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INITIAL ASSESSMENT STUDY
NAVY ASSESSMENT AND CONTROL
OF INSTALLATION POLLUTANTS (NACIP) PROGRAM
MCB CAMP LEJEUNE, NORTH CAROLINA

Prepared for:

NAVAL FACILITIES ENGINEERING COMMAND
NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY

Prepared by:

WATER AND AIR RESEARCH, INC.
Gainesville, Florida

June 1982

WAR Project No. 7188-020

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# FOREWORD

The Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program in OPNAVNOTE 6240 ser 45/733503 of 11 September 1980. The purpose of the program is to systematically identify, assess, and control contamination of the environment resulting from past hazardous materials management operations.

An Initial Assessment Study (IAS) was performed at Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, by a team of specialists under the direction of the Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, California. Further confirmation studies under the NACIP program were recommended at several areas at the activity. Sections dealing with significant findings, conclusions, and recommendations are presented in the earlier section of the report. The later technical sections provide more in-depth discussion on important aspects of the study.

Questions regarding the NACIP program should be referred to the NACIP Program Director, NEESA (Code 112N), Port Hueneme, CA 93043, AUTOVON 360-3351, FTS 799-3351, or commercial (805) 982-3351. Further information regarding this study may be obtained from Mr. Bill Powers, NACIP Program Director at the above numbers.

Daniel L. Spiegelberg, LCDR, CEC, USN
Environmental Officer
Naval Energy and Environmental Support Activity

# 1.0 INTRODUCTION

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### 1.1 PURPOSE OF INITIAL ASSESSMENT STUDY

As directed by CNO, NEESA, in conjunction with OESO, conducts IASs. The purpose of an IAS is to collect and evaluate all evidence which indicates imminent health hazard for people located on or off an installation. The IAS is the first phase of the NACIP program, which has the objective of identifying, assessing, and controlling environmental contamination from past hazardous materials storage, transfer, processing, and disposal operations. The NACIP program has been initiated by OPNAVNOTE 6240 ser 45/733503 of 11 September 1980 and Marine Corps Order 6280.1 of 30 January 1981.

### 1.2 SEQUENCE OF EVENTS

1,2. 1. MCB Camp Lejeune was designated for an IAS by CNO letter ser 451/397464 of August 1981. Included in this IAS is Helicopter Outer Landing Field (HOLF) Oak Grove.
The environmental consulting firm of Water and Air Research, Inc. (WAR) was selected to conduct the IAS in October 1981.

3. The Commanding Officer of MCB Camp Lejeune was notified via Naval Facilities Engineering Command (NAVFACENGCOM), Atlantic Division (LANTDIV), and by NEESA of the selection of MCB Camp Lejeune for an IAS. The NACIP Program Management Plan (Appendix A to NEESA 20.2-035) and Activity Support Requirements for the IAS were forwarded to the installation to outline assessment scope, provide guidelines to personnel, and request advance information for review by the IAS team.
4. LANTDIV staff were briefed on the NACIP program and the IAS on 25 January 1982 by Mr. Wallace Eakes, NEESA Project Officer, Dr. Jerry Steinberg, WAR Project Coordinator, and Dr. Hugh Putnam, WAR Team Leader.
5. MCAS Commanding Officer and staff received the same briefing by the same team on 26 January 1982.

6. During the period 8-25 February 1982 various government agencies were contacted for documents pertinent to the IAS effort. Agencies contacted included:

   a. NAVFACENGCOM Historian, Naval Construction Battalion Center (NCBC), Port Hueneme, California;
   b. NEESA Information Management Department, NCBC, Port Hueneme, California;
   c. NEESA Information Services Department, NCBC, Port Hueneme, California;
   d. Installations Planning Division and Real Estate Division of the LANTDIV Facilities Planning and Real Estate Department;
   e. Utilities, Energy, and Environmental Division of the LANTDIV Facilities Management Department;
   f. Federal Records Service Center, Southeast Regional Branch, East Point, Georgia;
   g. National Archives, Washington, D.C.;
   h. National Archives Annex, Suitland, Maryland;
   i. Federal Records Service Center, Suitland, Maryland;
   j. Operational Archives, Naval History Office, Washington Navy Yard, Washington, D.C.;
   k. Aviation History Office, Washington Navy Yard, Washington, D.C.;
   l. Naval History Division, Curator's Branch, Photographic Collection, Washington Navy Yard, Washington, D.C.;
   m. Department of Defense Explosive Safety Board, Alexandria, Virginia;
   n. Navy Bureau of Medicine and Surgery, Washington, D.C.;
   o. Marine Corps History Office, Washington Navy Yard, Washington, D.C.;
   p. Naval Sea Systems Command, Safety Ordnance File (SAFEORD), Naval Surface Weapons Center (NSWC), Dahlgren, Virginia;
   q. Accident Incident Data Bank (AID), NSWC, Dahlgren, Virginia;

r. EPA Environmental Photo Interpretative Center, Vint Hill Farm, Virginia (aerial photos);
s. NAVFAC Real Estate Office, Alexandria, Virginia;
t. USGS Public Information Office, Reston, Virginia; and
u. NCIC, Reston, Virginia.

7. On-site investigations were conducted during the period 15-24 March 1982. Among other duties, the field team interviewed current and past employees, examined records, and visited potential disposal sites. Mr. Wallace Eakes of NEESA and the following WAR personnel participated in on-site work:
   a. Dr. Hugh Putnam, Team Leader, Report Author, biologist;
   b. Mr. James Nichols, P.E., environmental engineer;
   c. Mr. Michael Hein, environmental scientist;
   d. Mr. William Adams, hydrogeologist;
   e. Mr. Charles Fellows, environmental chemist; and
   f. Dr. Jerry Steinberg, P.E., environmental engineer.

   Ground and aerial tours were made of MCB and the outer field. Efforts were made to corroborate specific information discovered during interviews. Verification sources included present and past employees with direct knowledge, aerial photographs, and documents. Substantiation has been obtained for most interview information affecting significant findings and recommendations.
8. From 1 April through 25 October, information, conclusions, and recommendations were developed into this final report document. This included review and comment by NEESA, LANTDIV, MCAS, NAVFAC Headquarters, and Marine Corps Commandant staff.

## 1.3 SUBSEQUENT NACIP STUDIES

Recommendations for the next phase of the NACIP program, a Confirmation Study, is based on the findings of an IAS. A Confirmation Study is conducted only if an IAS concludes that:

1. Sufficient evidence exists to suspect that an installation is contaminated; and

2. The contamination presents a definite danger to:
   a. Health of civilians in adjoining communities or personnel within the base fenceline, or;
   b. Environment within or outside the installation.

If these criteria are not met, no further studies will be conducted under the NACIP program.

As explained in this report, a Confirmation Study at MCB Camp Lejeune is warranted.

# 2.0 SIGNIFICANT FINDINGS

## 2.0 SIGNIFICANT FINDINGS

Because it is so large, Camp Lejeune historically has had to use localized dump sites for waste disposal. All waste, though, was not dumped at authorized areas. Indiscriminate dumping in about every part of the installation ranged from disposal on the ground surface, to use of borrow pits, to the spreading of waste oils, solvents and other POL compounds on roads for dust control.

Located at Camp Lejeune, including MCAS New River and OLF Oak Grove, are 72 sites at which some form of waste disposal took place. These sites were documented through past records and interviews with former employees. They are indicated in Figure 2-1. Assessments of human health or environmental risk have been made by considering factors such as type of material involved and potential for contaminant migration. Most sites were judged to present no significant risk and therefore do not need to be further evaluated. Some 17 sites had potentially hazardous materials and reasonable potential for material migration, and thus warranted more analysis, i.e., confirmation analysis.

Overall, most of the old dumps and areas which received wastes are in Hadnot Point, home of much of the base industrial activity, and at MCAS New River. Many of the sites judged as needing confirmation contain POL compounds--mainly contaminated fuels, waste oils, solvents, and hydraulic fluids that were buried. There have been unavoidable POL spills and leaks throughout the base. At the Hadnot Point Air Station and Camp Geiger Fuel Farms, there have been releases of either Avgas, Mogas, or JP-4 and JP-5 significant enough to generate concern about the groundwater aquifer.

Training functions on the base require use of large numbers of tracked and wheeled vehicles. In the past, waste oils from maintenance operations were either dumped on the ground or put into storm drains. This has been stopped and a pollution abatement program using oil-water separators has been instituted. At MCAS New River, waste oils, solvents

