 (Tarawa Terrace Dump), Site 16 (Montford Point Burn Dump), and Site 80 (Paradise Point Golf Course) at Marine Corps Base (MCB), Camp Lejeune, North Carolina. Figure 1 shows the overall locations of these sites.

The purpose of the Sample Strategy Plan is to provide the EPA Region IV, the North Carolina Department of the Environment, Health, and Natural Resources (DEHNR), and members of the technical review committee (TRC) with a summary of the proposed field investigations that will be presented by LANTDIV at an upcoming RI/FS scoping meeting. This document is meant to be used as a supplement to the scoping meeting, and is not intended for formal comment. Questions or comments on the proposed RI field investigations will be addressed by LANTDIV at the upcoming meeting.

The format of the Sample Strategy Plan is as follows. Each site is addressed separately in this document. A brief description of the site location and setting, site history, and a summary of previous investigations are provided. Previously-obtained analytical results are also presented in table format in order to familiarize the reader with the level and types of contamination at the site. The proposed field investigations are described, including the objectives and sampling rationale. Figures depicting the sampling stations are also included.

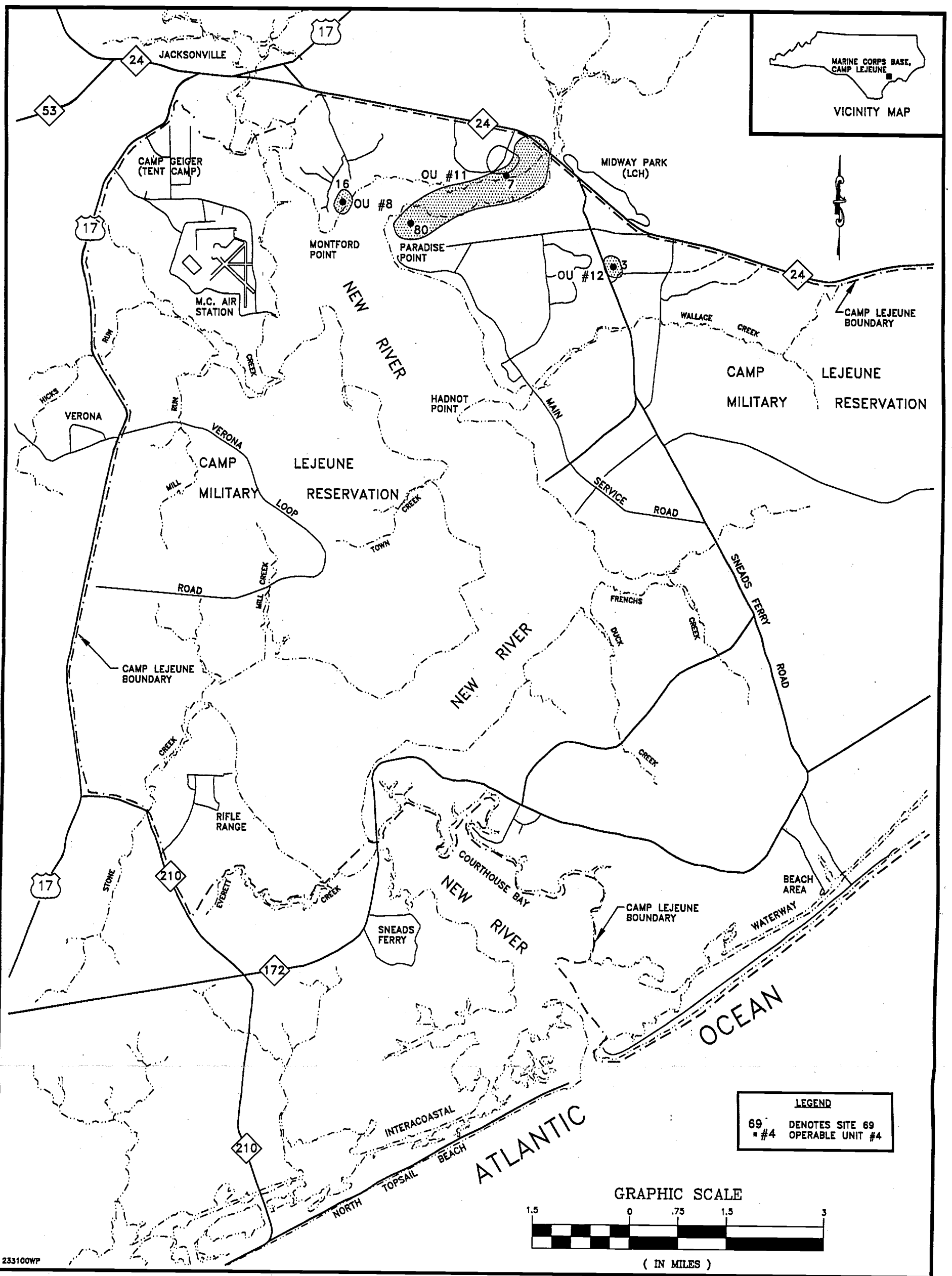


FIGURE 1
OPERABLE UNITS AND SITE LOCATIONS AT MARINE CORPS BASE CAMP LEJEUNE

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00221M012

OPERABLE UNIT NO. 8
SITE 16, BURN DUMP AREA

1.0 SITE LOCATION AND SETTING

The former burn dump area is located southwest of the intersection of Montford Landing Road and Wilson Drive in the Montford Point area of Camp Lejeune. The study area for this site is estimated at 4 acres in size. It is relatively flat, with a slight slope to the southeast. The Northeast Creek is approximately 400 feet southeast from the southeast boundary of the burn dump. The remainder of the study area is bordered by trees/woods. The general site location is shown on Figure 1.

2.0 SITE HISTORY

Limited information is available concerning operations of the burn dump. Practices at other burn dumps at Camp Lejeune indicate that the Montford Point burn dump accepted municipal waste/trash from the surrounding area housing and activities buildings. Typically, the debris was burned, then pushed to the sides so that more debris could be dumped and burned.

3.0 PREVIOUS INVESTIGATIONS

No previous investigations have been performed at this site.

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc. March 1994)

The Montford Point burn dump is a cleared area surrounded by woods on all four sides. There is a opening in the trees in the southeast corner of the burn dump that leads to Northeast Creek. An apparent storm sewer line, located to the southeast of the burn dump, runs in a northeast-southwest direction. There is also a storm sewer line that runs from the intersection of Coolidge Road and Harding Road, and connects to the storm line southeast of the site. Currently, the site is being used for storing vehicles used in training, and for training exercises. In the center of the former burn dump is a discarded jet aircraft. This aircraft is used in refueling exercises by tanker truck operators. During these exercises, however, no actual fuel is used. A four-foot wide ditch, believed to be a fire break, was noticed coming off of the storm sewer line to the southwest of the site and extending around the western and northern sides of the former burn dump. There are no permanent structures at this site. Figure 2 shows existing structures/features of the site.

5.0 PROPOSED FIELD INVESTIGATION

5.1 Soil Investigation

A series of soil borings will be performed within the boundary of the former burn dump. A 150 foot by 100 foot sampling grid will be established within the former burn dump. A total of twenty (20) borings will be drilled to a depth of approximately 10 feet(or to the top of the groundwater table) to determine the shallow stratigraphy at the site and to collect samples for laboratory analysis. Two (2) soil samples from each soil boring will be submitted for chemical analysis. These samples will be collected from the surface and just above the groundwater table for analysis of full TCL organics and TAL metals. Thirteen (13) hand auger locations will be drilled and sampled southeast of the site where there is a break in the trees

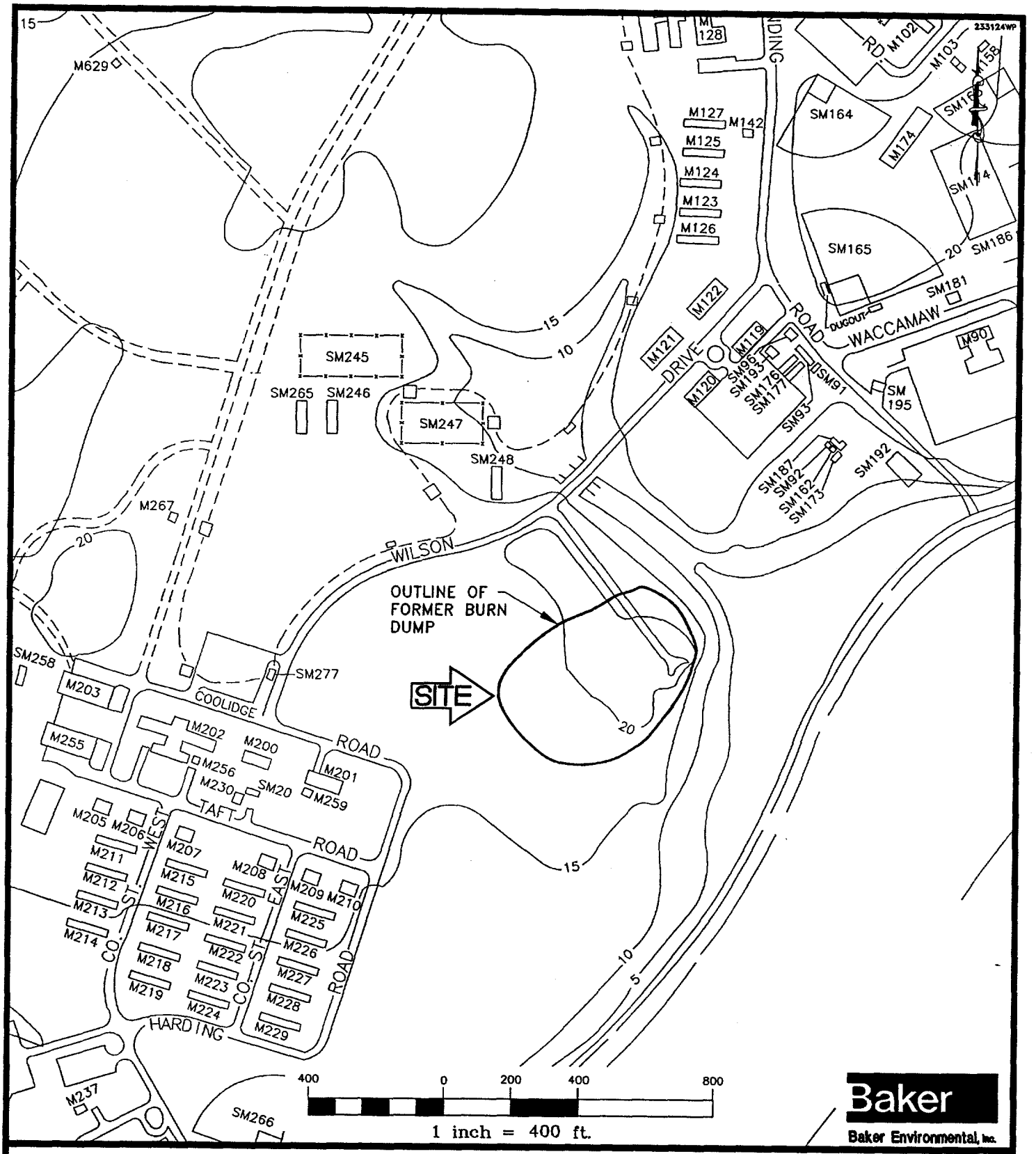


FIGURE 1
LOCATION MAP
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV., FEB. 1992

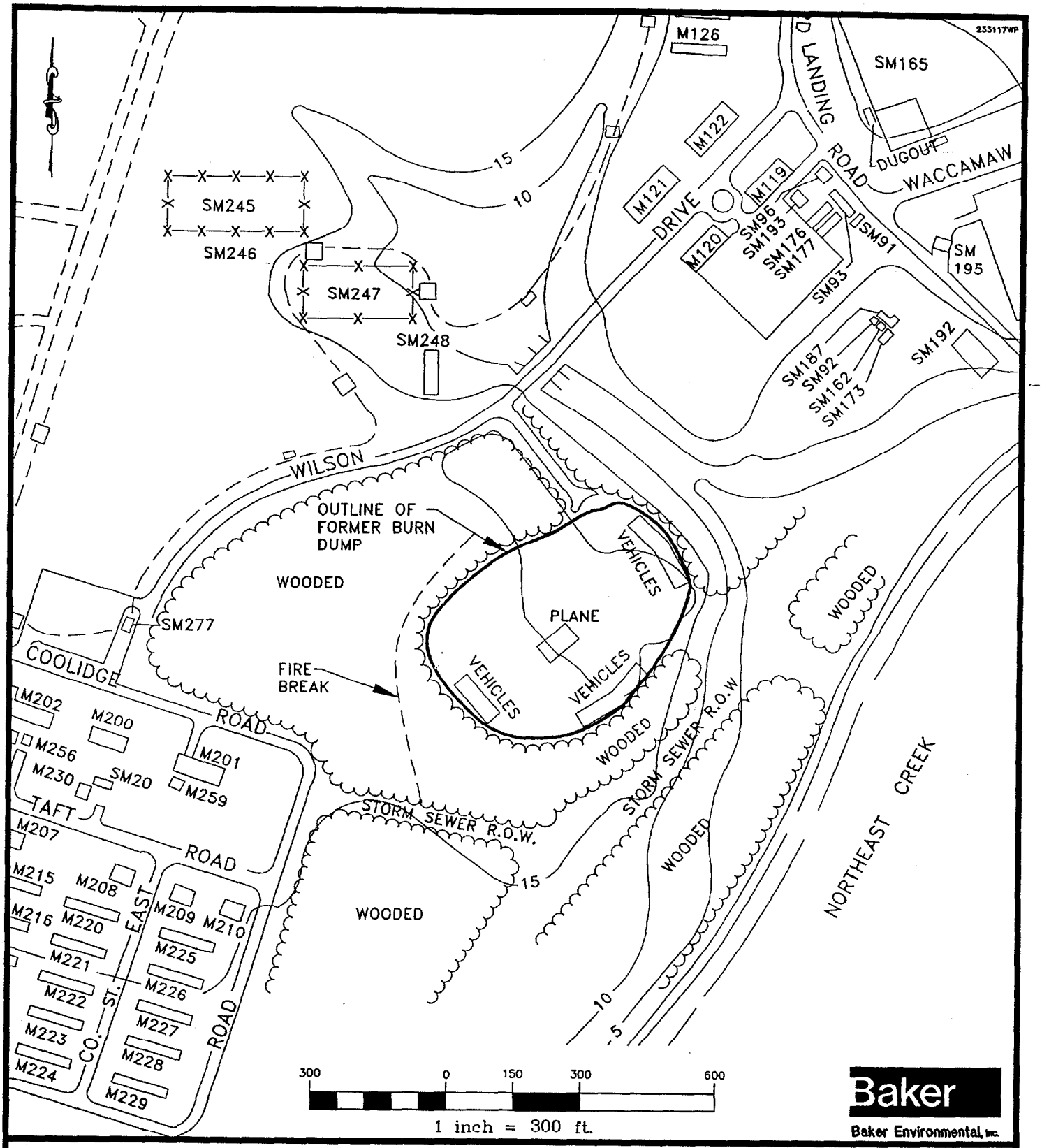


FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJUENE
NORTH CAROLINA

SOURCE: LANTDIV, FEB., 1992

and visible evidence of surface drainage to Northeast Creek. Two soil samples will also be collected from each of these locations for the same laboratory analyses. The locations of the soil sampling points are shown on Figure 3.

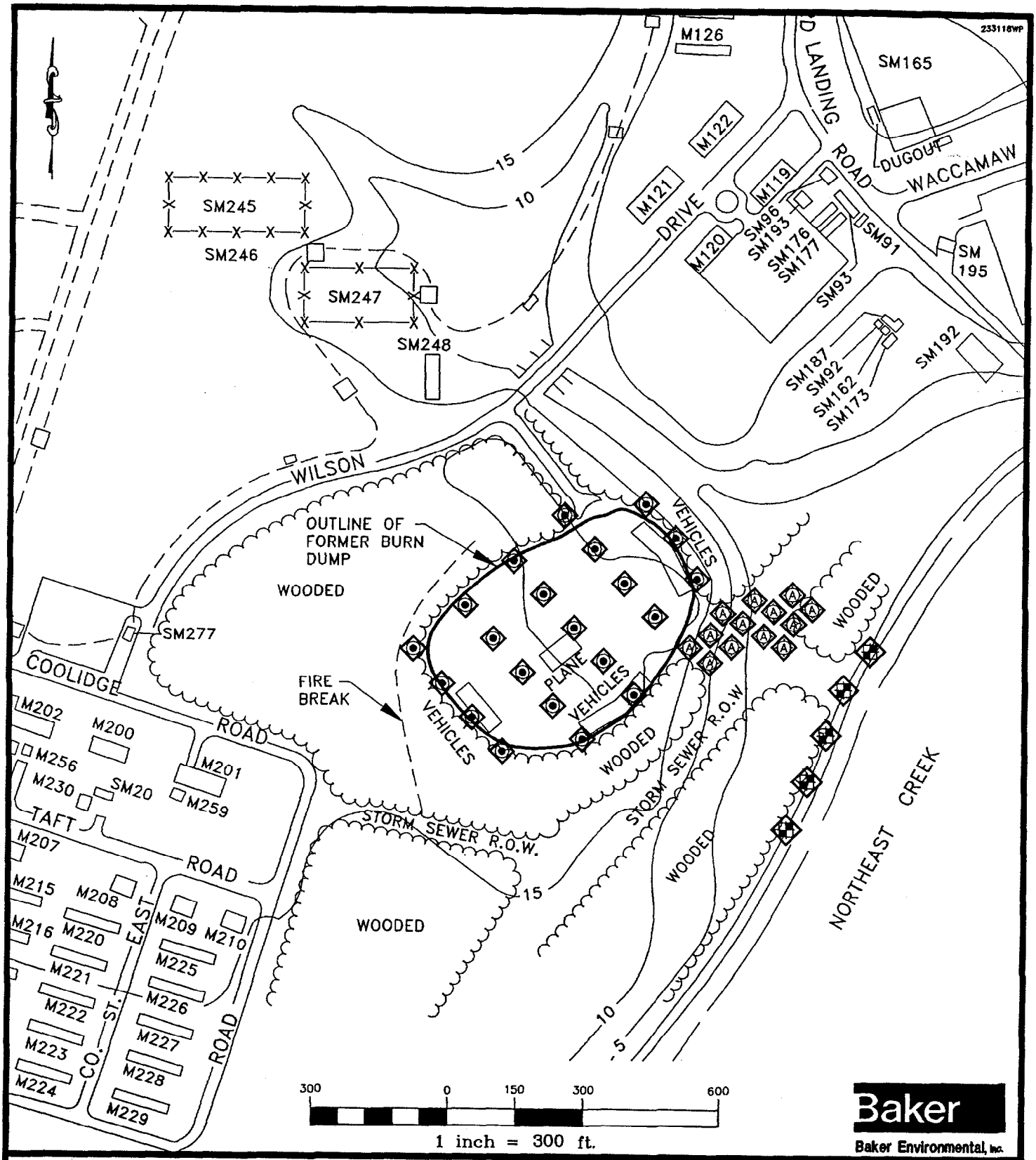
A minimum of two soil samples will be collected from each of the proposed groundwater monitoring well locations and submitted for laboratory analysis. The samples will be collected from the surface and just above the groundwater table.

5.2 Surface Water and Sediment Investigation

Five surface water and sediment sampling points are proposed along Northeast Creek. They will be spaced approximately every 100 feet along the creek starting at the landing area southeast of the former burn dump. Sediment samples will be collected from depths of 0 to 6 inches and 6 to 12 inches, and submitted for laboratory analysis. Analysis will be for full TCL organics and TAL metals. The proposed locations of the surface water and sediment sampling points are shown on Figure 3.

5.3 Groundwater Investigation

Five (5) shallow groundwater monitoring wells are proposed for this investigation to determine if the former disposal/burning activities have affected groundwater. One well will serve as an upgradient, background well. A second shallow well will be placed along the southeastern portion of the burn dump, downgradient of groundwater flow. Three shallow wells will be installed downgradient of the site to assess off-site groundwater quality. These wells will be approximately 20 to 25 feet deep. The proposed locations for the monitoring wells are shown on Figure 4. Based on elevated HNU readings and visual observations of contaminants in the field, a sixth shallow monitoring well may be installed within the former burn dump.



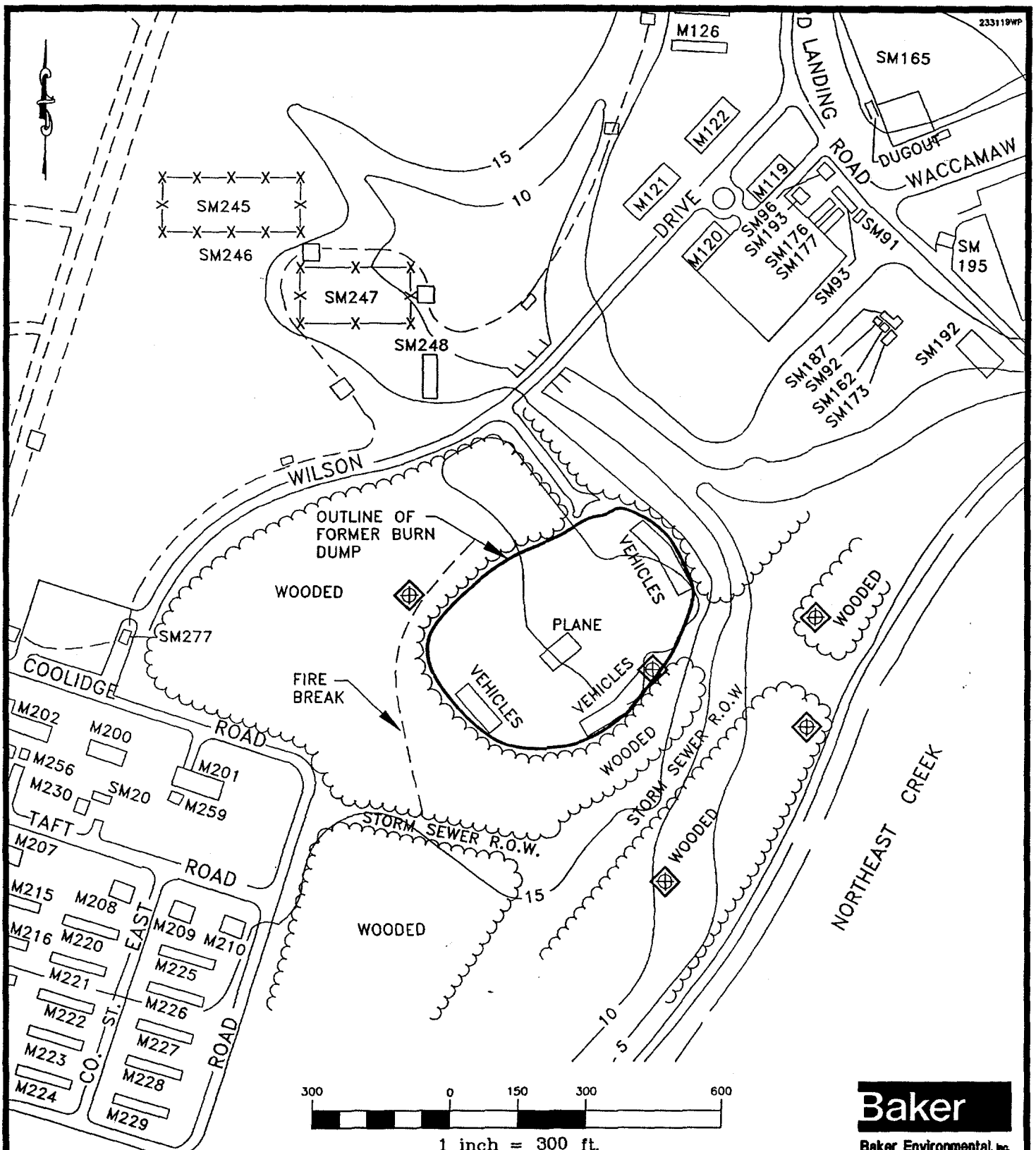
LEGEND

- PROPOSED HAND AUGER SAMPLE LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION

SOURCE: LANTDIV, FEB., 1992

FIGURE 3
PROPOSED SOIL INVESTIGATION
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJUENE
NORTH CAROLINA



LEGEND

◈ PROPOSED SHALLOW MONITORING WELL LOCATION

SOURCE: LANTDIV, FEB., 1992

FIGURE 4
PROPOSED GROUNDWATER INVESTIGATION
SITE 16
BURN DUMP AREA

MARINE CORPS BASE, CAMP LEJUENE
NORTH CAROLINA

OPERABLE UNIT NO. 11
SITE 7, TARAWA TERRACE DUMP

1.0 SITE LOCATION AND SETTING

Site 7 is located north and east of the sewage treatment plant, south of the Community Center, and is bordered to the north and south by Tarawa Boulevard and Northeast Creek, respectively. The study area is approximately 5 acres, and access is not restricted. A marsh area is encountered in the southern portion of the study area in the vicinity of Northeast Creek. The entire study area is dense with wooded areas and ground cover. Northeast Creek flow to the west in the direction of the New River. The general site location is shown on Figure 1.

2.0 SITE HISTORY

Tarawa Terrace Dump is a former dump, but the precise years of operation are unknown. It was used during the construction of the base housing located in Tarawa Terrace. The dump was closed in 1972. Past history does not indicate that hazardous materials were disposed of at this facility. Only construction debris, sewage treatment plant filter media, and household trash are known to have been disposed. The general arrangement of the site is shown on Figure 2.

3.0 PREVIOUS INVESTIGATIONS

- A Site Inspection was conducted in 1991 by Halliburton/NUS.
- Preliminary Draft Site Inspection Report (Halliburton/NUS, November 1991).
- Site Inspection sampling locations are presented on Figure 3.

3.1 Groundwater Investigation

Three shallow monitoring wells were installed and one round of groundwater samples were analyzed for full TCL organics and TAL metals and cyanide. Analytical findings are summarized on Table 1.

Two pesticides, dieldrin and endrin ketone, were reported a low levels. Metals were reported in all groundwater samples.

3.2 Soil Investigation

Eight surface soil samples (0 to 2 feet) and five subsurface soil samples (3 to 12 feet) were collected. All samples were analyzed for full TCL organics and TAL metals and cyanide. Analytical findings are summarized on Table 2.

Soil sample location MW02 exhibited elevated levels of PCBs and pesticides. Pesticides and PCBs were also reported in soil samples SB01 and SB02. The highest level of PCBs were detected in the subsurface soil (7.5 to 9.5 feet) at location MW02.

3.3 Surface Water/Sediment Investigation

Not conducted as part of the Site Inspection.

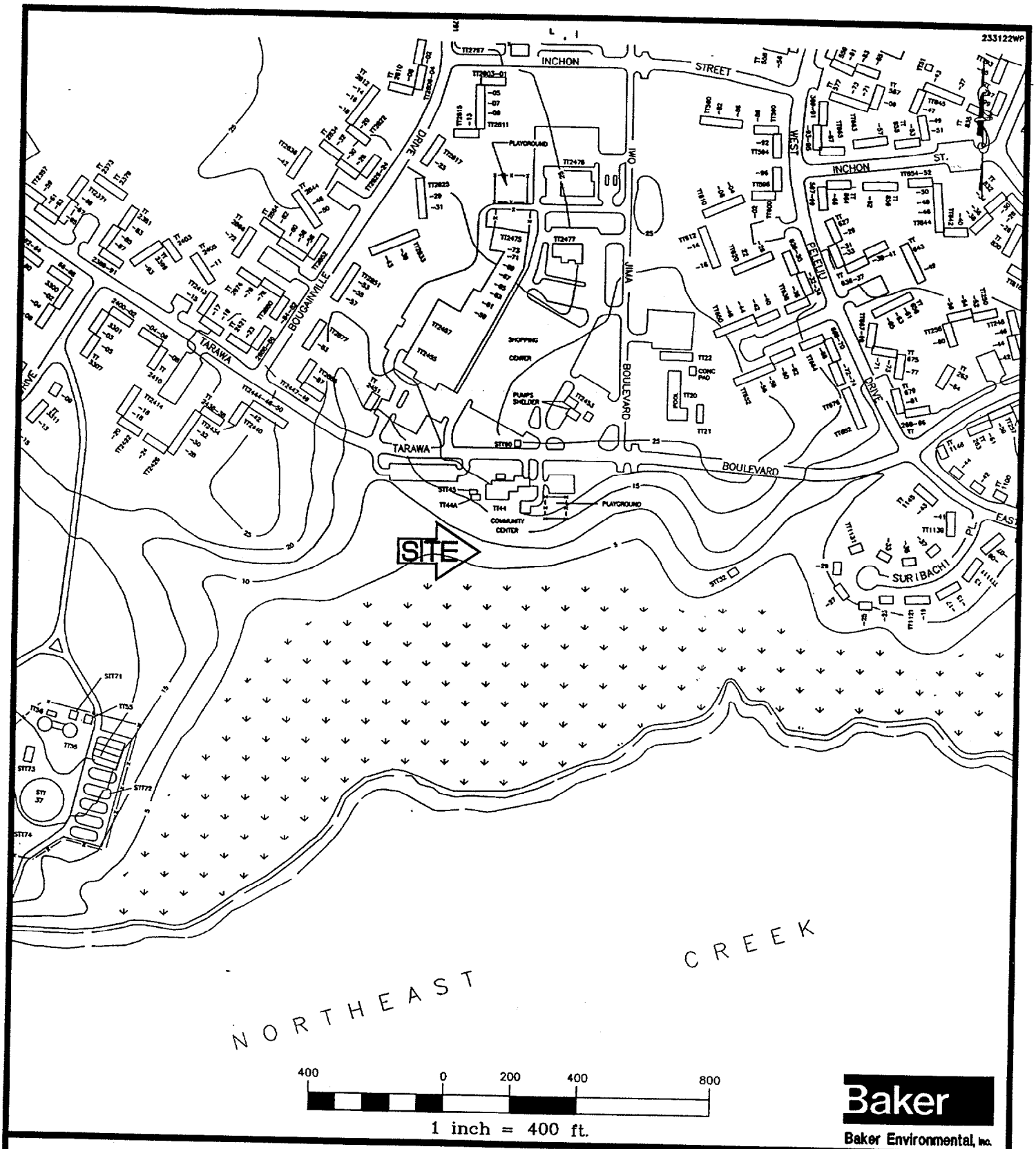
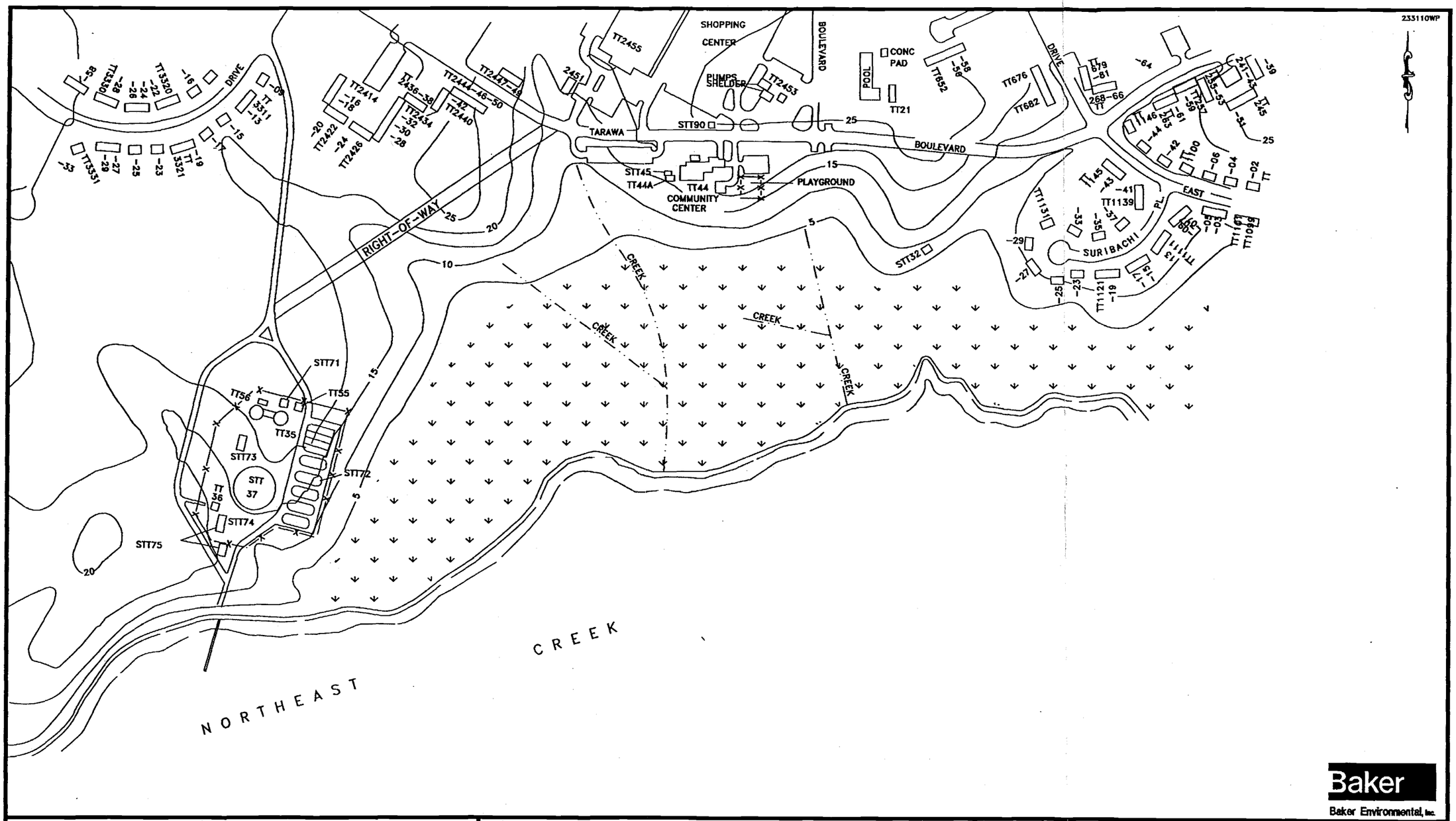