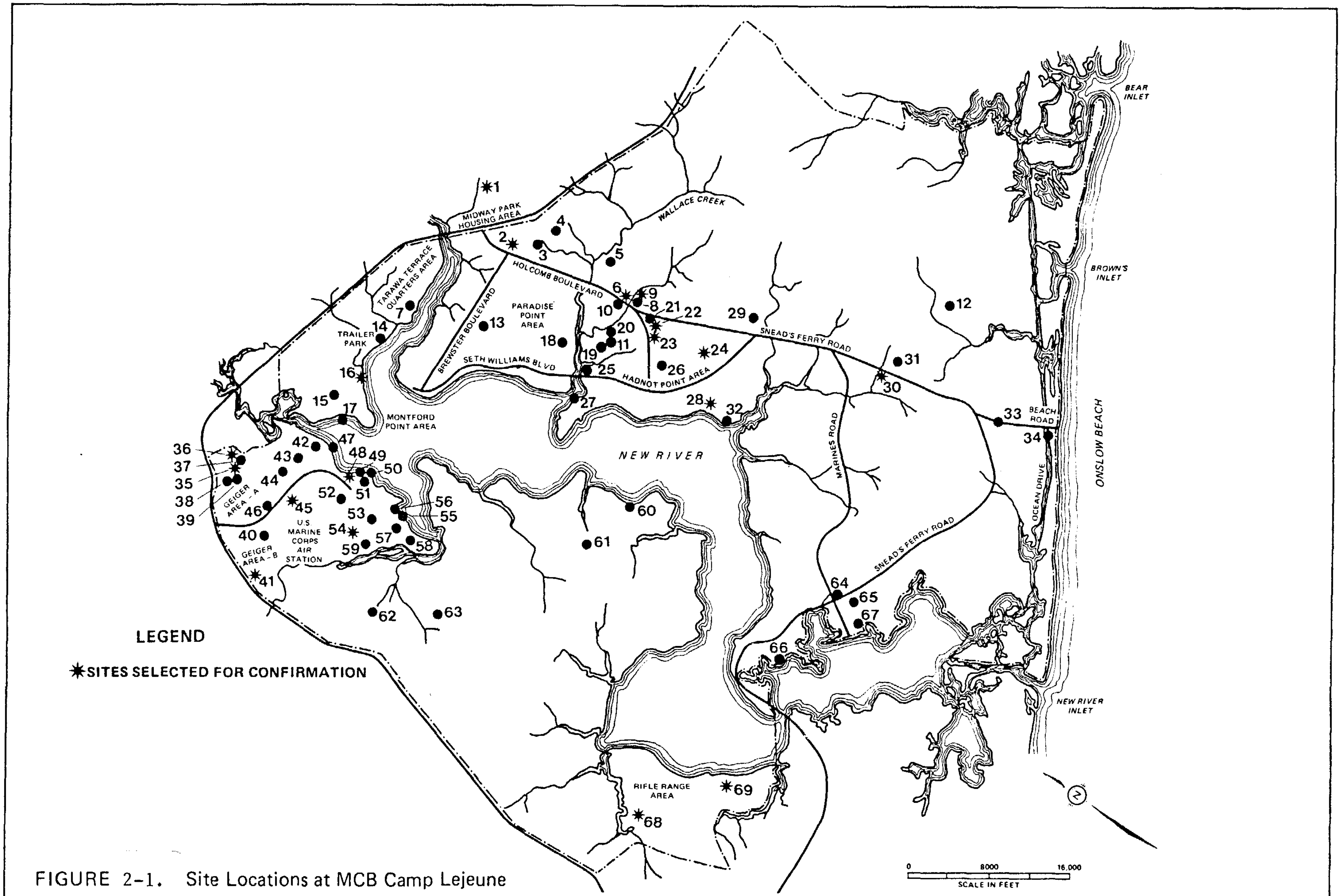


FIGURE 2-1. Site Locations at MCB Camp Lejeune

and other compounds were often released to storm drains that entered New River. Another practice was to store fuel, oils, and solvents and use them to control dust on unimproved roads. About 1,000 gallons per week of contaminated JP fuel, crankcase fluids, paint thinners, and other assorted POL compounds were used. Fuels and solvents were and still are used for crash crew training and firefighting. There is a separate area for each activity on the base.

Since the base was constructed in the 1940s, large amounts of chemicals have been stored, used, and wasted. One principal disposal site is the chemical landfill. The area is closed now, but in the past all types of hazardous materials were buried here. Although some of the chemicals are known, records identifying other chemicals have been lost. It is not known exactly how much material is involved, although it is recognized to involve hundreds of pounds of wastes. Because groundwater contamination is a concern, test wells have been installed and an intermittent sampling program instituted.

The mission of the base requires training using live ordnance. For this purpose, year-round impact areas have been set aside. Explosions have a local blast effect on the environment, but they are not thought to threaten the ground water. Skilled EOD personnel handle unexploded rounds in contained areas where ordnance is either burned or exploded electrically.

The Camp Lejeune complex covers approximately 170 square miles and over the history of the base wastes have been dumped in many areas. Knowledge regarding the location of the base dump sites is incomplete. Some sites may never be found and much information now known lacks detail. Most was gained from recall, little from existing records. Table 2-1 presents a summary of all disposal sites investigated at Camp Lejeune.

Potential for contamination of the aquifer varies at Camp Lejeune because of the discontinuous nature of confining layers. Therefore knowledge of

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 6 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
|---|---|---|---|---|---|
| 57 | Runway 36 Dump | Unknown | Debris | 768419 | 2-9 |
| 58 | MCAS Tank Training Area | Unknown | Tank parts, miscellaneous trash | 768417 | 2-9 |
| 59 | MCAS Infantry Training Area | 1950s | Stumps | 753424 | 2-9 |
| 60 | Explosive Ordnance Disposal K-326 Range | 1974-Present | Burn pits for explosives | 818365 | — |
| 61 | Rhodes Point Road Dump | Unknown | Bivouac waste | 799363 | — |
| 62 | Race Course Area Dump | Unknown | Bivouac waste | 738447 | — |
| 63 | Vernon Road Dump | Unknown | Bivouac wastes | 757393 | — |
| 64 | Marines Road-Sneads Ferry Road - Mogas Spill | 1978 | Mogas spill Feb. 28, 1975 | 835297 | 2-10 |
| 65 | Engineer Area Dump | Pre-1958 to 1972 | Burn area dump, construction debris | 837293 | 2-10 |
| 66 | AMTRAC Landing Site and Storage Area | 1950s-Present | Oil spills, POL, battery acid | 815285 | 2-10 |
| 67 | Engineers TNT Burn Site | 1951 | TNT disposal | 845284 | — |
| 68 | Rifle Range Dump | 1942-1972 | Solvents, construction materials, WTP sludge | 748302 | 2-11 |

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 2 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
|---|---|---|---|---|---|
| 12 | Explosive Ordnance Disposal | Early 1960s | Ordnance burned or exploded, colored smokes, white phosphorus | 925325 | — |
| 13 | Golf Course Construction Dump Site | 1944 | Clippings, branches, some asphalt | 827437 | — |
| 14 | Knox Area Rip-Rap | 1973 | Broken concrete and asphalt | 809454 | 2-4 |
| 15 | Montford Point Dump, Site B | 1948-1958 | Litter, asphalt, STP sand | 789453 | 2-4 |
| 16 | Montford Point Burn Dump, Site A | 1958-1972 | Garbage, waste oils, asbestos | 795450 | 2-4 |
| 17 | Montford Point Area Rip-Rap | 1968- | Concrete rubble | 787446 | 2-4 |
| 18 | Watkins Village (E) Site | 1976-1978 | Construction materials and debris | 853419 | — |
| 19 | Naval Research Lab Dump | 1956-1960 | Radioactive contaminated animals, empty tanks, scrap metals | 848402 | 2-5 |
| 20 | Naval Research Lab Incinerator | 1956-1960 | Some ash, debris | 850402 | 2-5 |
| 21 | Transformer Storage Lot 14 | Pre-1960 to Present | PCB spill | 863391 | 2-5 |
| 22 | Industrial Area Tank Farm | 1979 | Fuel (leaks) | 864389 | 2-5 |

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 3 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
|---|---|---|---|---|---|
| 23 | Roads and Grounds, Bldg. 1105 | 1957-1960 | Pesticide, herbicide storage | 862387 | 2-5 |
| 24 | Industrial Area Fly Ash Dump | 1972-Approx. 1980 | Fly ash and cinders, WTP sludge, STP sludge, construction debris | 866380 | 2-5 |
| 25 | Base Incinerator | 1940-1960 | Burned trash, melted glass | 843398 | 2-5 |
| 26 | Coal Storage Area | Present | Coal storage runoff | 855383 | 2-5 |
| 27 | Naval Hospital Area Rip-Rap | 1970- | Concrete, granite rip-rap erosion control | 833397 | 2-5 |
| 28 | Hadnot Point Burn Dump | 1946-1971 | Solid wastes, industrial wastes, garbage, trash, oil-based paint | 855364 | 2-5 |
| 29 | Base Sanitary Landfill | 1972-Present | Garbage, construction debris, general trash | 881370 | — |
| 30 | Sneads Ferry Road-Fuel Tank Sludge Area | 1970 | Sludge from fuel storage tank, tetraethyl lead and related compounds | 898324 | 2-6 |
| 31 | Engineering Stockade-G-4 Range Road | 1950-early 1970s | Waste oils | 901320-922327 | — |
| 32 | Frenchs Creek | 1973-1979 | Rip-rap dumped | 856356 | — |
| 33 | Onslow Beach Road | Unknown | Waste oil and cinders for dust control | 906298-917276 | — |

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 4 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
|---|---|---|---|---|---|
| 34 | Ocean Drive | Unknown | Waste oil | 915273 | — |
| 35 | Geiger Area Fuel Farm | 1957–1958 | Mogas (spill) | 756466 | 2-7 |
| 36 | Geiger Area STP Dump | Late 1940s–Late 1950s | Mixed industrial and municipal solid waste | 763462 | 2-7 |
| 37 | Geiger Area Surface Dump | 1950-1951 | Motor parts, garbage, wood | 758462 | 2-7 |
| 38 | Geiger Construction Dump | Present | Construction debris, branches | 756469 | 2-7 |
| 39 | Geiger Construction Slab Dump | Unknown | Concrete slabs | 753468 | 2-7 |
| 40 | Geiger Area Borrow Pit | 1969– | Auto parts, metal | 738446 | 2-8 |
| 41 | Camp Geiger Dump | Approx. 1946–1970 | Mixed industrial and municipal wastes, POL, solvents, old batteries | 732442 | 2-8 |
| 42 | Bldg. 705, BOQ Dump | 1950-1960 | Trees, tree stumps, boards | 773448 | 2-9 |
| 43 | Agan Street Borrow Pit | Unknown | Boards, trash, WTP sludge, fiberglass | 766454 | 2-9 |
| 44 | Jones Street Dump | 1950s | Debris, cloth, boards, old paint cans | 761455 | 2-9 |
| 45 | Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm at Air Station | 1978 | Avgas, JP-4 and JP-5 | 754444 | 2-9 |

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 5 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
|---|---|---|---|---|---|
| 46 | MCAS Main Gate Dump | 1958-1962 | Construction and demolition debris | 755451 | 2-9 |
| 47 | MCAS Rip-Rap Near Stick Creek | Unknown | Construction and demolition debris | 777447 | 2-9 |
| 48 | MCAS Mercury Dumpsite | 1956-1966 | Dumping of approximately 1 gal. mercury yearly for approximately 10 years | 772438 | 2-9 |
| 49 | MCAS Suspected Minor Dump | Unknown | Paint cans | 774437 | 2-9 |
| 50 | MCAS Small-Craft Berthing Rip-Rap | Unknown | Demolition debris, asphalt, concrete | 777434 | 2-9 |
| 51 | MCAS Football Field | Approx. 1967-1968 | Paint cans, hydraulic fluid cans | 773433 | 2-9 |
| 52 | MCAS Direct Refuel Depot | 1971 | Aviation fuel spill, JP fuels | 762436 | 2-9 |
| 53 | MCAS Warehouse Building 3525 Area. Oiled Roads | 1970-1975 | Crankcase, waste oils, JP fuels, paint thinners | 755426-764430-766427 | 2-9 |
| 54 | Crash Crew Fire Training Burn Pit | 1950s-Present | Contaminated fuels, oil spills | 755428 | 2-9 |
| 55 | Air Station East Perimeter Dump | 1950s-1960 | Barrels, tires, trash, metal planking, telephone poles | 774421 | 2-9 |
| 56 | MCAS Oiled Roads to Marina | 1975- | Crankcase and waste oils, contaminated fuels | 773423 | 2-9 |

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 6 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
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| 68 | Rifle Range Dump | 1942-1972 | Solvents, construction materials, WTP sludge | 748302 | 2-11 |

Table 2-1. Disposal Sites at Camp Lejeune Complex (Continued, Page 7 of 7)

| Site No. | Site Description | Dates Used | Material Deposited | Special Map Coordinates | Fig. No.* |
|---|---|---|---|---|---|
| 69 | Rifle Range Chemical Dump | Mid-1950s to 1976 | (Chemical warfare training) Gas testing, Malathion, DDT, PCBs | 770290 | 2-11 |
| 70 | Oak Grove Field Surface Dump | 1940s-1950s | Mess hall wastes, cans, bottles, old paint cans | — | 2-12 |
| 71 | Oak Grove Buried Dump | 1940s-1950s | Garbage, cans and bottles | — | 2-12 |
| 72 | Oak Grove Coal Pile | 1940s | Coal storage use for heating living quarters | — | 2-12 |

*Site Nos. 1-72 are located on Figure 2-1.

nearby geological conditions is needed to evaluate a specific site completely. Geohydrology of the Lejeune complex is such that ground water generally moves toward New River and its tributaries. Potable wells at the base are usually deep, but, due to voids in the confining layer, this carries some risk. Also, heavy demands for water may at times produce an overall decline of pressure in the semi-confined aquifer. Therefore, contaminants can migrate: (1) laterally to surface water and (2) vertically through gaps in the confining layer.