FIGURE 1
LOCATION MAP
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV., FEB. 1992



Baker
Baker Environmental, Inc.

LEGEND

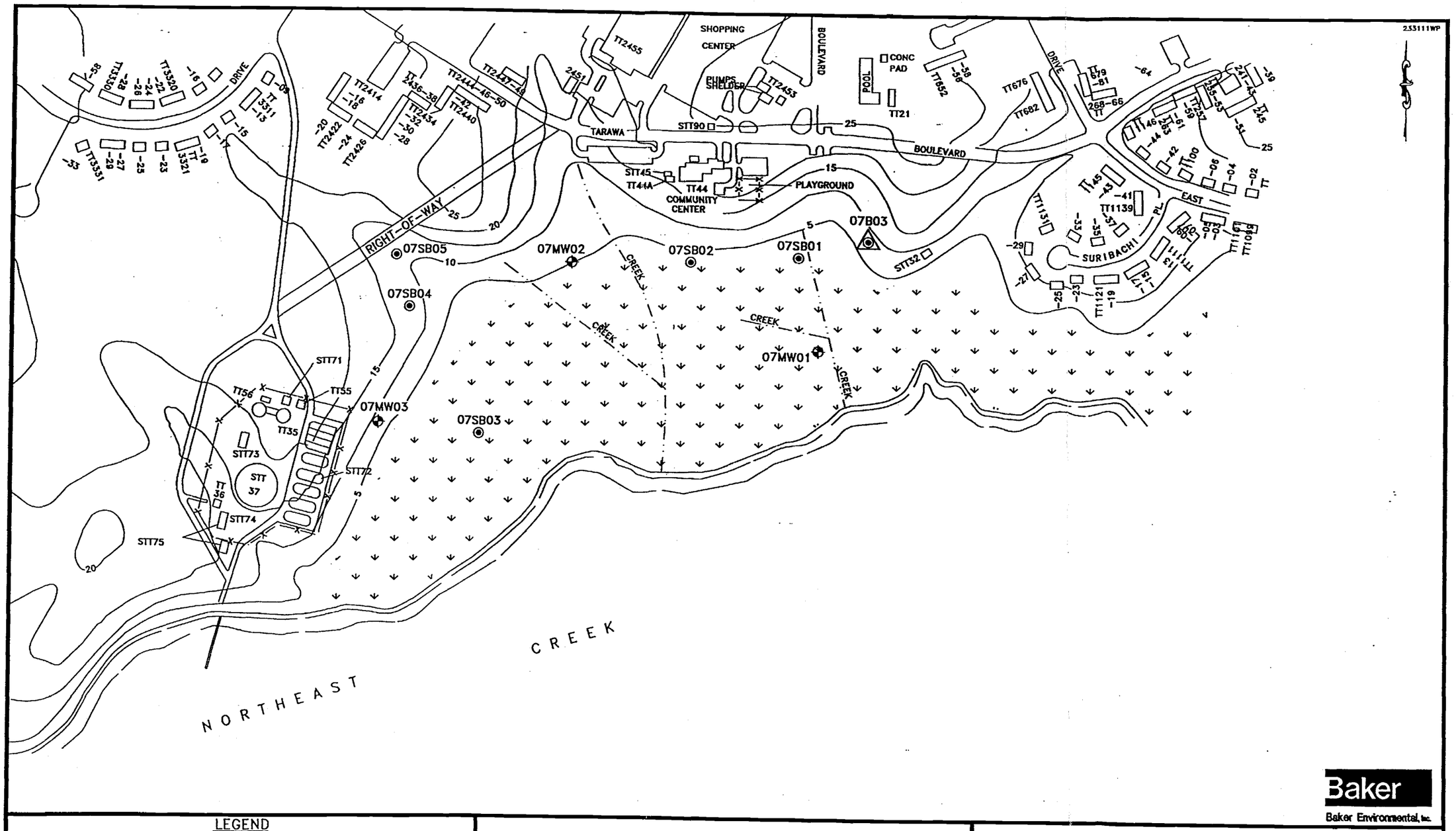
SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

07MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07B03 EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

Baker

Baker Environmental, Inc.

FIGURE 3
PREVIOUS INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TABLE 1

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION
OU NO. 11 (SITE 7)
TARAWA TERRACE DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/L)	Location of Maximum Concentration
Benzoic Acid	2/3	9-12	MW03
Dieldrin	1/3	0.63	MW02
Endrin Ketone	1/3	0.09	MW02
Aluminum	3/3	29,000-137,000	MW02
Antimony	1/3	4.75	MW02
Barium	3/3	427-706	MW02
Beryllium	2/3	3.1-9.4	MW02
Chromium (III)	3/3	47.8-251	MW02
Cobalt	2/3	9.6-21.7	MW01
Copper	3/3	17.7-41.6	MW02
Iron	3/3	26,400-228,000	MW02
Lead	3/3	30.3-37.3	MW01
Magnesium	1/3	13,500	MW01
Manganese	3/3	56.9-220	MW01
Mercury	2/3	0.24-0.36	MW03
Potassium	1/3	5,240	MW02
Selenium	1/3	3.4	MW01
Sodium	1/3	156,000	MW01
Vanadium	3/3	37.8-442	MW02
Zinc	3/3	83.6-151	MW02

µg/L - microgram per liter
Reference: Halliburton NUS, 1991

TABLE 2

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 11 (SITE 7)
TARAWA TERRACE DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)	
	No. of positive Detections/ No. of Samples	Range of Positive Detections	No. of positive Detections/ No. of Samples	Range of Positive Detections
Organics [1]				
Bis(2-ethylhexyl)phthalate	1/8	1,000	0/5	ND
Fluoranthene	2/8	220-290	0/5	ND
Benzoic acid	2/8	6,300-15,000	1/5	7,900
Aldrin	1/8	4.3	0/5	ND
4,4'-DDD	3/8	12-20	2/5	58-190
4,4'-DDE	1/8	240	0/5	ND
Dieldrin	3/8	12-540	3/5	400-2,500
Endosulfan II	3/8	7.6-1,400	3/5	73-2,000
Endrin	2/8	91-140	4/5	14-1,300
Aroclor-1260	3/8	108-12,000	4/5	660-25,000
Inorganics [2]				
Aluminum	8/8	3,690-9,700	5/5	1,030-5,030
Arsenic	3/8	1.1-1.7	3/5	1.1-1.5
Barium	8/8	9.1-223	5/5	6.6-72.8
Beryllium	4/8	0.26-2.1	3/5	0.29-3.6
Cadmium	8/8	1.1-5.0	5/5	1.2-4.5
Calcium	7/8	190-58,200	3/5	3,660-9,990
Chromium (III)	8/8	4.2-10.6	5/5	5.2-12.5
Cobalt	8/8	1.7-8.1	5/5	1.9-10.2
Iron	8/8	876-5,330	5/5	981-5,490
Lead	8/8	3.0-114	5/5	2.4-17.0
Magnesium	8/8	104-1,150	4/5	99.9-541

TABLE 2 (Continued)

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 11 (SITE 7)
TARAWA TERRACE DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)	
	No. of positive Detections/ No. of Samples	Range of Positive Detections	No. of positive Detections/ No. of Samples	Range of Positive Detections
Nickel	8/8	2.8-13.1	5/5	3.1-11.7
Potassium	6/8	110-507	4/5	120-452
Selenium	1/8	0.54	0/5	ND
Silver	8/8	0.66-3.0	5/5	0.72-2.7
Sodium	1/8	754	1/5	1,020
Thallium	8/8	0.44-2.0	5/5	0.47-1.8
Vanadium	8/8	4.5-18.1	5/5	4.5-9.8
Zinc	2/8	1.1-44.5	3/5	1.2-4.5
Cyanide	8/8	0.54-2.5	5/5	0.60-2.3

(1) - Organic concentrations expressed in μg/kg (microgram per kilogram).
(2) - Inorganic concentrations expressed mg/kg (milligram per kilogram).
ND - Not detected.
Reference: Halliburton NUS, 1991

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc., March 1994)

Two surface water bodies were located during the site reconnaissance. The larger of the two surface water bodies flows in southern direction to Northeast Creek. The other surface water body flows in a southeastern direction feeding the larger surface water body. Based on visual observations, it is believed that these surface water bodies are formed due to groundwater seepage and stormwater runoff.

Four areas of concern were apparent during the site visit and from a review of historical photographs. Visual debris (i.e., paint cans, motor oil cans, other unknown rusted cans) were present in one area, due east of the Wastewater Treatment Plant. What appeared to be a cleared area, where past dumping may have occurred was observed in a southwest direction from the smaller surface water body.

Aerial photos from 1973 and 1978 showed another potential dump area east of the utility right-of-way. Additionally, a smaller cleared area was shown on the western side of the utility right-of-way.

5.0 PROPOSED FIELD INVESTIGATION

In order to define the extent of potential contamination due to reported dumping practices the following activities will be conducted:

- Soil Investigation
- Groundwater Investigation
- Surface Water/Sediment Investigation

5.1 Support Activities

Collection of at least one round of water level measurements from existing and newly installed monitoring wells.

Placement of staff gauges in the two surface water bodies within the boundaries of this site.

5.2 Soil Investigation

Soil characterization during the RI will comprise of sampling surface and subsurface soil. The soil investigation will be conducted throughout the study area. The following investigations will be conducted in the study area.

Soil characterization to be conducted in the southwest corner of the study area, where surficial debris was noted, will comprise of excavating up to 5 trenches, and sampling the surface (0 to -12 inches) and subsurface soil. The subsurface soil sample will be a composite sample representative of the excavation.

All soil samples will be analyzed for full TCL organics and TAL metals.

A 300 by 300-foot sampling grid will be established along the northwestern boundary of the study area along the slope of the former dump. Within the two potential areas of concern (i.e., the "cleared areas") a 150 by 150-foot sampling grid will be established. Soil characterization within these grid areas will comprise of one surface soil and one subsurface soil per grid location. Surface soil characterization will be comprised of sampling soils to a depth not to exceed twelve inches. The subsurface soil characterization will be comprised of sampling soils from a depth just above the water table. All surface and subsurface soil samples will be submitted for laboratory analysis including full TCL organics and TAL metals.

Soil samples will also be collected during the drilling of monitoring well test borings. Split-spoon samples will be collected at two-foot centers from the ground surface to 10 feet below the water table. Two samples will be collected for laboratory analysis of full TCL organics and TAL metals from each boring. These samples include a surficial soil sample (0 to 12 inches) and one from just above the water table. These soil borings will be converted into monitoring wells.

Test boring locations for the study area are shown on Figure 4.

5.3 Groundwater Investigation

The groundwater investigation will consist of installing three shallow monitoring well and three temporary shallow monitoring wells in order to assess groundwater quality in the shallow (i.e., water table) aquifer.

Two permanent shallow monitoring wells will be installed in the southern portion of the study area to assess horizontal migration of contamination in the direction of Northeast Creek. Three temporary wells will be positioned in the southwestern portion of the study area, where access with a drilling rig is restricted due to the marshy conditions. The third permanent well will be installed north of the water treatment plant to assess background groundwater quality.

Two rounds of groundwater samples will be obtained from the three existing and three newly installed shallow monitoring wells. The first round of samples will be collected approximately one week following the development of the new wells. The second round will be collected approximately three months following the first round. One round of groundwater samples will be obtained from the three temporary shallow monitoring wells. All groundwater samples will be analyzed for full TCL organics and TAL metals (total and dissolved).

The proposed and existing shallow monitoring well locations are shown on Figure 5.

5.4 Surface Water/Sediment Investigation

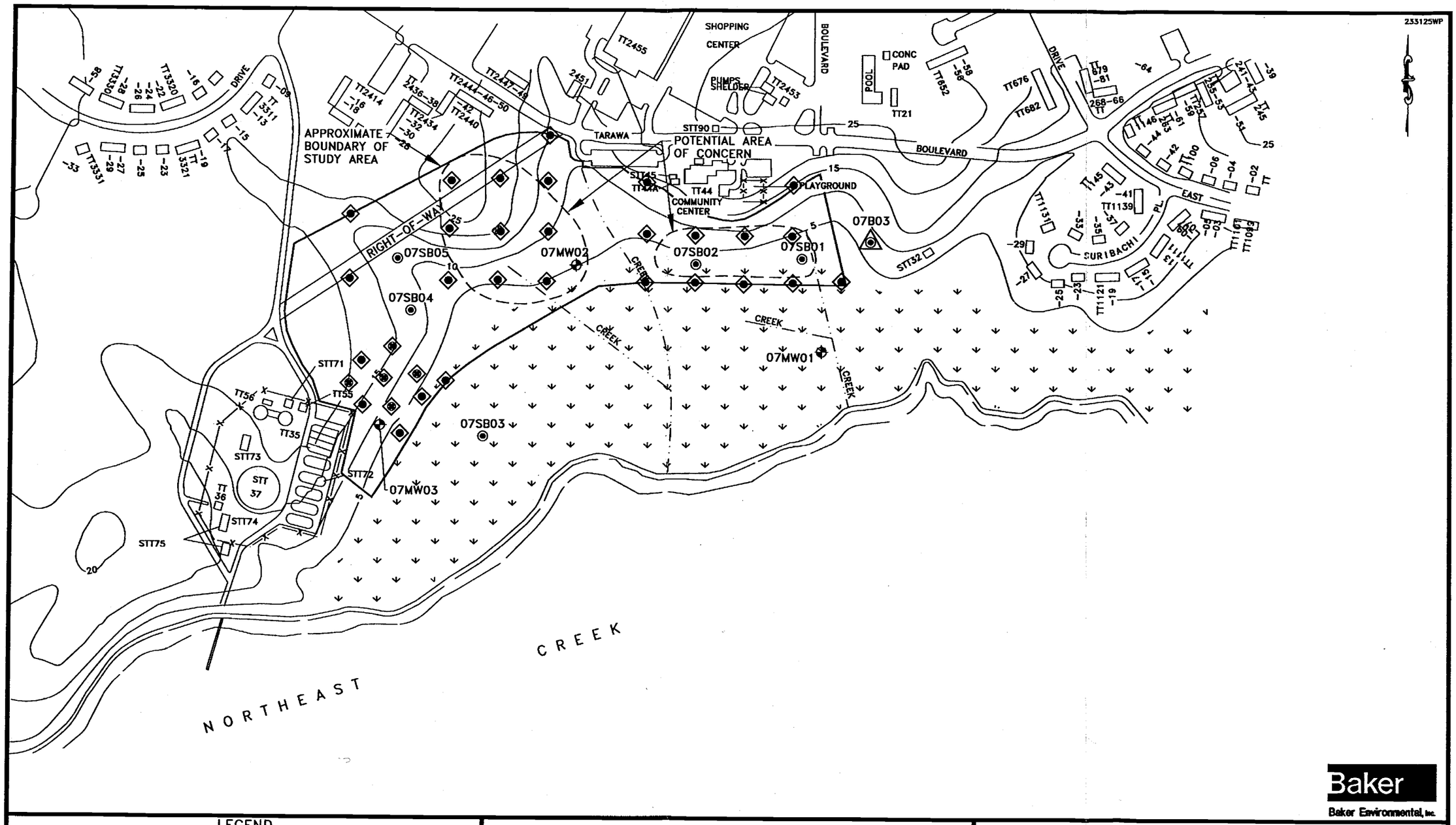
Potential impacts to surface water/sediment has not been assessed. There are three surface water bodies within Site 7. A surface water/sediment investigation will be conducted on each of these surface water bodies. The proposed investigations will include; Northeast Creek, the west and east tributaries of Northeast Creek, and the drainage ditch.

Six sampling stations are proposed within Northeast Creek. At each sampling station, one surface water and two sediment samples, a surface (0 to 6 inches) and subsurface (6 to 12) inches will be collected.

A surface water/sediment investigation will be conducted in the western and eastern tributary to Northeast Creek. Samples will be collected from six sampling stations in the west tributary and from four sampling stations in the east tributary. At each sampling station, one surface water and one surface sediment (0 to 6 inches) will be collected.

Up to three surface water and sediment stations are proposed for the drainage ditch which feeds the western tributary to Northeast Creek. One surface water and one surface sediment (0 to 6 inches) will be collected at each station.

A sediment investigation will be conducted in the marsh area in the southern portion of the study area. Two sediment samples will be collected from up to four sample stations. Sediment samples will be collected the surface (0 to 6 inches) and the subsurface (6 to 12 inches) at each station.



LEGEND

07MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

07B03 EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

PROPOSED SOIL SAMPLE LOCATION

PROPOSED TRENCH LOCATION

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

FIGURE 4
PROPOSED SOIL INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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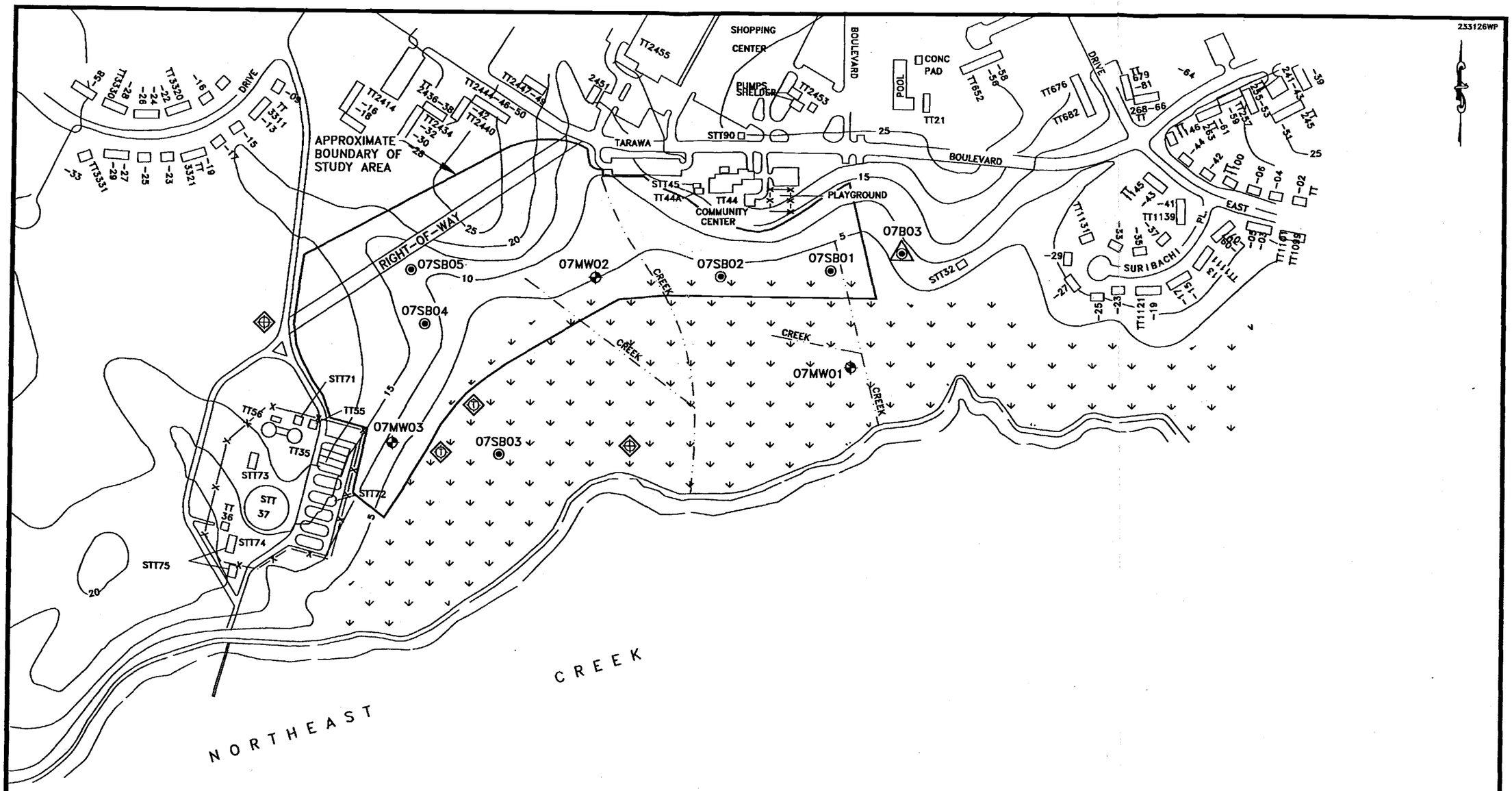

LEGEND

- 07MW01 EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07SB01 EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07B03 EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SHALLOW MONITORING WELL LOCATION
- PROPOSED TEMPORARY WELL LOCATION

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

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FIGURE 5
PROPOSED GROUNDWATER INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

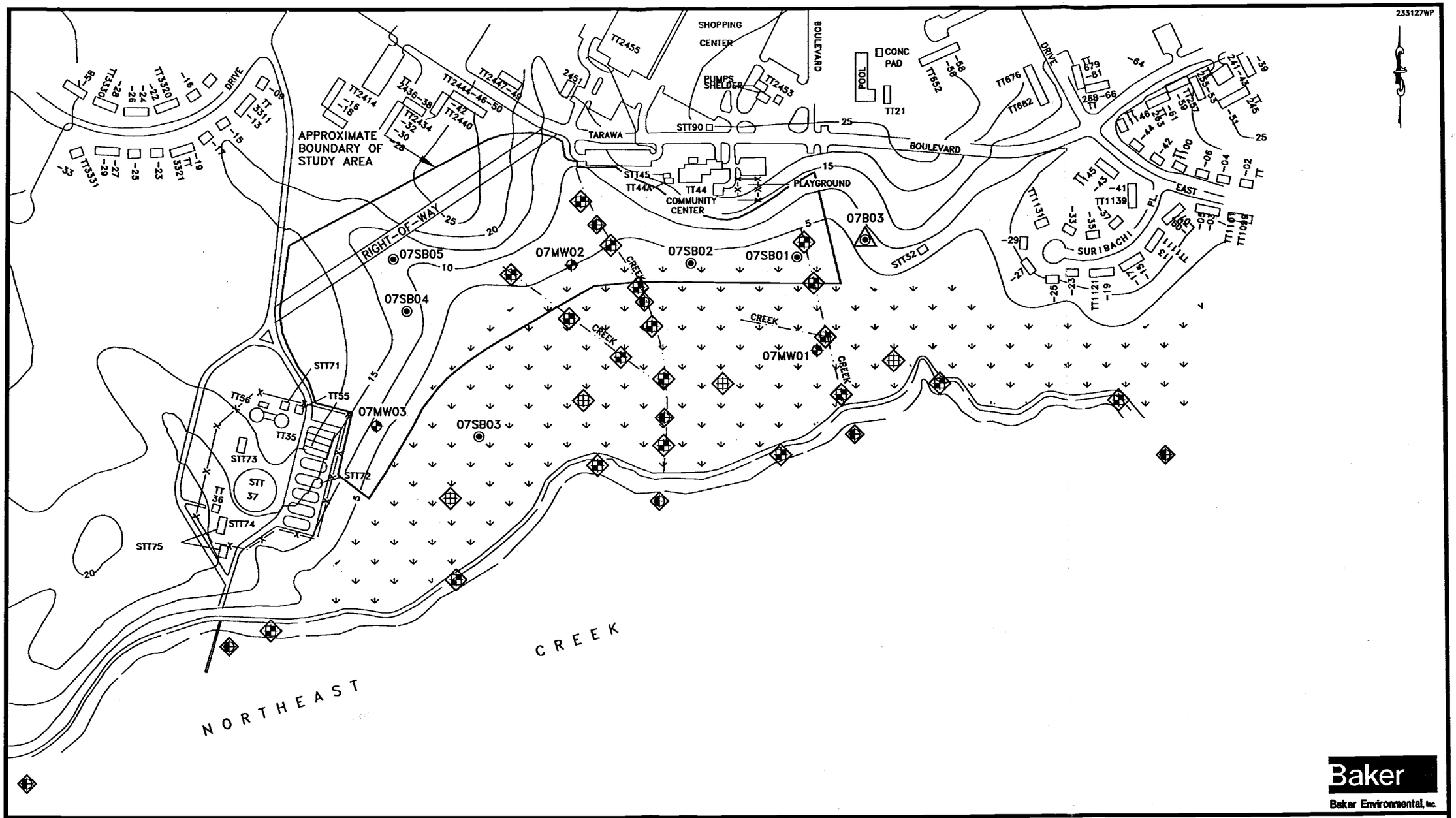
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

All surface water and sediment samples will be analyzed for full TCL organics and TAL metals.

In addition to the surface water/sediment investigation, benthic samples will be collected in Northeast Creek and the western tributary to Northeast Creek. Samples will be collected from three stations in the tributary and five stations in Northeast Creek.

A gill net will be positioned where the west tributary feeds Northeast Creek in order to determine whether this tributary is a significant ecological area. If appropriate, fish samples may be collected for analysis.

Figure 6 presents the proposed sample stations for the surface water/sediment and benthic investigation.



LEGEND

- 07MW01 — EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07SB01 — EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 07B03 — EXISTING BACKGROUND SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION
- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED BENTHIC SAMPLE LOCATION

SOURCE: LANTDIV, FEB. 1992

300 0 150 300 600

1 inch = 300 ft.

Baker Environmental, Inc.

FIGURE 6
PROPOSED ECOLOGICAL INVESTIGATION
SITE 7
TARAWA TERRACE DUMP

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 11
SITE 80, PARADISE POINT GOLF COURSE

1.0 SITE LOCATION AND SETTING

The study area is located northwest of Brewster Boulevard within the Paradise Point Golf Course. A general site location of this study area is shown on Figure 1. Site 80 consists of a 1-acre area located in the rear of machine shop (Building 1916) and a maintenance wash area consisting of a concrete wash pad and a sump. The sump is used to collect water and oil runoff generated from the spraying of the maintenance equipment. The sump has been known to overflow during periods of heavy rain. Pesticide mixing and handling was once performed in this area also. The wash rack was reportedly constructed over the former mixing area. A drainage ditch is located to the southeast of the wash area. Figure 2 depicts the current site structures. Behind the machine shop are mounds of soil and an "open" area where tree cuttings and other debris are in piles. The mounds of dirt are overgrown with young pines (5 to 7 years old).

2.0 SITE HISTORY

Site 80 is used for maintenance and cleaning of equipment used at the golf course. This area is currently used to house and mix pesticides and herbicides used in the golf course maintenance. Prior to the construction of the existing concrete wash pad, chemical mixing was conducted on a concrete pad with no apparent containment controls. The soil mounds behind Building 1916 are excavated soils generated during the construction of a pond along one of the fairways in 1987 or 1988. It was reported that wastes were disposed behind Building 1916. Employees of the maintenance garage were instructed not to use the soil for fill material.

3.0 PREVIOUS INVESTIGATIONS

- A Site Inspection was conducted in 1991 by Halliburton/NUS.
- Preliminary Draft Site Inspection Report (Halliburton/NUS, November 1991).
- Site Inspection sampling locations are presented on Figure 3.

3.1 Groundwater Investigation

Three shallow monitoring wells were installed and one round of groundwater samples were analyzed for TCL volatile organics, pesticides/PCBs, and chlorinated herbicides. Analytical findings are summarized on Table 1.

Low levels of toluene, ethylbenzene, and xylenes were reported in 80MW03.

3.2 Soil Investigation

Three surface soils (0 to 6 inches), seven surface soil samples (0 to 2 feet), and seven subsurface soil samples (3 to 17 feet) were collected. All samples were analyzed for TCL volatile organics, pesticides/PCBs, and chlorinated herbicides. Analytical findings are presented on Table 2.