The following sites warrant confirmation based on consideration of type of material and potential for migration. The NACIP Confirmation Study Ranking System (model) was used as the framework within which these judgments were made. Information in this section is extracted from one or more later sections in this report. As a minimum, reference should be made to detailed site information forms included in Section 6.6 for:

1. Cautions regarding limitations on estimates of some quantities;
2. Supporting information regarding activities and dates of use, and;
3. Locations according to streets or other known landmarks.

<u>Site No. 1: Midway Park Dump</u>--The site is at Special Map coordinates 859458 (Figure 2-2). It is near Onslow Community College on property that was excessed by Camp Lejeune and is now a park. Building and construction debris were buried here. The only material of concern is asbestos siding. This site was active from early 1960s to around 1972. Amount of material in the dump is unknown, despite interviews with retired personnel. The dump is estimated to contain 100,000 to 200,000 cubic yards of material. No reliable information was found as to how much of the total is asbestos. If 0.1 percent were asbestos, then 100 to 200 cubic yards would be present. Data do not support or refute this value.

<u>Site No. 2: Nursery/Day-Care Center (Building 712)</u>--This site is at Special Map coordinates 855441 (Figure 2-2). From 1943 to 1958, pesticides of various kinds were stored, handled, and dispensed here. Residuals are present but reliable data from which to quantify

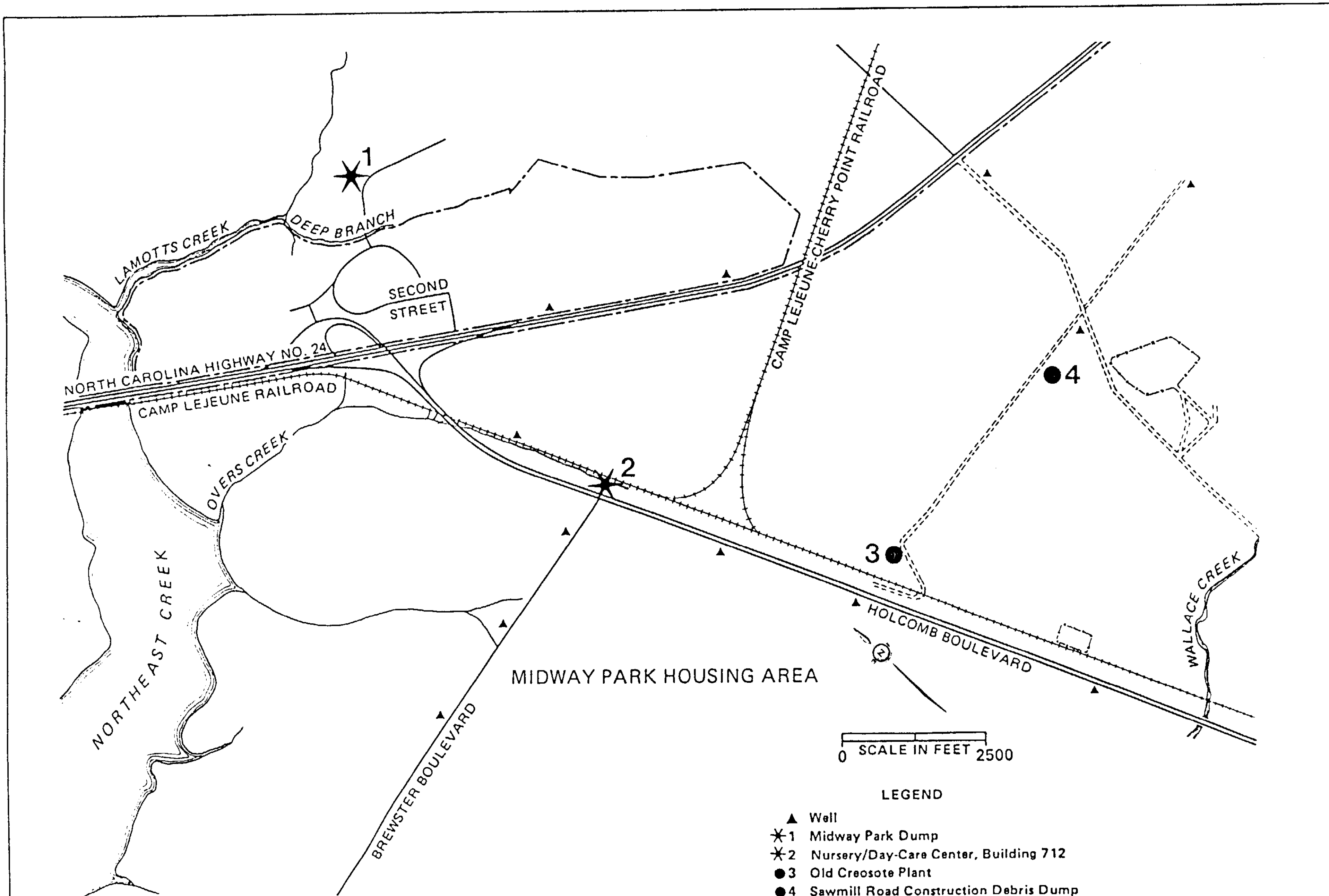



FIGURE 2-2. Site Locations at Midway Park Housing Area

residuals or spill volumes have not been found. Chemicals used in significant amounts include Chlordane, DDT, Diazinon, and 2,4-D. Stored only or used to a minor extent were Baygon, Dieldrin, Dursban, Lindane, Malathion, Mirex, Silvex, and 2,4,5-T. Contaminated areas are the fenced playground, approximately 6,300 square feet; the mixing pad covering; approximately 100 square feet; and the wash pad, approximately 225 square feet. An adjacent drainage ditch possibly received washout and spills. Table 2-2 presents results of a preliminary sampling program in April 1982.

Site No. 6: Storage Lots 201 and 203--This site is at Special Map coordinates 866406 (Figure 2-3). In the 1940s, the area occupied by Lot 203 was a dump. In the northeast corner, an unknown quantity of DDT was buried and is marked. Attempts to estimate amount have been unsuccessful. The area where DDT was buried is assumed to be within an 80- to 100-foot radius of the dump marker. The size of Lots 201 and 203 is approximately 25 and 46 acres, respectively. Transformers containing PCBs and DDT also were stored here and there is a possibility of leaks or spills. No information referring specifically to PCB leaks has been found. Reports of white powder on the ground indicate DDT spills have occurred.

Site No. 9: Fire Fighting Training Pit at Piney Green Road--This site is at Special Map coordinates 868398 (Figure 2-3). It has been in operation from the 1960s to the present. Pollution abatement devices, including an oil-water separator and an impermeable liner in the training pit, have been installed. About 30,000 gallons per year of used oil, solvents, and contaminated fuels are burned during training exercises. Until the mid- to late 1960s, the pit was unlined. The present pit is lined and is approximately 800 square feet. The entire site is about 1 to 2 acres in size. The soils are sandy and lack ground cover.

Site No. 16: Montford Point Burn Dump Site A--The dump is at Special Map coordinates 795450 (Figure 2-4). It was opened around 1958 and was