Several pesticides were detected in these samples, such as aldrin, chlordane, 4,4'-DDT, and its metabolites, and dieldrin. 4,4'-DDD was the pesticide reported at the greatest concentration (700 μg/kg in sample

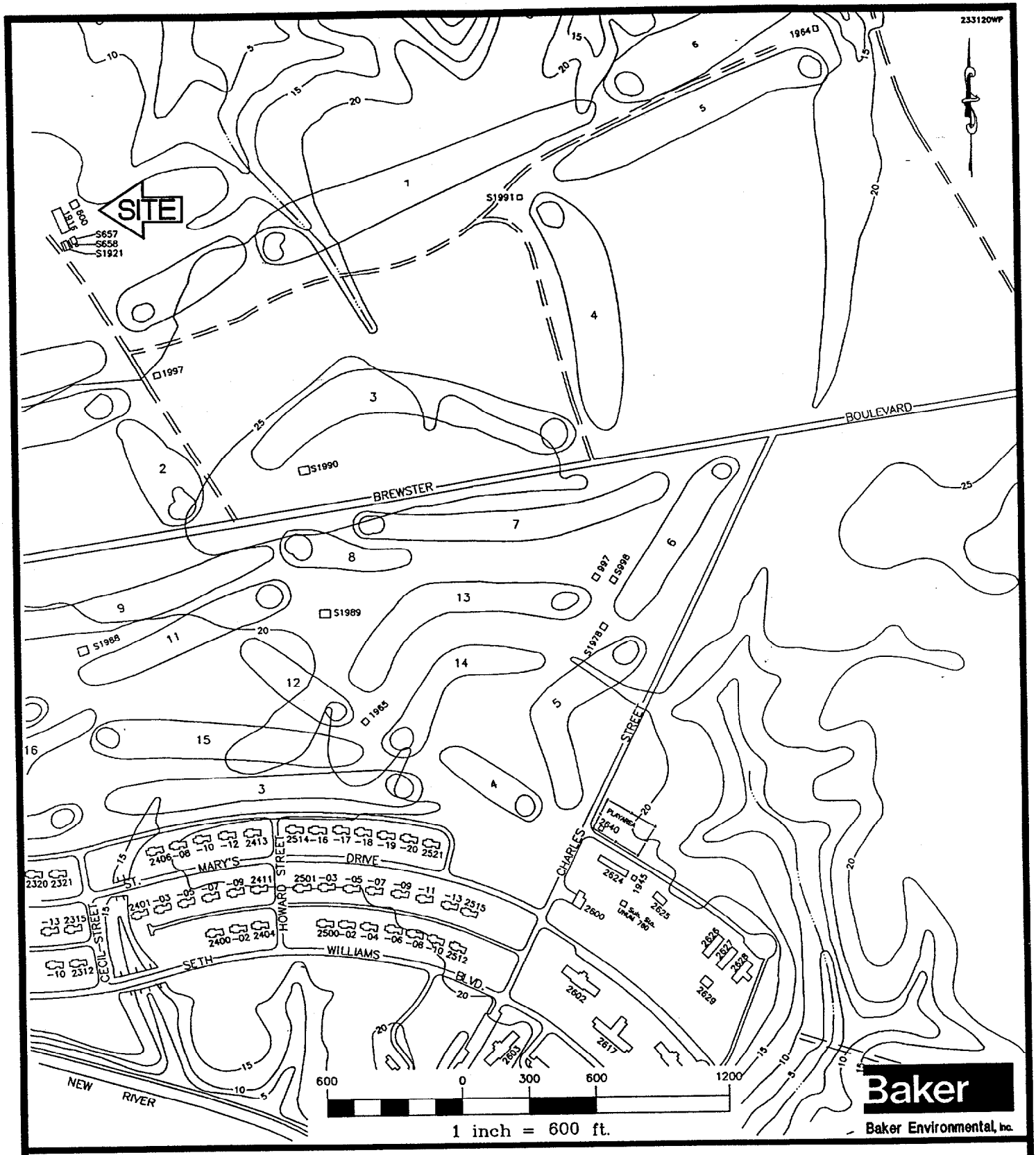


FIGURE 1
LOCATION MAP
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV, FEB. 1992

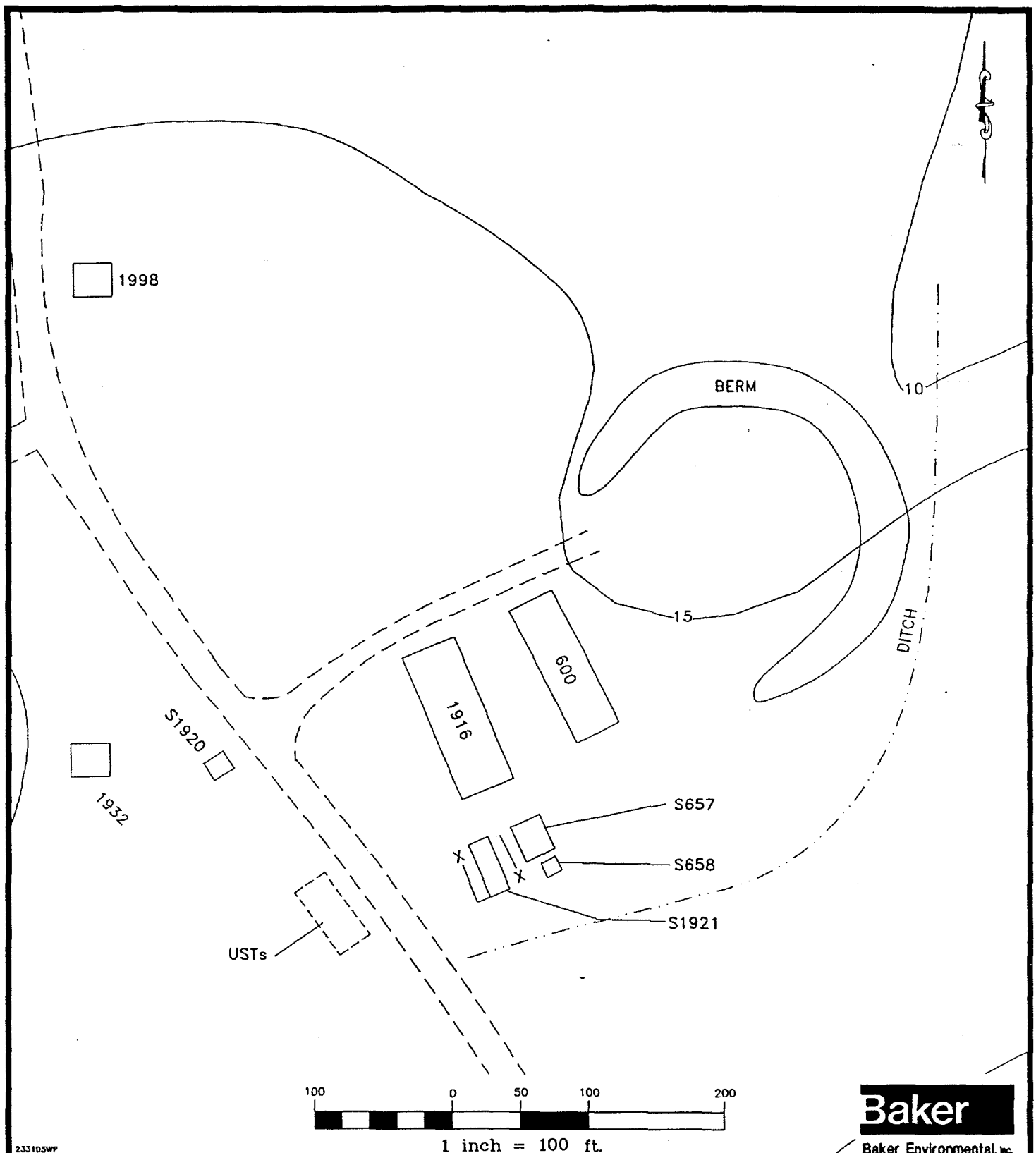
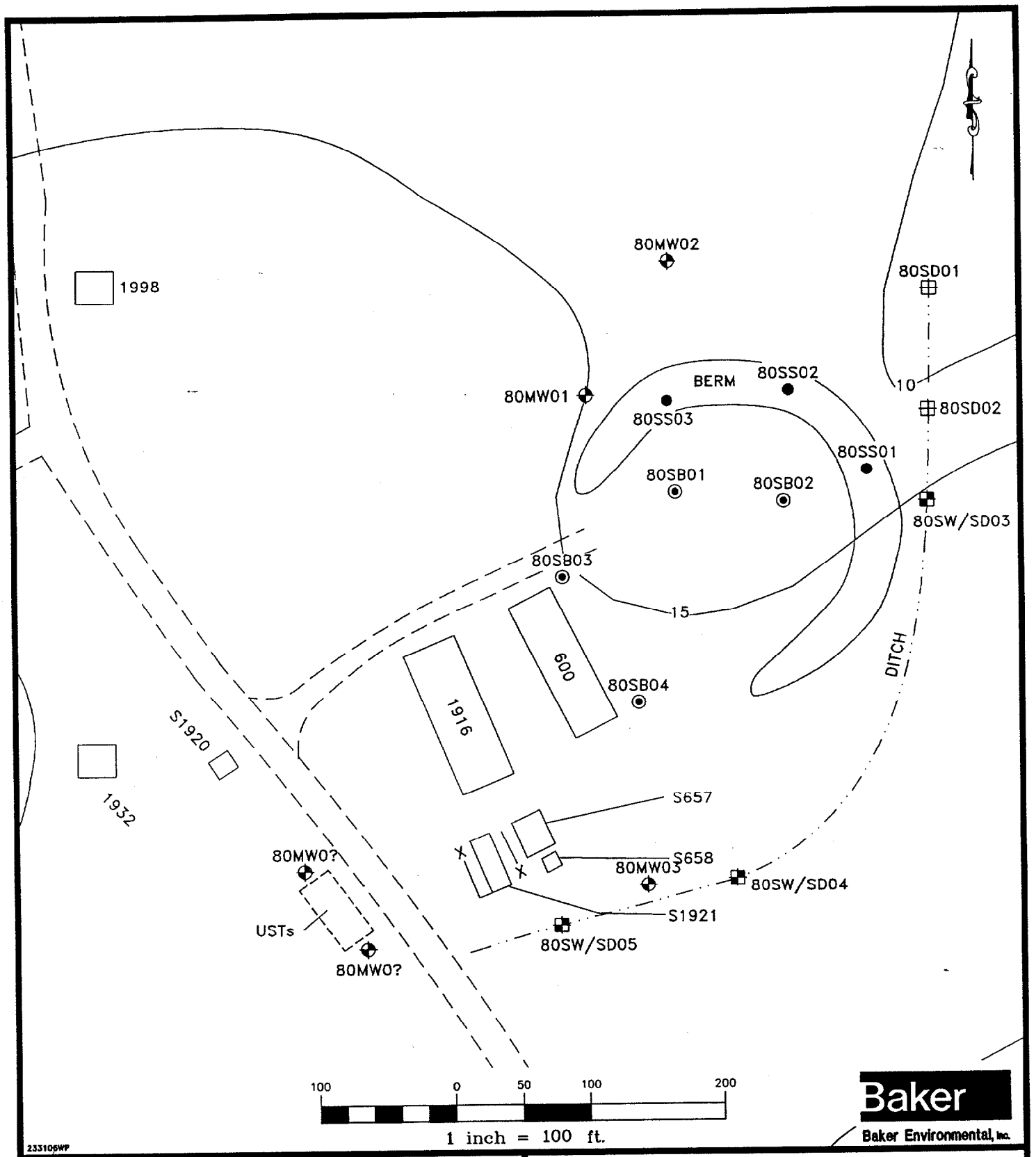


FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV, FEB. 1992



LEGEND

80MW01	EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SB01	EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SD01	EXISTING SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SW/SD03	EXISTING SURFACE WATER/SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
80SS01	EXISTING SURFACE SOIL SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: LANTDIV, FEB. 1992

FIGURE 3
PREVIOUS INVESTIGATIONS
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TABLE 1

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION
OU NO. 11 (SITE 80)
PARADISE POINT GOLF COURSE
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	No. of Positive Detections/ No. of Samples	Range of Positive Detections (μg/L)	Location of Maximum Concentration
Toluene	1/3	180	MW03
Ethylbenzene	1/3	5	MW03
Xylenes	1/3	21	MW03
Carbon Disulfide	1/3	25	MW03

μg/L - microgram per liter
Reference: Halliburton NUS, 1991

TABLE 2

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 11 (SITE 80)
PARADISE POINT GOLF COURSE
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)		Subsurface Soil (>12 feet)	
	No. of Positive Detections/No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/No. of Samples	Range of Positive Detections (µg/kg)
Methylene Chloride	1/10	7	0/6	ND	0/1	ND
Aldrin	2/10	6.8-220	0/6	ND	0/1	ND
alpha-Chlordane	1/10	60	0/6	ND	0/1	ND
4,4'-DDD	4/10	18-700	0/6	ND	0/1	ND
4,4'-DDE	5/10	16-210	0/6	ND	0/1	ND
4,4'-DDT	4/10	14-290	0/6	ND	0/1	ND
Dieldrin	4/10	16-440	0/6	ND	0/1	ND
Aroclor	2/10	830-1,500	0/6	ND	0/1	ND

µg/kg - microgram per kilogram
ND - Not detected.
Reference: Halliburton NUS, 1991

SB02-0002). Aroclor-1254 was detected in two discrete samples (SB02 and MW03) at concentrations of 830 μg/kg and 1,500 μg/kg, respectively.

3.3 Surface Water/Sediment Investigation

Three surface water samples and five sediment samples were collected from the drainage ditch and analyzed for TCL volatile organics, pesticides/PCBs, chlorinated herbicides, and total petroleum hydrocarbons.

Analytical findings are summarized on Table 3.

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc., March 1994)

The wash/mixing pad and sump approximately five years old. During heavy rains, surface water was observed flowing in front of the concrete pad and in the direction of 80MW03 to the ditch.

Two flush mounted monitoring wells were located across the access road from the wash/mixing pad. These two wells were installed in connection with the underground storage tank.

Conversation with Mr. Gerald Latham, who has been employed at the golf course for the past forty years, indicated that many pesticides were mixed and applied on the golf course. Additionally, an old mixing pad, with no containment controls, was located in the area where the new pad was constructed. According to Mr. Latham, all past and current chemical mixing activities were conducted in the area where the current pad exists. Historically, a documented inventory of chemicals used at the golf course was maintained, however it could not be located at the time of the site visit. The current Greens Maintenance Supervisor is Mr. Gary Appleton.

The large soil mound, located to the northeast of Building 1916, was generated during the excavation of a golf course pond.

Two drums were noted to the left side of the access road leading to the mounded dirt area. Based on visual observance, one of the drum contents appears to be solidified and the other drum is approximately one quarter full of liquid. A petroleum odor was evident from the drum in which the liquid contents were observed.

There is old maintenance equipment placed in the lawn and wooded areas around the machine shop (Building 1916). An oil collection system was located in the maintenance building behind Building 600.

Three existing shallow monitoring, and two flush mounted monitoring wells were located within the site boundaries.

5.0 PROPOSED FIELD INVESTIGATIONS

The objectives of these investigations are to identify contaminants and media of potential concern; identify routes of exposure; delineate suspected areas where prior practices may have impacted the soil or groundwater.

TABLE 3

NATURE AND EXTENT OF SURFACE WATER CONTAMINATION
OU NO. 11 (SITE 80)
PARADISE POINT GOLF COURSE
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Near Site (SW03, SW04, SW05)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (μg/L)
Acetone	3/3	11-190
Toluene	2/3	30-104
Carbon Disulfide	1/3	6
Total Petroleum Hydrocarbons (mg/L)	2/3	1.39-1.65

μg/L - microgram per liter
Reference: Halliburton NUS, 1991

5.1 Support Activities

Free product measurements will be conducted in the two flush mounted monitoring wells.

All newly installed monitoring wells will be surveyed.

All soil boring locations will be surveyed.

Static water level measurements will collected from existing and newly installed monitoring wells.

5.2 Soil Investigation

The objectives of the soil investigation are to vertically and horizontally delineate contaminant levels in four potential areas of concern (lawn area around the sump and wash pad, the soil mounds located in northeast corner of the site, the "open area" near the soil mounds, and the soil where drums are now present).

The following investigations are proposed.

A soil investigation will be conducted in the lawn area adjacent to the collection sump and concrete wash pad. Seven test borings will be drilled to characterize soil in this area. One surface soil and one subsurface soil sample will be collected from each test boring. Surface soil characterization will comprise of sampling soils to a depth not to exceed twelve inches. Subsurface soil samples will be collected from a depth just above the water table, which is estimated at 8 to 20 feet bgs. All soil samples will be submitted for laboratory analysis including full TCL organics and priority pollutant metals.

A soil investigation will be conducted within the level "open" area adjacent to the soil berm in the northeast corner of the study area. A total of seven test borings will be drilled in this area to investigate this reported disposal area. One surface soil and subsurface sample will be collected from each test boring. Surface soil samples will comprise of sampling soils to a depth not to exceed twelve inches. Subsurface soil samples will be collected from a depth just above the water table. The surface and subsurface soil samples will be submitted for laboratory analysis including full TCL organics and priority pollutant metals.

A soil investigation will be conducted along the soil berm/mounds in the northeast corner of the study area. One surface soil sample will be collected from ten random areas. Surface soil samples will comprise of sampling soils to a depth not to exceed twelve inches. In addition, one subsurface soil sample will be collected from three areas within the berm. Subsurface soil samples will be collected at a depth of eight feet, which is approximately the original ground surface. Due to access restrictions, a drill rig will not be used to collect the subsurface soil samples. Subsurface soil samples will be obtained via a power auger. Surface soil samples will be obtained with a hand auger.

The surface and subsurface soil samples will be submitted for laboratory analysis including full TCL organics and priority pollutant metals.

A soil investigation will be conducted in the area where two drums were found north of the maintenance building. One surface soil sample will be collected from two locations.

One monitoring well test boring will be augured in this area. Soil samples will be collected from the surface (0 to 12 inches) and just above the water table. Soil samples will be submitted for laboratory analysis of full TCL organics and priority pollutant metals.

Soil samples will also be collected during the construction of monitoring wells. Split spoon samples will be collected at 2-foot intervals along 2-foot centers to a depth of 10 feet. Two soils will be collected per

Soil samples will also be collected during the construction of monitoring wells. Split spoon samples will be collected at 2-foot intervals along 2-foot centers to a depth of 10 feet. Two soils will be collected per test boring. These samples include a surficial soil (0 to 12 inches) and one from just above the water table. Soil samples will be submitted for laboratory analysis of TCL organics and priority pollutant metals.

Proposed soil sampling locations are presented on Figure 4.

5.3 Groundwater Investigation

The principal interest of the groundwater investigation will be the shallow water table. However, because low levels of TEX contamination have been reported in one on-site well, deeper groundwater will also be investigated. In order to characterize the groundwater conditions, additional monitoring wells will also be required.

The groundwater investigation will involve the following activities:

- Installation of four shallow monitoring wells throughout the study area. Two wells will serve as downgradient wells from the mixing pad area. One of the two downgradient wells will also help characterize groundwater quality in the area where the two drums were found. The third shallow well will be installed in the "open area" behind the maintenance garage. The fourth well will serve as a background well.

- One intermediate monitoring well (approximately 40-50 feet) will be installed next to existing monitoring well MW03.

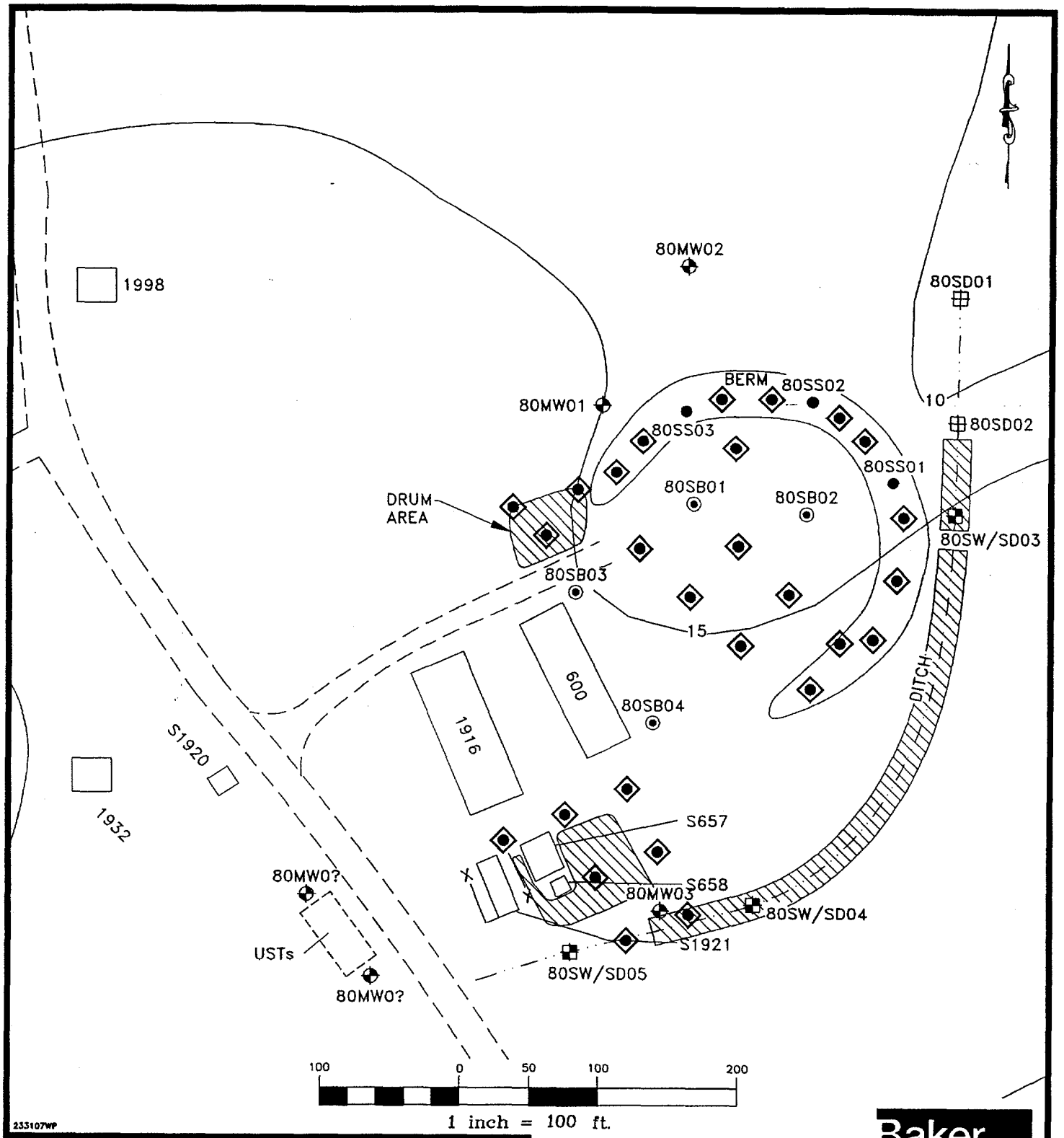
- The new and existing shallow wells will be used in assessing current groundwater conditions (i.e., groundwater flow direction).

- Two rounds of groundwater samples to be conducted on all existing and newly installed monitoring wells.

Proposed monitoring well locations are shown on Figure 5.

5.4 Surface water/Sediment Investigation

The drainage ditch in this area is not a classifiable surface water body. Five surface water/sediment samples were obtained as part of the SI. Three samples were analyzed for full TCL organics and TAL inorganics (Level IV data quality). Therefore, a surface water/sediment investigation will not be conducted.



LEGEND

- 80MW01 — EXISTING MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SB01 — EXISTING SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SD01 — EXISTING SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SW/SD03 — EXISTING SURFACE WATER/SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SS01 — EXISTING SURFACE SOIL SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SOIL SAMPLING LOCATION
- AREAS OF CONCERN

SOURCE: LANTDIV, FEB. 1992

Baker

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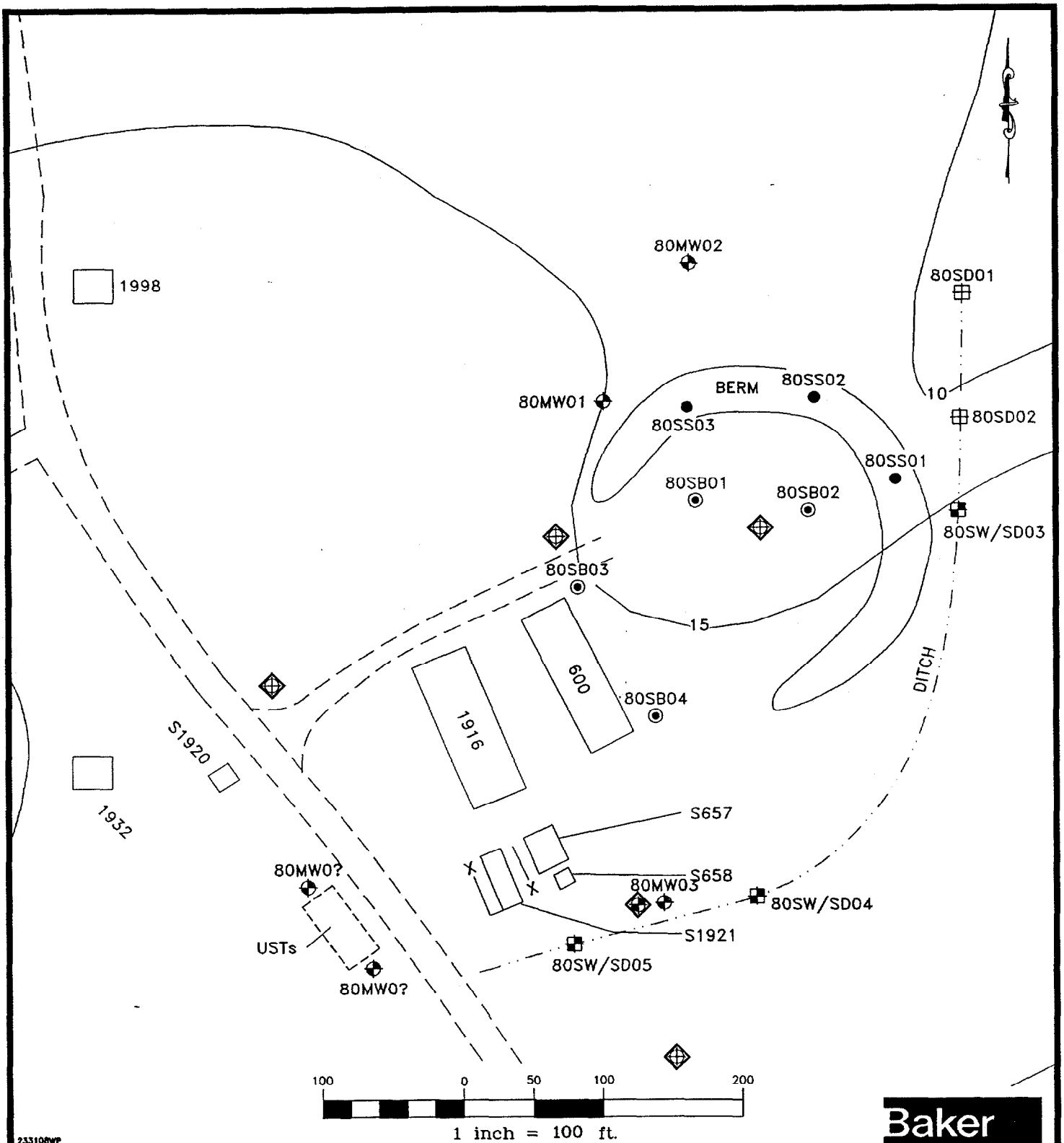
FIGURE 4
PROPOSED SOIL INVESTIGATION
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

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- 80SW/SD03 EXISTING SURFACE WATER/SEDIMENT SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 80SS01 EXISTING SURFACE SOIL SAMPLE INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SHALLOW MONITORING WELL LOCATION
- PROPOSED INTERMEDIATE MONITORING WELL LOCATION

SOURCE: LANTDIV, FEB. 1992

FIGURE 5
PROPOSED GROUNDWATER INVESTIGATION
SITE 80
PARADISE POINT
GOLF COURSE
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

OPERABLE UNIT NO. 12
SITE 3, OLD CREOSOTE PLANT

1.0 SITE LOCATION AND SETTING

The study area is located on the mainside of MCB Camp Lejeune approximately one quarter mile east of Holcomb Boulevard and one mile north of Wallace Creek (see Figure 1). Remnants of a creosote plant including the concrete pads, train rails, are present on the site. The site area encompasses approximately 5 acres, is generally flat and unpaved, and is intersected by a dirt road. This study area can be directly accessed from Holcomb Boulevard. The Camp Lejeune Railroad lies approximately 200 feet to the west of the study area. The remainder of the area is surrounded by woods. The general site location of this area is shown on Figure 1.

2.0 SITE HISTORY

The old creosote plant reportedly operated from 1951 to 1952 to supply treated lumber during construction of the railroad on the base. Logs were cut into railroad ties at an on-site sawmill, then pressure treated with hot creosote stored in a railroad tank car. There is no indication of creosote disposal on site, and records show that creosote remaining in the pressure chamber at the end of a treatment cycle was stored for future use. The location of current site structures are shown on Figure 2.

3.0 PREVIOUS INVESTIGATIONS

- A Site Inspection was conducted in 1991 by Halliburton/NUS.
- Preliminary Draft Site Inspection Report (Halliburton/NUS, November 1991).
- Site Inspection sampling locations are presented on Figure 3.

3.1 Groundwater Investigation

Three shallow monitoring wells were installed and one round of groundwater samples were analyzed for TCL semivolatile organics. Analytical findings are summarized on Table 1.

Well 03MW02 exhibited elevated levels of PAHs.

3.2 Soil Investigation

Eight surface soil samples (0 to 2 feet) and 8 subsurface soil samples (3 to 17 feet) were collected. All samples were analyzed for TCL semivolatile organics. Analytical findings are summarized on Table 2.

Two soil sample locations, 03MW02 and 03SB04, exhibited elevated levels of PAHs, which are contaminants normally associated with creosote operations. The highest levels were detected in subsurface soil near the former creosote treatment area.

3.3 Sediment Investigation

Two sediment samples were collected from low lying areas of the site that collect water. Both samples were analyzed for TCL semivolatile organics. Analytical findings are presented on Table 3.