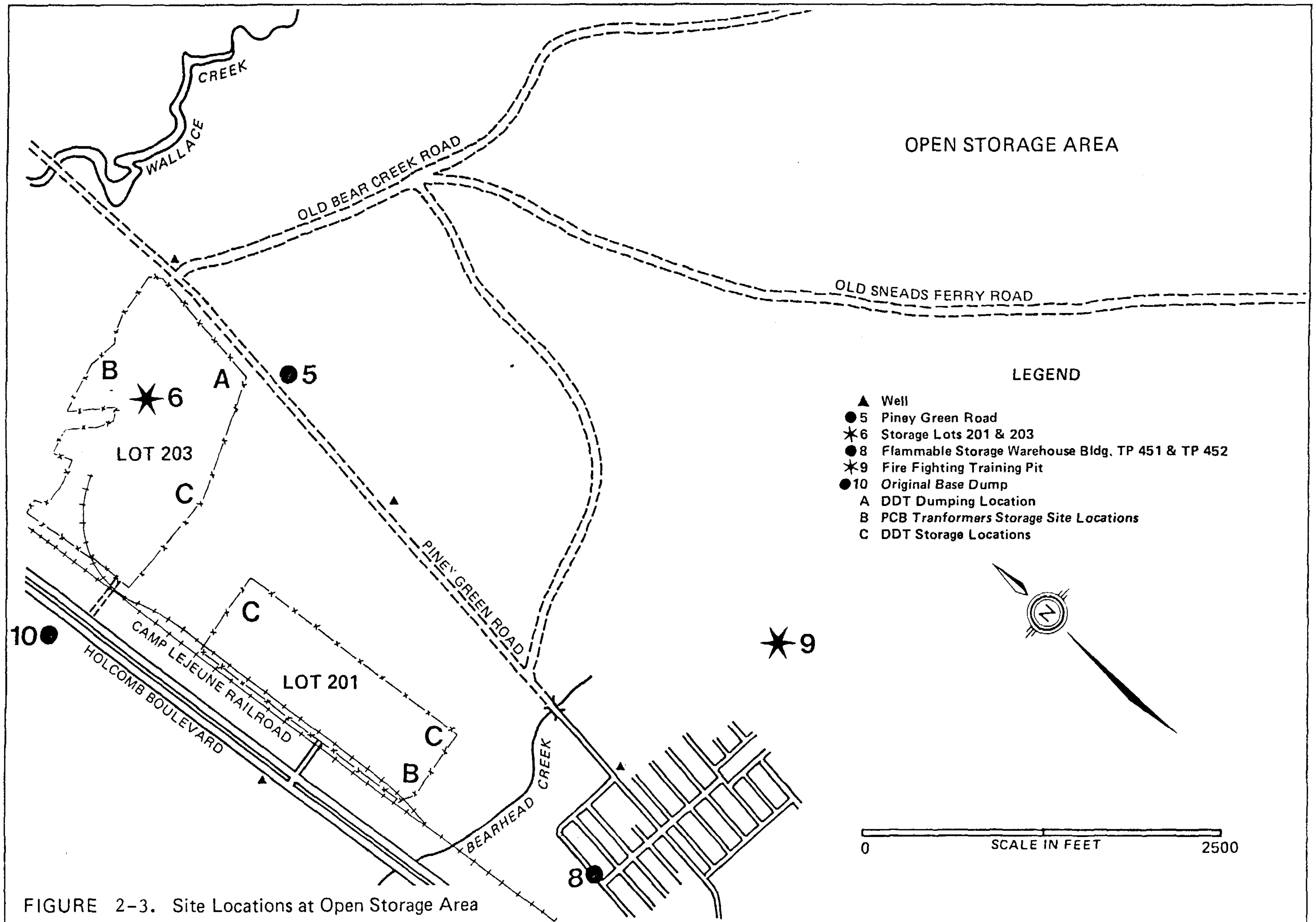



FIGURE 2-3. Site Locations at Open Storage Area

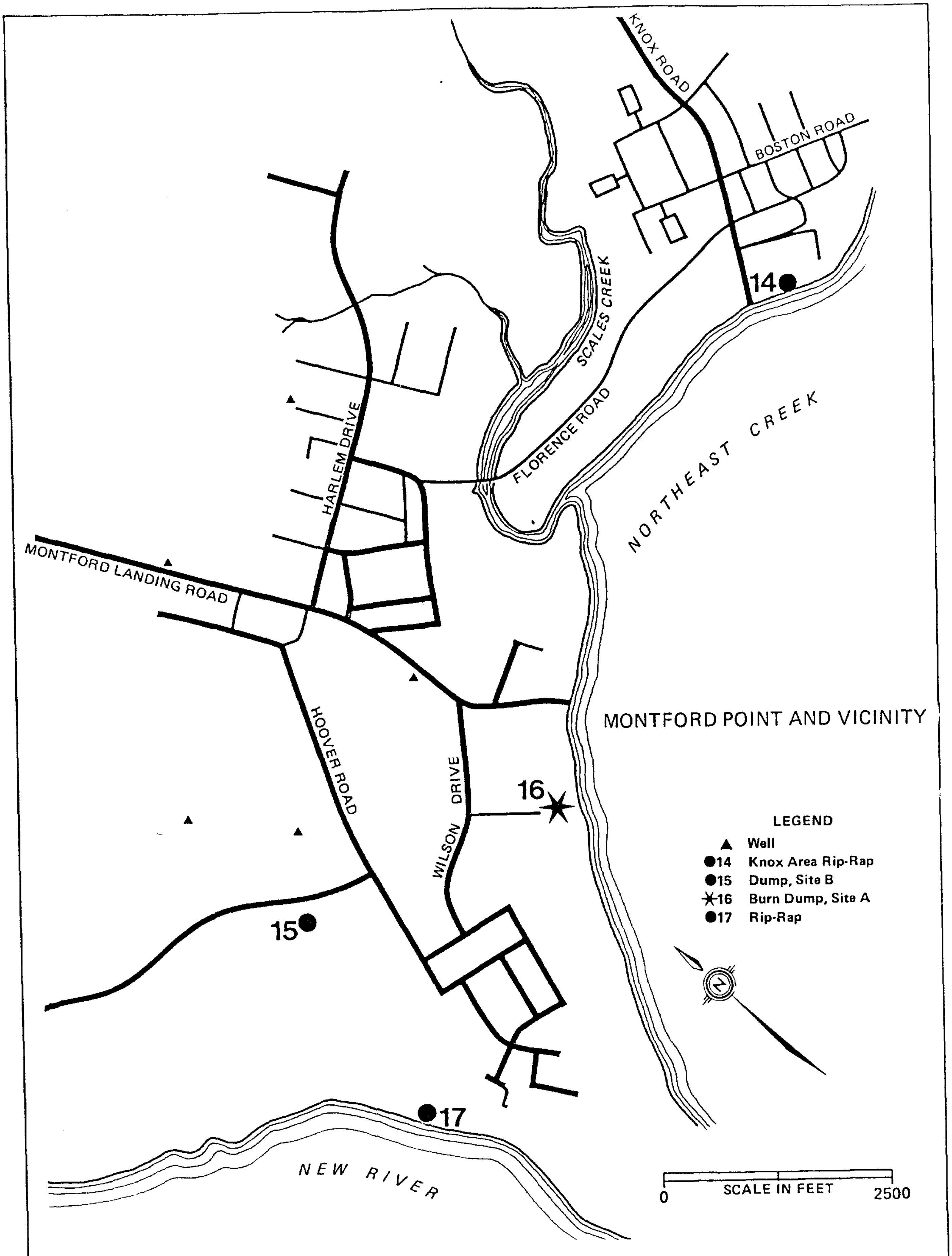



FIGURE 2-4. Site Locations at Montford Point and Vicinity

closed in 1972. Although officially closed, unauthorized dumping still occurs. The site contains building debris, garbage, tires, and waste oils. The quantity of these is unknown, but the amount of oil buried here is considered insignificant. Materials have been dumped on the surface and include asbestos insulating material for pipes. The amount is estimated at less than 1 cubic yard. The site covers about 4 acres.

Site No. 22: Industrial Area Tank Farm--The tank farm, at Special Map coordinates 864389 (Figure 2-5), is currently in operation. In 1979, a fuel leak of an estimated 20,000 to 50,000 gallons occurred. The leak was in an underground line slightly behind the tank truck loading facility and between the building and the large aboveground fuel tank. The site covers about 4 acres.

Site No. 24: Industrial Area Fly Ash Dump--This site is at Special Map coordinates 866380 (Figure 2-5). It was first used in 1972 and was active until approximately 1980, when transporting ash to the present sanitary landfill began. The dump site is adjacent to upstream portions of Cogdels Creek. Size is estimated to be 20 to 25 acres. Materials disposed of include fly ash, solvents, used paint stripping compounds, sewage sludge, and water treatment spiractar sludge. The amount of fly ash is estimated at 31,500 tons. The estimate of stripping compounds dumped here is about 45,000 gallons over 7 years.

Site No. 28: Hadnot Point Burn Dump--This site is at Special Map coordinates 855364 (Figure 2-5). The dump was used for the base industrial area from 1946 to 1971. A variety of industrial waste was burned and covered. It is estimated that between 185,000 to 370,000 cubic yards of material is buried here. The area has been graded and seeded with grass and now supports a good ground cover. Its proximity to Cogdels Creek and New River poses health and environmental risks. Base environmental personnel have seen leachate and seepage to Cogdels Creek.

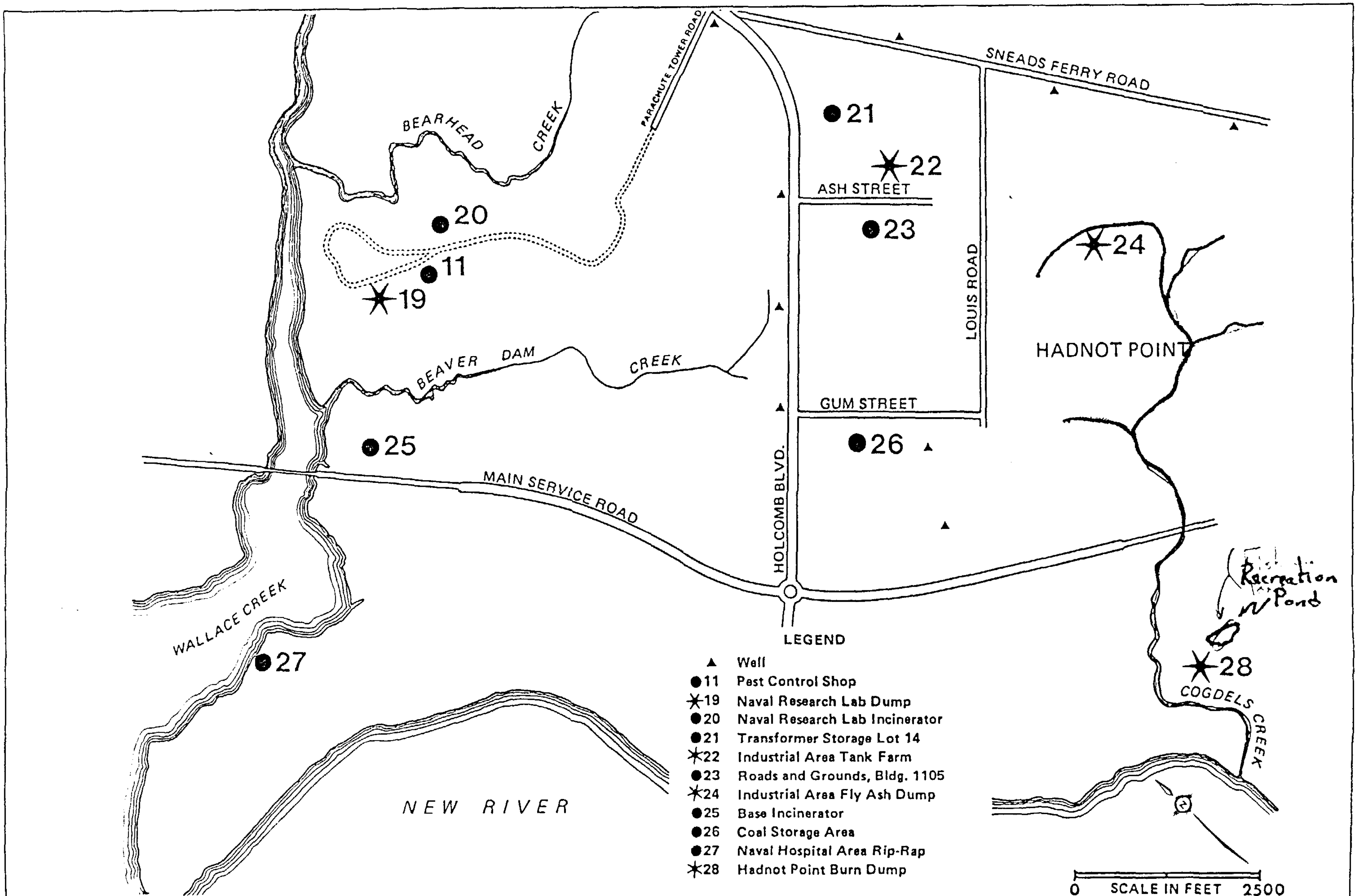



FIGURE 2-5. Site Locations at Hadnot Point

Site No. 30: Sneads Ferry Road--Fuel Tank Sludge Area--This site is at Special Map coordinates 898324 (Figure 2-6). It contains sludge and/or washout from storage tanks at the industrial area fuel farm. When the contents of the tank were changed from leaded to unleaded fuel in 1970, sludge and/or washout was drained from the tank by a private contractor and disposed of along a tank trail which intersects Sneads Ferry Road. Two 12,000-gallons tanks were involved. Based on knowledge of tank capacity below tank outflow ports, about 600 gallons of sludge and were dumped. It is possible that the site has been used for similar wastes from other tanks. Therefore, the 600-gallon amount must be considered a minimum. Composition of sludge and/or washout is unknown and may vary from containing substantial amounts of tetraethyl lead to containing mostly cleaning compounds. Soils in the area are sandy and conducive to migration toward Frenchs Creek, about 1,500 feet away. Because tetraethyl lead is involved, further investigation is warranted.