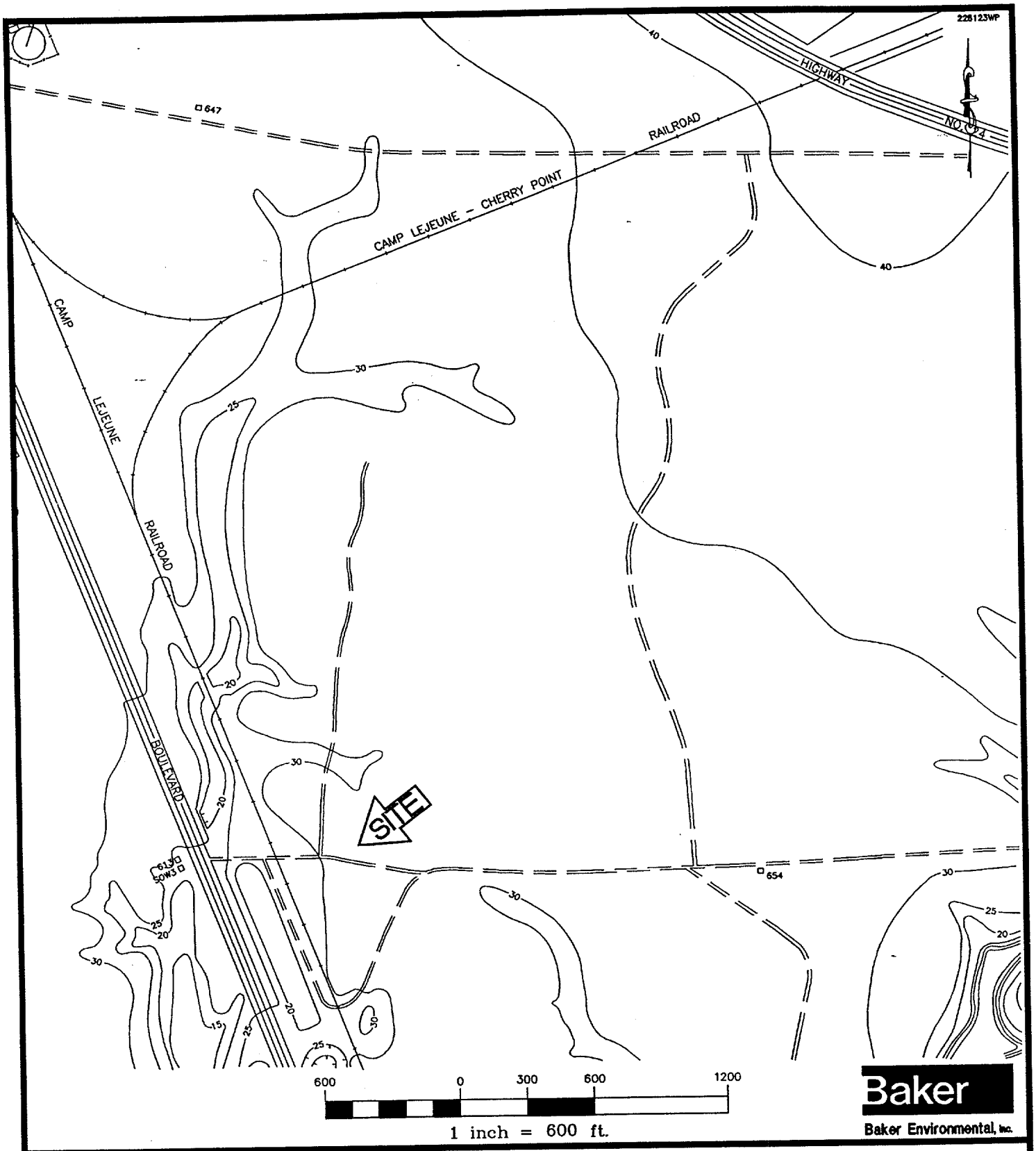


FIGURE 1
LOCATION MAP
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV., FEB. 1992

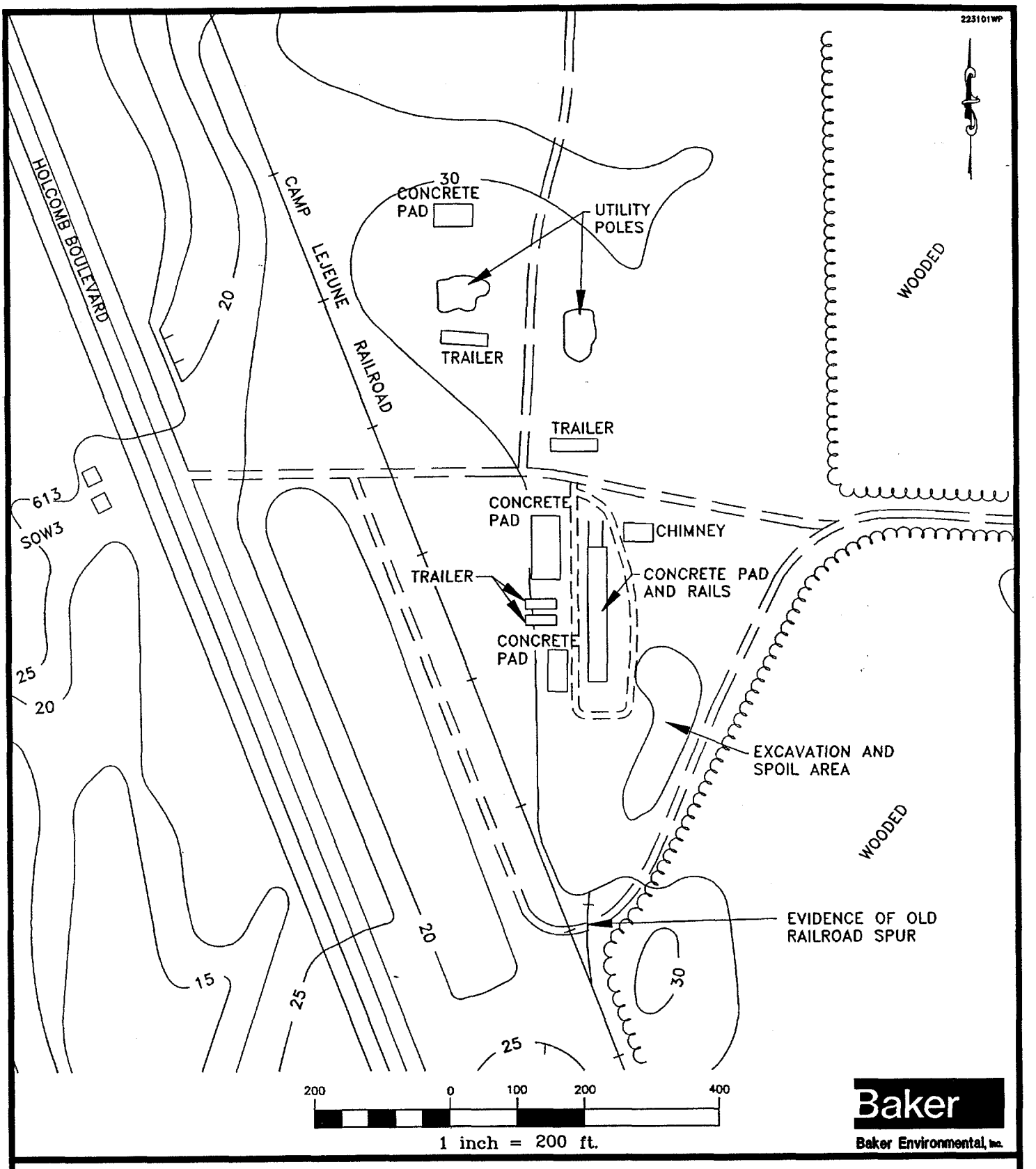
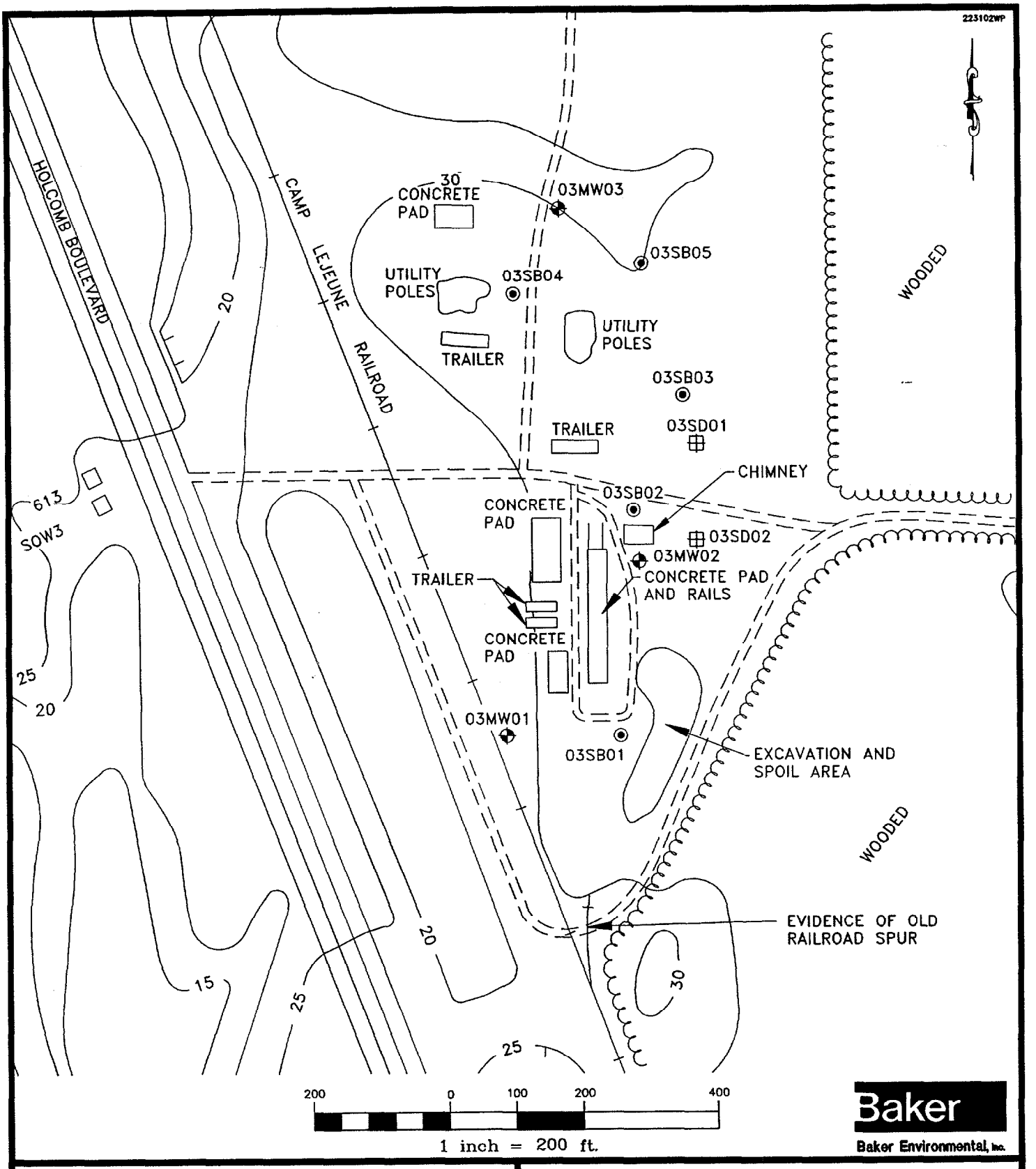


FIGURE 2
EXISTING SITE STRUCTURES/FEATURES
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: LANTDIV, FEB. 1992



LEGEND

- 03MW01 — MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 — SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 — SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991

SOURCE: LANTDIV, FEB. 1992

FIGURE 3
PREVIOUS INVESTIGATIONS
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TABLE 1

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION
OU NO. 12 (SITE 3)
OLD CREOSOTE PLANT
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	No. of Positive Detections/ No. of Samples	Range of Positive Detection (µg/kg)	Location of Maximum Concentration
Acenaphthene	1/3	1,500	MW02
Anthracene	1/3	260	MW02
Chrysene	1/3	96	MW02
Fluoranthene	1/3	640	MW02
Fluorene	1/3	890	MW02
2-Methylnaphthalene	1/3	1,500	MW02
Naphthalene	2/3	9-4,400	MW02
Phenanthrene	1/3	1,600	MW02
Pyrene	1/3	460	MW02
Dibenzofuran	1/3	1,100	MW02

µg/L - microgram per liter
Reference: Halliburton NUS, 1991

TABLE 2

NATURE AND EXTENT OF SOIL CONTAMINATION
OU NO. 12 (SITE 3)
OLD CREOSOTE PLANT
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil (0-2 feet)		Subsurface Soil (3-12 feet)		Subsurface Soil (> 12 feet)	
	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)
Acenaphthene	0/7	ND	0/5	ND	1/2	37,000
Antracene	1/7	1,900	0/5	ND	1/2	8,600
Benzo(a)anthracene	2/7	460-660	0/5	ND	1/2	5,600
Benzo(b)fluoranthene	2/7	520-2,200	0/5	ND	1/2	2,300
Benzo(k)fluoranthene	2/7	420-1,200	0/5	ND	1/2	2,100
Benzo(g,h,i)perylene	2/7	260-720	0/5	ND	0/2	ND
Benzo(a)pyrene	2/7	320-1,300	0/5	ND	0/2	ND
Chrysene	2/7	750-1,400	0/5	ND	1/2	5,900
Flouranthene	2/7	1,000-1,600	0/5	ND	1/2	35,000
Fluorene	0/7	ND	0/5	ND	1/2	35,000
Indeno(1,2,3-cd)pyrene	2/7	340-1,000	0/5	ND	0/2	ND
2-Methylnaphthalene	0/7	ND	0/5	ND	1/2	26,000
Napthalene	1/7	550	0/5	ND	1/2	52,000
Phenanthrene	1/7	310	0/5	ND	1/2	81,000
Pyrene	2/7	920-1,400	0/5	ND	1/2	27,000
Dibenzofuran	0/7	ND	0/5	ND	1/2	35,000

µg/kg - microgram per kilogram
Reference: Halliburton NUS, 1991

TABLE 3

NATURE AND EXTENT OF SEDIMENT CONTAMINATION
OU NO. 12 (SITE 3)
OLD CREOSOTE PLANT
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	No. of Positive Detections/ No. of Samples	Range of Positive Detections (µg/kg)
Bis(2-ethylhexyl)phthalate	1/2	750

µg/kg - microgram per kilogram
Reference: Halliburton NUS, 1991

4.0 SITE VISIT OBSERVATIONS

(Baker Environmental, Inc., March 1994)

Three concrete pads, not previously indicated on any figures or described in historical literature, were located. Two pads are located in the southern portion of the site where wood treating operations were probably performed. The third pad is located in the far northwest corner of the site. The historical use for these pads is unknown. Some staining is evident on the pad surface. The integrity of the concrete is very good, indicating that these pads may have been under cover, or the pads were recently constructed. During a period of heavy rain standing water was observed on the pads.

A large concrete slab, bordered by rail lines, was observed in the southern portion of the site, just southwest of the chimney structure. Some surface staining was evident on the concrete surface. This pad was likely associated with the creosote operations.

Two piles utility poles are located in the northern portion of the site. Based on visual evidence, it does not appear that these poles are remnants of the creosote treating that occurred at this site.

Evidence of the railroad spur that connected this area with the Lejeune railroad was found in the southwest corner of the site.

An excavated area was observed in the southeastern corner of the site. A black oily substance was observed beneath the surficial excavated soil. Based on visual observation the area where the excavated soil was placed may have been lined prior to placement. However, the integrity of the plastic is suspect.

Historical aerial photos indicate that the access road which currently divides the site was not present. The access road around the southern portion of the site is currently overgrown with vegetation but still is accessible.

Free standing water was observed in eastern portion of the site. This water was observed in depressed area that was probably created as a result of utility vehicle traffic.

5.0 PROPOSED FIELD INVESTIGATION

A investigation involving the collection and analysis of soil and groundwater media will be conducted. The objectives of this investigation are to delineate the site related contamination, predict contaminant migration potential, estimate human exposures and environmental impacts, and evaluate remediation options, if necessary. The following investigations and support activities will be conducted at Site 3.

5.1 Support Activities

All newly installed monitoring wells will be surveyed.

All soil sampling locations will be surveyed.

One round of static water level measurements will be collected from the existing and newly installed monitoring wells.

5.2 Soil Investigation

Soil characterization during the RI will comprise of sampling of surface and subsurface soil. The soil investigation will be conducted in the northern region of the site, in the excavated and spoil area in the

southeastern portion of the study area, and the area believed to be where creosote treatment practices occurred (i.e., near the concrete pads). The following investigations are proposed.

A 200 by 200-foot sampling grid will be established in the northern portion of the study area. Soil characterization in this area will focus only on surficial soil since PAH compounds are relatively immobile. PAHs present in the surface soil would be an indication that creosote operations, including storage, may have taken place in this area . Soil samples will be collected using a decontaminated hand auger. The vertical and horizontal extent of the sampling grid will be expanded based on the presence of elevated PAH levels.