Site No. 35: Geiger Area Fuel Farm--The site is at Special Map coordinates 756466 (Figure 2-7). A leak in an underground fuel line occurred near the pad supporting the overhead tanks in the late 1950s, probably in 1958. Amount of fuel is estimated to be in the thousands of gallons. The fuel moved east toward Brinson Creek. Holes were dug to the water table, where fuel floating on the groundwater surface was ignited and burned. Fuel contaminating Brinson Creek also was ignited and burned. The distance from the fuel farm to Brinson Creek is approximately 400 feet.

Site No. 36: Geiger Area Sewage Treatment Dump--The site, at Special Map coordinates 763462 (Figure 2-7), received mixed industrial and municipal wastes. These were burned and later covered; however, some materials may have been dumped on the ground surface and covered unburned. The dump was active from 1950 to 1959. The site is near Brinson Creek and a small roadside drainage ditch is located on the opposite side of the dump. The site covers 25,000 square feet and rises 10 to 12 feet above grade. Estimated volume is 14,000 cubic yards. Wastes of concern are

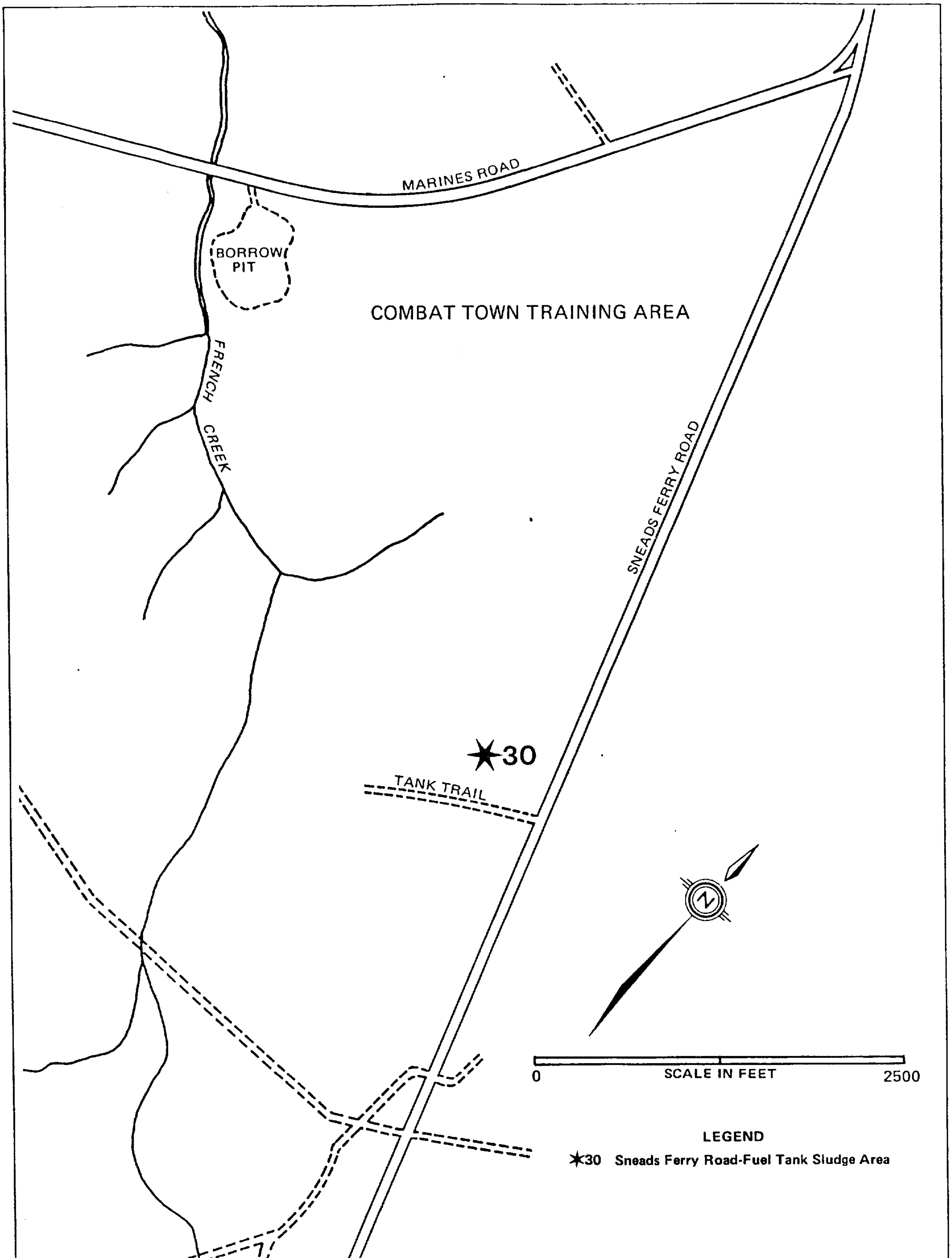



FIGURE 2-6. Site Locations at Combat Town Training Area

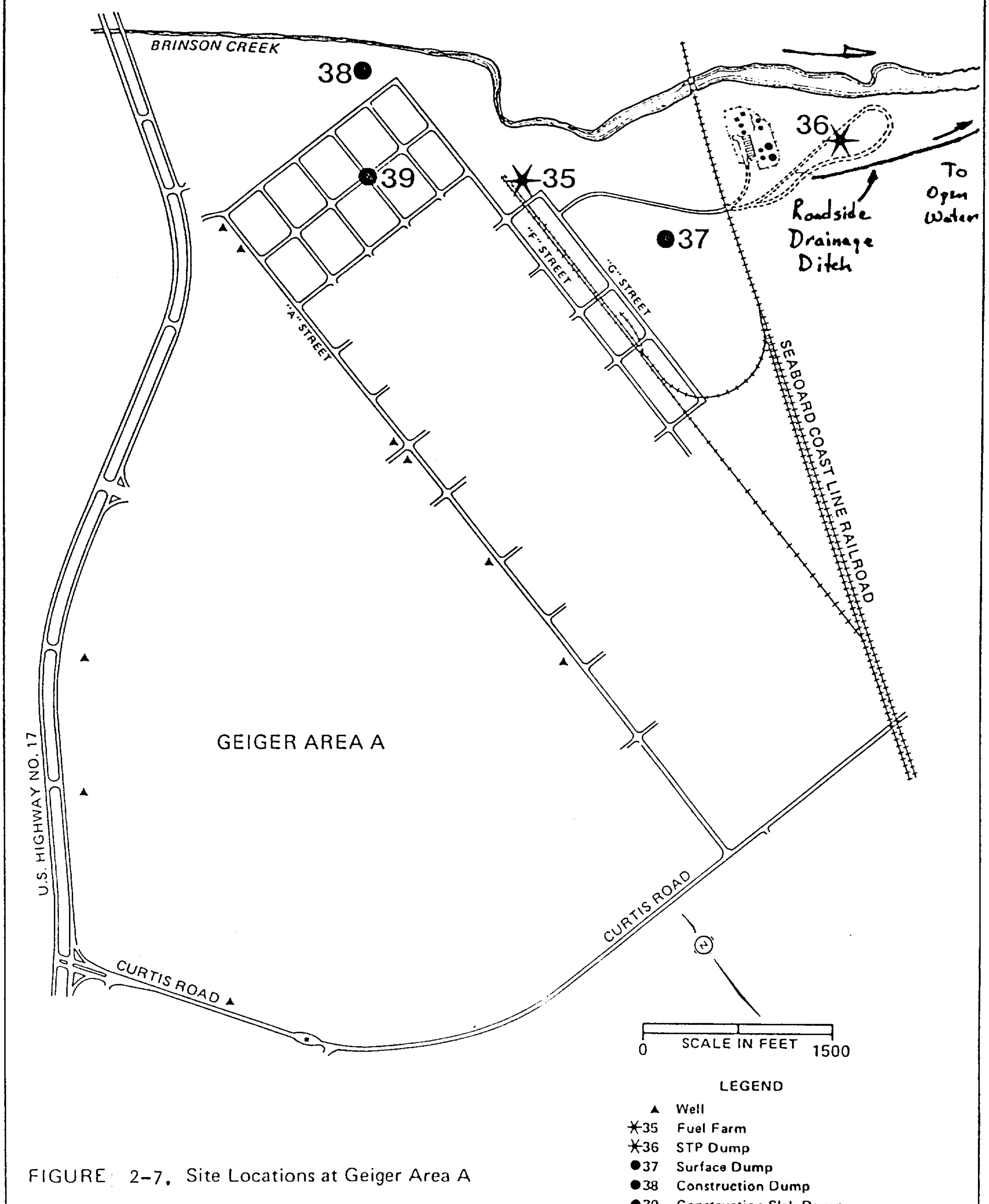



FIGURE 2-7. Site Locations at Geiger Area A

hydrocarbons (solvents, waste oils, hydraulic fluids) that were generated at Camp Geiger or the air station. As many as 10,000 to 15,000 gallons may have been disposed of over 9 years. Most were probably burned.

Site No. 41: Camp Geiger Dump--This dump, at Special Map coordinates 732442 (Figure 2-8), was active from 1953 to 1970. According to interviews with air station personnel, it received POL compounds, solvents, old batteries, and other assorted municipal waste. The area is estimated to be 15 acres and to contain 110,000 cubic yards of waste. Solvents and oils disposed of here are estimated to be about 10,000 to 15,000 gallons.

Site No. 45: Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm--This site is at Special Map coordinates 754444 (Figure 2-9). The two facilities are on each side of White Street and on the north side of Campbell Street. In 1978, 200 to 300 gallons of Avgas were spilled or leaked from this facility. During 1981 and 1982, due to corrosion of underground lines at the JP Fuel Farm, more than 100,000 gallons of fuel may have leaked into surrounding soil. These lines have been replaced with an aboveground system. Although the volume of Avgas loss is low, the estimate may be conservative.

Site No. 48: MCAS Mercury Dump Site--This area is located on the Special Map at coordinates 772438 (Figure 2-9). From 1956 to 1966, metallic mercury from the delay lines of the radar units was reported to have been buried around the photo lab, Building 804. One gallon per year was disposed of in this area. More than 100 pounds may be dispersed over approximately 20,000 square feet adjacent to New River.

Site No. 54: Crash Crew Fire Training Burn Pit--This site can be located at Special Map coordinates 755428 (Figure 2-9). The area off Runway 5-23 has been used since the 1950s for crash crew training with various POL compounds. Originally, training was on the ground surface surrounded by a berm. Later, a pit was used, which was eventually lined. The affected

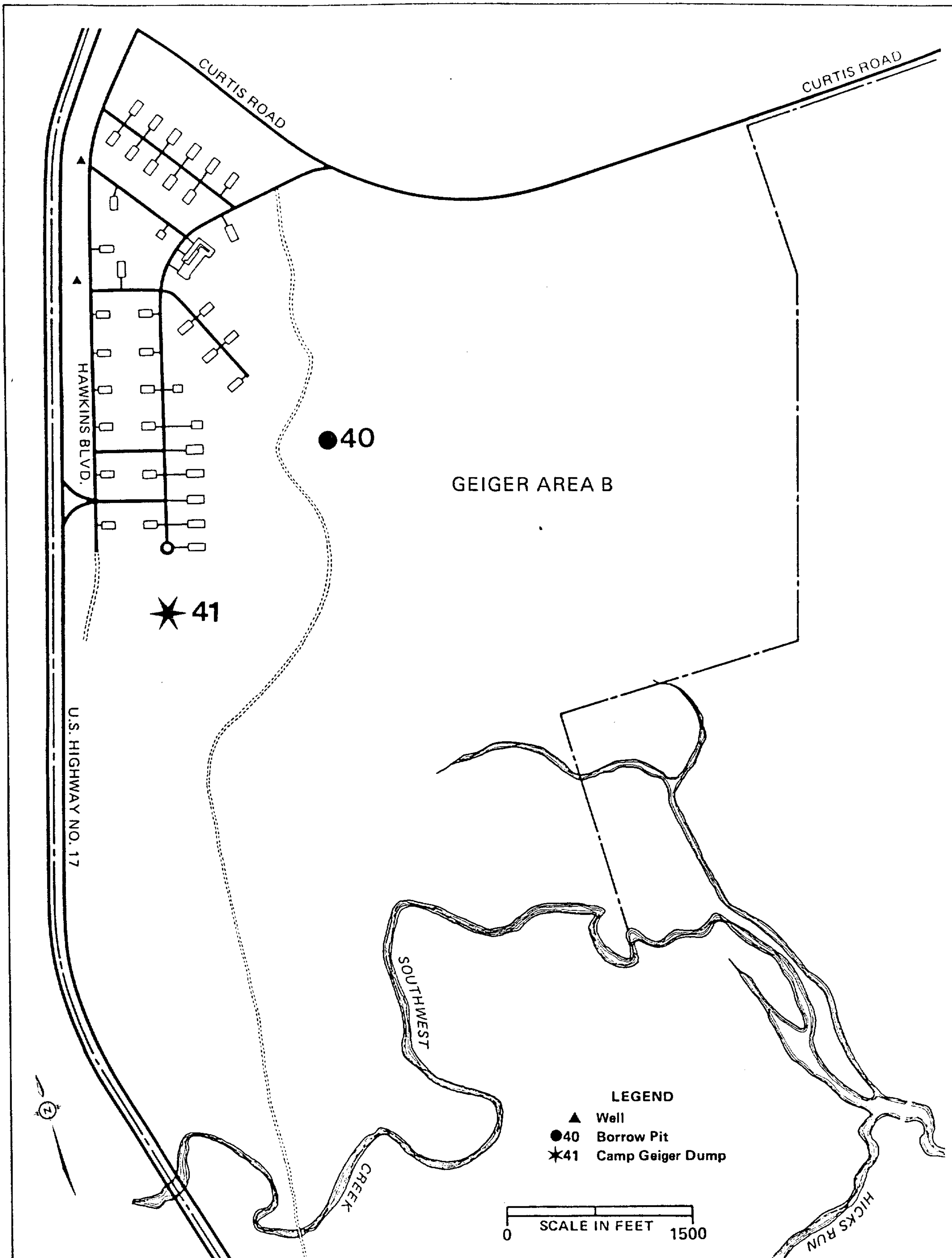



FIGURE 2-8. Site Locations at Geiger Area B

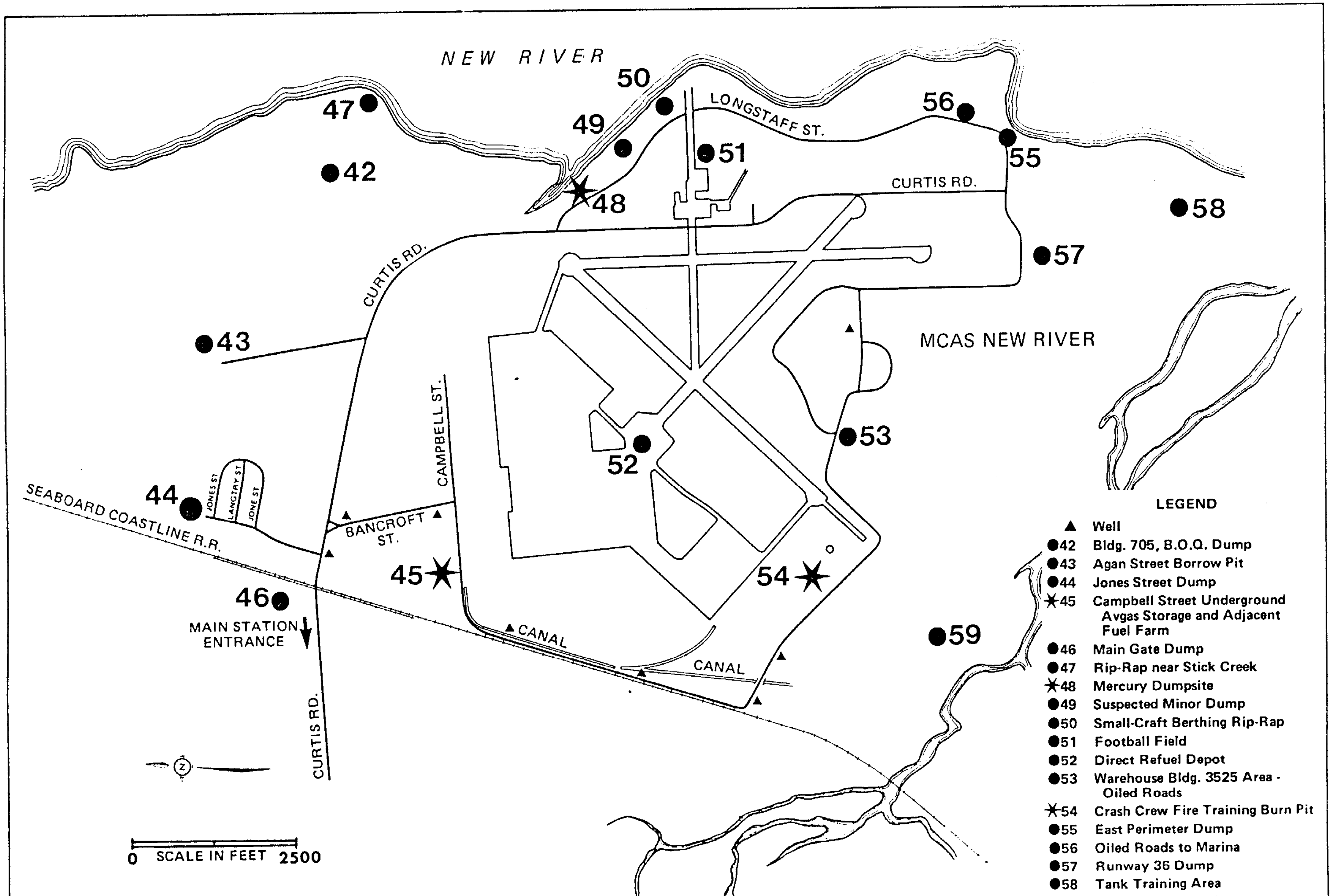



FIGURE 2-9. Site Locations at MCAS New River

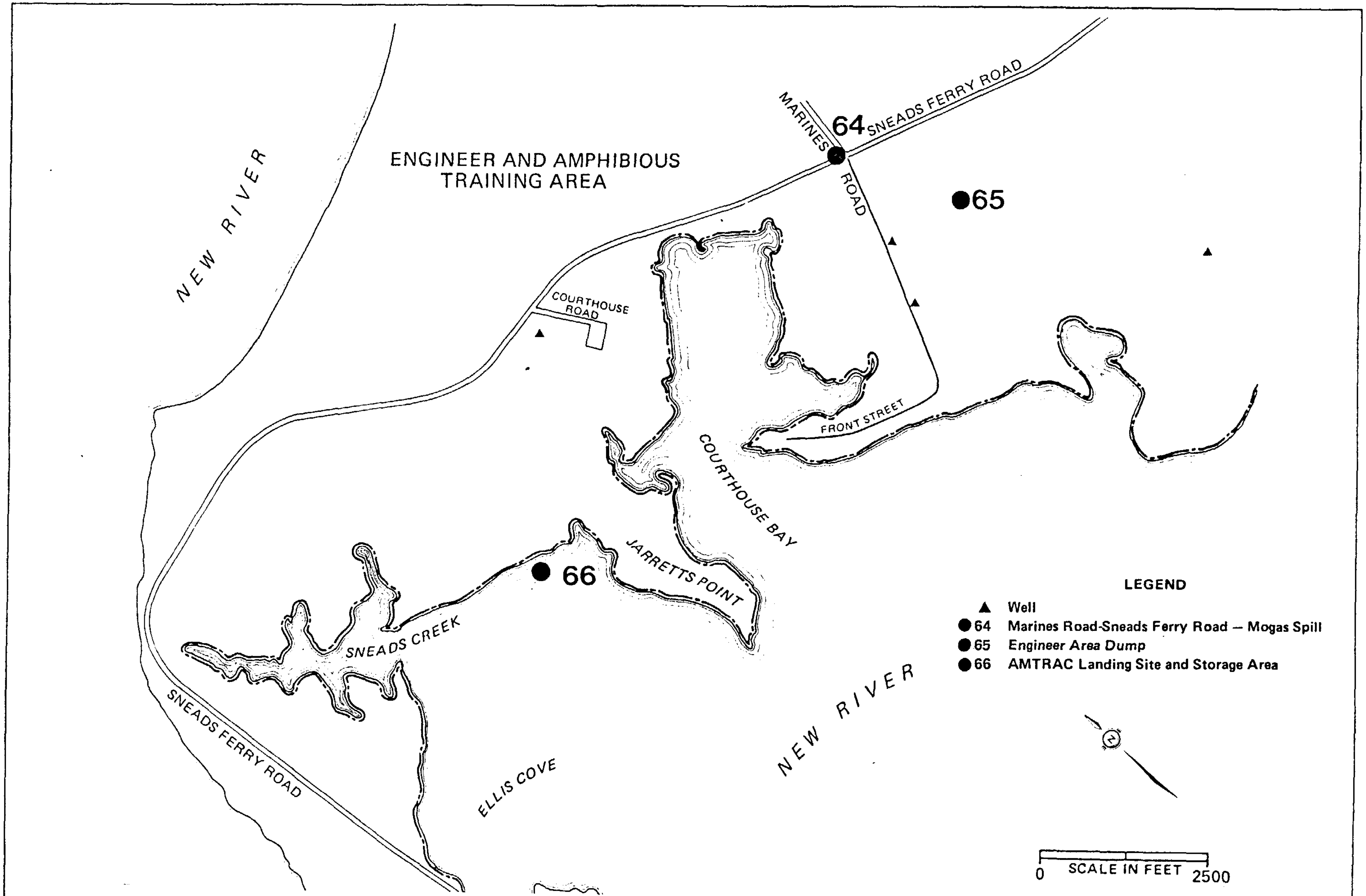



FIGURE 2-10. Site Locations at Engineer and Amphibious Training Area

area is about 1.5 acres. Based on present annual usage of 15,000 gallons of POL, nearly one-half million gallons of these compounds have been used at this site. Most of these were burned, but as many as 3,000 to 4,000 gallons may have soaked to soils.

Site No. 68: Rifle Range Dump--This site is at Special Map coordinates 748302 (Figure 2-11) and was active from 1942 to 1972. Types of wastes buried here are garbage, building debris, WTP sludge, and solvents. Solvents have been used extensively for weapons cleaning. However, amounts are relatively small and total volume disposed of is estimated to be about 1,000 to 2,000 gallons. Fill volume is estimated at 100,000 cubic yards. Solvents are of concern because nearby Well Nos. RR-45 and RR-97 contain organic contaminants. The distance between the wells and the dump is approximately 1,500 feet. Although the wells are upgradient, pumping could draw contaminants toward these wells. Table 2.4 contains results of analyses run on active Well Nos. RR-45, RR-47, RR-85, and RR-97.

Site No. 69: Rifle Range Chemical Dump--This site is at Special Map Coordinate 770290 (Figure 2-11). It was once designated for disposal of all hazardous chemicals. It has received much attention and is discussed in detail here. Although past records have been lost, it is known that pesticides, PCBs, pentachlorophenol, TCE, and many other compounds were buried here. The dump was active from the early to mid-1950s to approximately 1976. Orientation is difficult when on-foot at the site. Therefore, Figure 2-13 is included. It shows an aerial perspective of the site with notable surface features identified.

Tributaries to New River (including Everette Creek and unnamed creeks and guts), the Rifle Range wells, and surface seeps are nearby. Test wells already exist and intermittent sampling has been done. Also, samples have been collected from a small tributary to Everett Creek and from pools on or near the site. Results of analyses for the presence of metals, volatile organics and pesticides are in Tables 2-3, 2-4 and 2-5.

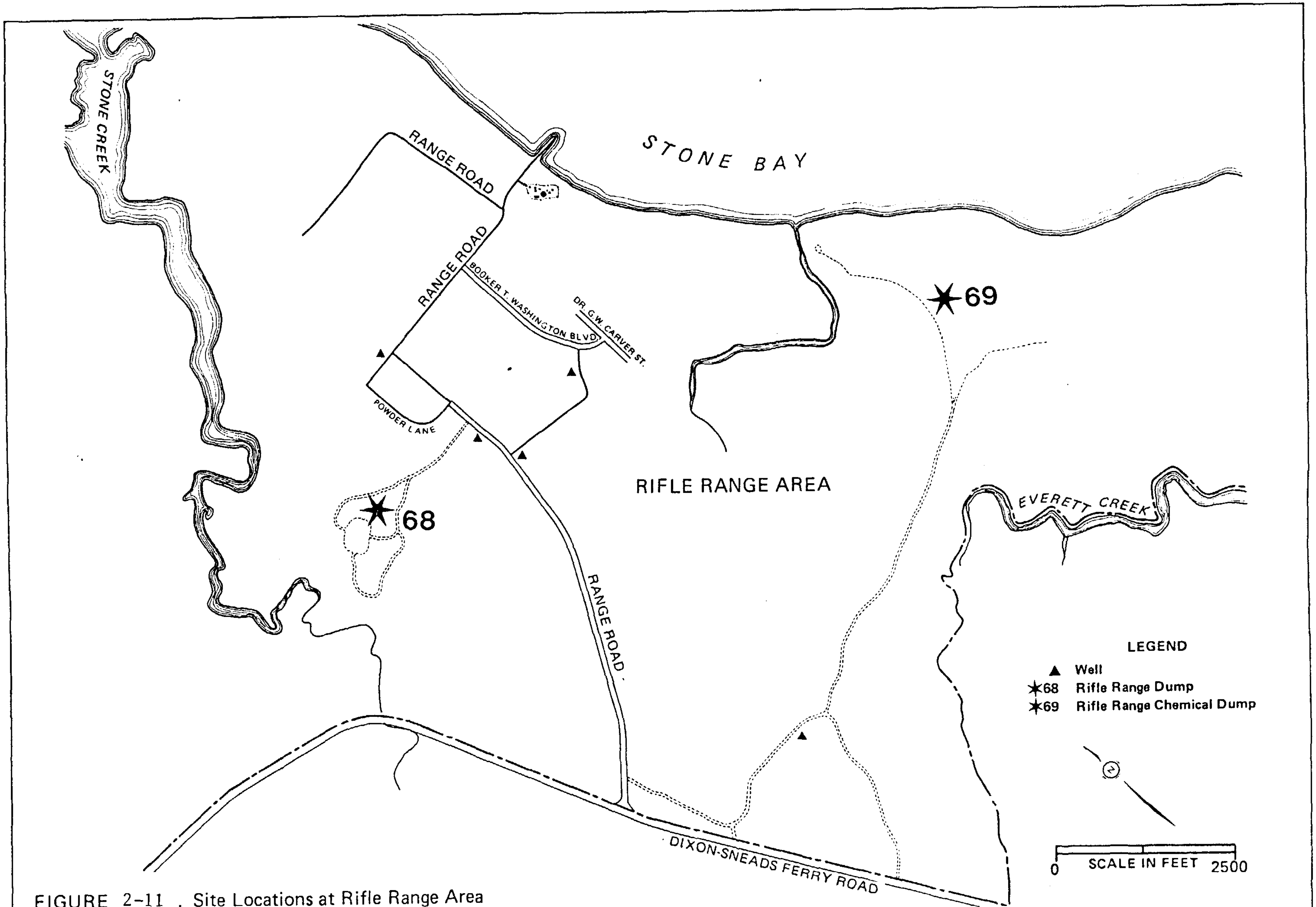



FIGURE 2-11 . Site Locations at Rifle Range Area

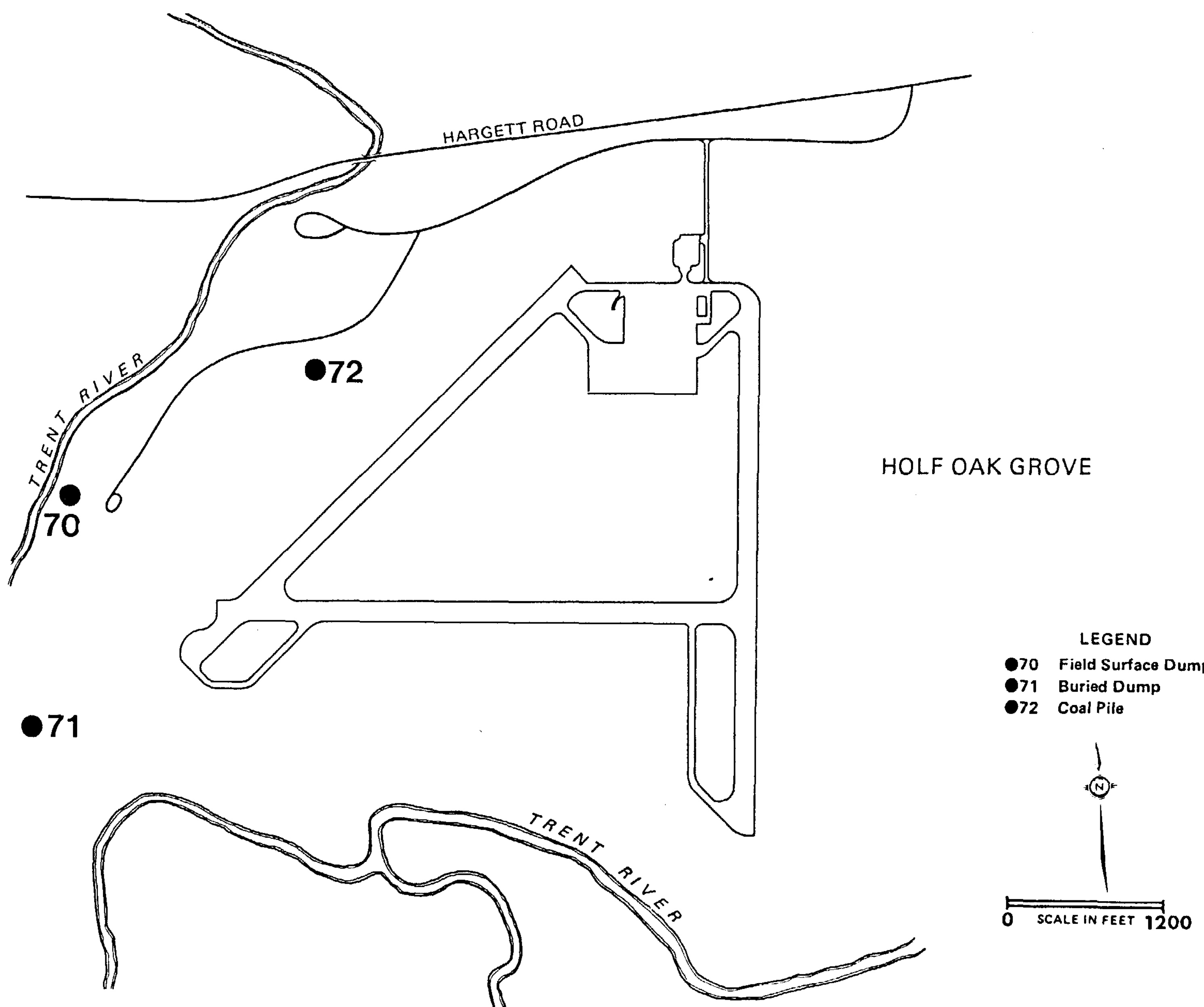



FIGURE 2-12. Site Locations at HOLF Oak Grove

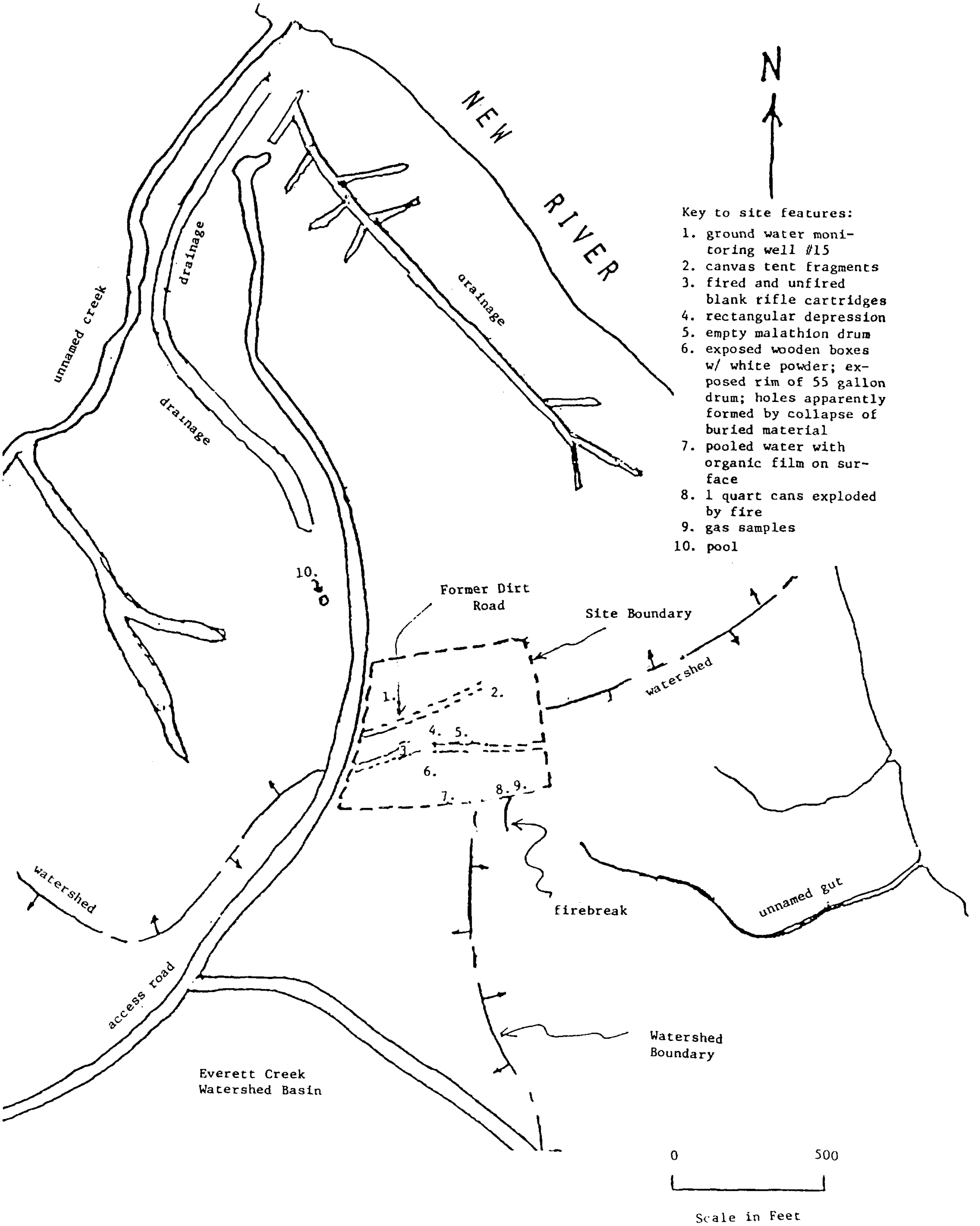



FIGURE 2-13. Physical Features and Locator Map for Site 69 (locations of site features are approximate)

Source: WAR,1982

Data show that water from Test Well Nos. 15 and 16 contains elevated levels of organic contaminants. Samples of surface water from a nearby pool also showed a high concentration of volatile organic compounds. The pool is a pit 10 to 15 feet deep. It collects ground water through its sides and bottom.

Because there is a risk of contaminating the potable supply at the Rifle Range, samples were collected at three operating wells. These were Well Nos. RR-45, RR-47 and RR-97. The latter well is about 6,000 feet from the dump site. Analyses were run for organic contaminants. Analyses were also made on finished water. These results, shown in Table 2-4, indicate that Well No. RR-97 had three organic contaminants. No contaminants were detected in Well No. RR-47, but Well No. RR-45 had 4 parts per billion (ppb) of methylene chloride. Finished water (Well No. RR-85) showed levels of 17 ppb of chloroform and 3 ppb of methylene chloride. Possible sources of contamination are discussed in Section 4.0.

Samples from the Rifle Range wells of raw and treated water have been analyzed for trihalomethane compounds. Results show that treated water in August of 1981 contained total THM in excess of 100 ppb. Further sampling in 1981 and 1982 (with the exception of that in December) indicates levels approximately half those observed in August. Reduction of trihalomethanes here may well be possible through changes in the water treatment process. Elimination or reduction in prechlorination has been successful in reducing trihalomethanes in other plants.

# 3.0 CONCLUSIONS

## 3.0 CONCLUSIONS

1. Potentially hazardous chemical wastes have been generated by military activities at Camp Lejeune.
2. Although sites were identified throughout the base, the air station and Hadnot Point areas had the largest number. One site (Site No. 1) is off-base property.
3. No industrial or municipal wastes were found to be migrating onto base property.
4. Confining beds separating the water table aquifer and the semi-confined aquifer are discontinuous at Camp Lejeune. This condition increases the risk of leachate from old dumps migrating into the semi-confined aquifer, the source of potable water.
5. The water table aquifer is highly susceptible to contamination from hazardous waste disposal practices.
6. Surface water contamination is also possible because flow in the shallow unconfined aquifer generally follows land contours and discharges to surface tributaries of the New River or to the river itself.
7. Past use of aircraft, tracked and wheeled vehicles has caused POL contamination. These substances were involved in eight of the 17 sites judged to require confirmation.
8. Monitoring should continue at the chemical dump near the Rifle Range. Contaminants entering ground water from this source move downgradient and away from the potable wells at the Rifle Range. These wells, on the basis of this preliminary study, are not at risk from chemical dump wastes. The dump west of Well Nos. RR-45 and RR-97 requires further investigation. Solvents buried at this site (68) may have had an opportunity to move upgradient toward these wells during heavy groundwater withdrawal.
9. HOLF Oak Grove does not contain any significant sites.

# 4.0 RECOMMENDATIONS

## 4.0 RECOMMENDATIONS

In this section, specific suggestions for further study at 17 sites are presented. The 17 sites are those judged to require confirmation investigation. Recommendations typically involve field work which varies in effort according to perceived magnitude and extent of contamination potential. Important information at sites may remain to be gathered during confirmation. This is because the purpose of this study has been to determine contamination potential, and at many sites, this has been satisfactorily assessed without processing all information which may be relevent to a confirmation investigation. For example, at some sites, precise location of site boundaries remain inexact, and an important aspect of confirmation will be to better define them.

### 4.1 OVERVIEW OF THE RECOMMENDATIONS PROCESS

In the following section, recommendations are given for additional investigation at each site requiring confirmation. In a limited sense, confirmation would produce a yes or no answer regarding contamination presence. Also, strictly speaking, this initial assessment is intended to produce a yes or no answer regarding potential for contamination. While worthy ideals, practically neither is easy to attain for many sites. Regarding initial assessment: it is difficult to rule out most sites using the criteria for potential contamination; there is some finite probability of contamination at most all sites. Rather, the notion of reasonable potential must be considered. Therefore, in addition to formal guidelines, some professional judgment is relied upon when segregating sites into groups requiring either no or some additional investigation.

For the following confirmation recommendations, a similar framework is necessary. Objectives of a Confirmation Study are, in some cases, difficult to nearly impossible to achieve in a single sampling effort. One must be particularly cautious in concluding that no problem exists based on limited samples that show no contamination. Movement of pollutants in ground water may be very slow and/or nonuniform, so that sample wells may not draw from affected parts of the aquifers. Consequently, one should carefully consider, along with sampling results, all facts known about a site, including what and how much waste was put there, hydrogeology, and potential routes of pollutants back into the environment. Thus, whereas detection of pollutants in groundwater samples is generally conclusive evidence, negative results for a limited number of samples does not prove that pollutants are not and/or will not be present. This philosophical framework is used in making recommendations for confirmation work.

Recommendations are presented on a site-by-site basis, and a standard format is used throughout. It contains the following:

| | |
|---|---|
| Problem: | A short statement indicated types of materials involved. Information regarding type of potential environmental contamination may also be given. |
| Goal: | A concise statement addressing specific confirmation objectives |
| Approach: | An overview of general strategy applied |
| Wells: | General instructions for siting wells, if used |
| Samples: | General directions giving types and numbers of soil, sediment, ground water or surface water samples specified. General location for samples, other than wells, is often included. |
| Frequency: | A brief specification of when, and over what period, to collect the various types of samples |
| Analyses: | For each different type of sample, specification of information to be collected. Generally laboratory analyses are specified, but relevant supporting information may also be noted. |

Frequency and analyses specifications are omitted if not samples are recommended.

## 4.2 SPECIFIC RECOMMENDATION BY SITE

Recommendations for confirmation work at specific sites are outlined below. Details for monitoring-well construction are given in Appendix A.

Note: Core sampling is generally specified as at 1- to 2-foot intervals down into water table. This spacing is based on an assumed depth to ground water of 5 to 10 feet (i.e., 4 or 5 total samples). If depth to ground water is greater, intervals should be selected to yield 4 or 5 samples between surface and 1 foot below water table.

Note: Tetraethyl lead analysis has been specified in certain instances of potential gasoline contamination. Other hazardous substances may also be present as fuel additives. However, tetraethyl lead is considered a useful indicator.

Note: Upgradient wells to document background groundwater quality are specified at many sites. Where several sites are relatively close, one or two background wells may serve all sites.

<u>Site No. 1:</u> Midway Park Dump

<u>Problem:</u> Building construction debris, which includes asbestos siding, has been disposed of at this site.

<u>Goal:</u> Clean up asbestos on surface, dispose in proper manner.

<u>Approach:</u> Conduct a careful inspection of the site using a hand auger to define more precisely extent of the disposal area. Because asbestos is nonmobile in soil, test wells are not recommended. Asbestos probably would move because of a disruption of the integrity of the site. This could occur through construction. Once demarcated, the site should be permanently excluded from any land use that would expose asbestos to surface movement. Asbestos on the surface should be cleaned up and buried in a sanitary landfill.

<u>Wells:</u> None

<u>Samples:</u> None

Site No. 2: Nursery/Day-Care Center at Building 712

Problem: This building was formerly the pesticide storage and handling facility. Residual pesticides in soils and the building may pose health risks to supervisory personnel and small children. Preliminary sampling results are shown in Table 2-2. An adjacent drainage creek (ditch) probably received washout and spills.

Goal: Determine types and amounts of pesticides in the playground area and building, remainder of area