Surface soil samples will be analyzed for TCL semivolatile organics only.

A soil investigation will be conducted around the concrete pad located in the northwest corner of the study area. One surface soil sample will be collected from the midpoint of each of the four sides of the pad and analyzed for TCL semivolatiles only.

Test boring locations for the northern portion of the study area are shown on Figure 4.

A soil investigation will be conducted in the excavation and spoil area in the southern portion of the study area. One composite soil sample will be collected from three areas within the excavation and spoil area. Composite soil samples will be analyzed for full TCL organics and TAL metals since it is unknown whether the soil is associated with Site 3, or whether this soil is associated with another base related problem (e.g.the soil may have been brought to Site 3 from another area of the base).

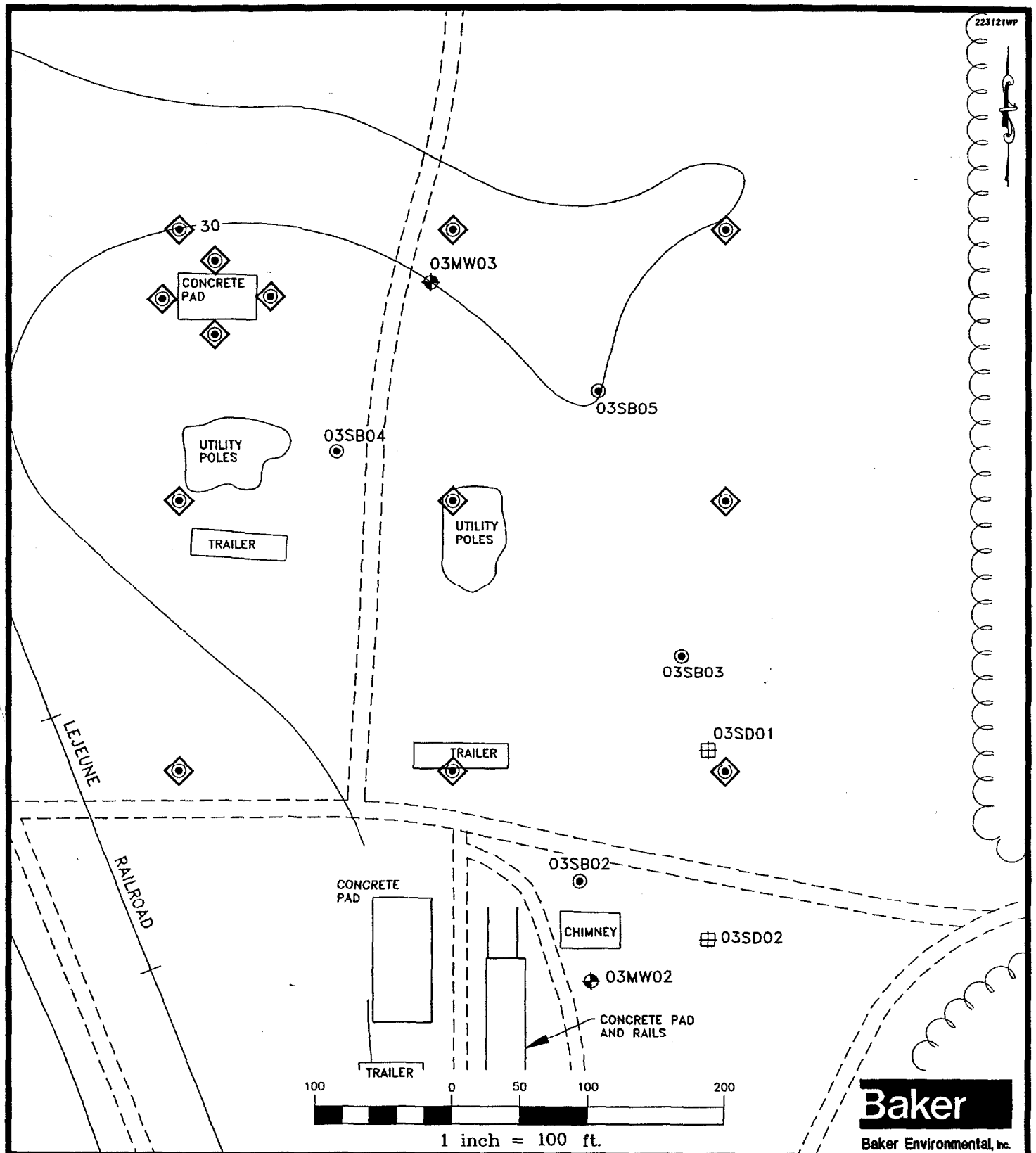
A soil investigation will be conducted around the two concrete pads located in the southern portion of the study area, near the former creosote operation. One soil sample will be collected from the midpoint of each of the four sides of the two concrete pads. Soil characterization will comprise of sampling soils to a depth not to exceed twelve inches, and submitting samples for quick-turn laboratory analysis for TCL semivolatiles only. If PAHs are detected, subsurface soils will be collected to define the vertical extent of contamination.

A soil investigation will be conducted around the former creosote treatment area in the southern portion of the study area.

A 50 by 50-foot sampling grid will be established in this area. Soil characterization in this area will comprise of sampling soils via hand auguring to a depth not to exceed twelve inches. Surface soil samples will be analyzed using Ensys PAH Soil Sensitivity and Ensys Petro Soil to detect total PAHs and total creosote, respectively. Based on the findings of the quantitative findings of these immunoassay-based testing methods, positive results for total PAHs or total creosote will be submitted for confirmatory laboratory analysis.In addition, ten percent of soil samples reported as nondetect will be submitted for laboratory analysis.

One soil sample will be collected from two locations in the area where the railroad spur line was located. Soil characterization will comprise of sampling soils via hand auguring to a depth not to exceed twelve inches. Surface soil samples will be analyzed for TCL semivolatile organics.

A soil investigation will be conducted during the monitoring well installation. Monitoring well test borings will be augured and soil samples collected. Soil samples will be collected with a split spoon for 2-foot intervals along 2-foot centers to a depth of ten feet. A maximum of three soil samples will be submitted per test boring. These samples include a surficial soil (0 to 12 inches) and two subsurface soil samples, one from just above the water table and one at mid-depth.. Soil samples will be submitted for analysis of TCL semivolatile organics only.



LEGEND

- 03MW01 — MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 — SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 — SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SOIL BORING LOCATION

SOURCE: LANTDIV, FEB. 1992

FIGURE 4
PROPOSED SOIL INVESTIGATION
NORTH AREA – SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

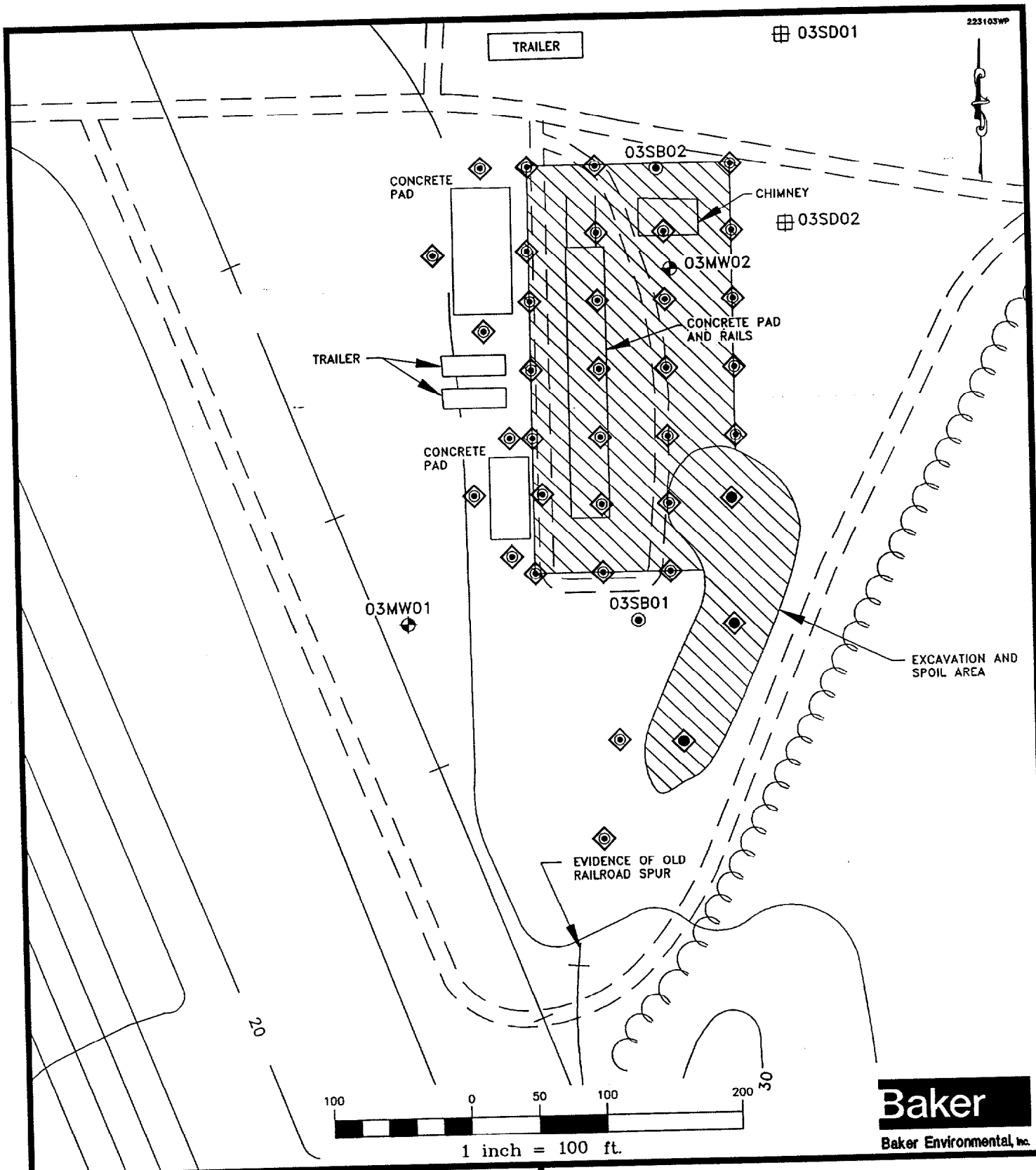
Test boring and monitoring well test boring locations for the south area are shown on Figure 5.

5.3 Groundwater Investigation

Four shallow monitoring wells will be constructed in a configuration to delineate the extent of PAH contaminated groundwater at well 03MW02, and to assess background groundwater quality. On intermediate depth monitoring well (40-50 feet) will be installed adjacent to existing shallow monitoring well 03MW02 in order to assess the vertical migration of PAHs. The proposed shallow wells are estimated to be installed to a depth of 20 feet.

One round of groundwater samples will be collected from 3 existing, 4 newly installed shallow monitoring wells, and 1 newly installed intermediate well. All groundwater samples will be analyzed for TCL volatile and semivolatile organics. Groundwater samples collected from newly-installed monitoring wells will be submitted for "quick-turn" analysis.

Existing and proposed monitoring well locations are shown on Figure 6.



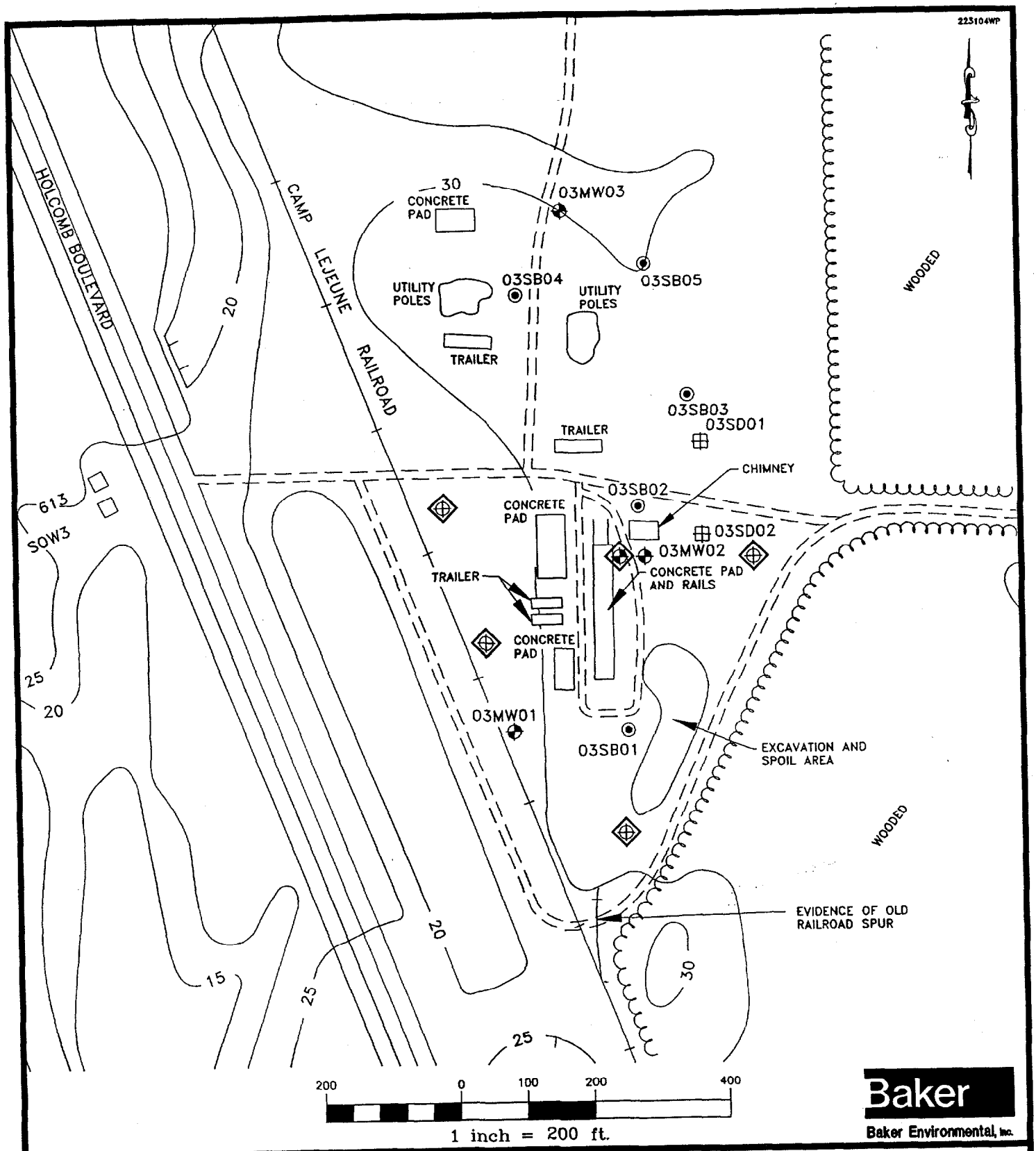
LEGEND

- 03MW01 — MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 — SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 — SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SOIL BORING LOCATION
- PROPOSED COMPOSITE SOIL SAMPLING LOCATION
- AREA OF CONCERN – ENSYS TESTING

SOURCE: LANTDIV, FEB. 1992

FIGURE 5
PROPOSED SOIL INVESTIGATION
SOUTH AREA – SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- 03MW01 MONITORING WELL INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SB01 SOIL BORING INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- 03SD01 SEDIMENT SAMPLE LOCATION INSTALLED BY HALLIBURTON NUS, NOVEMBER 1991
- PROPOSED SHALLOW MONITORING WELL LOCATION
- PROPOSED INTERMEDIATE MONITORING WELL LOCATION

SOURCE: LANTDIV, FEB. 1992

FIGURE 6
PROPOSED GROUNDWATER INVESTIGATION
SITE 3
OLD CREOSOTE PLANT

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA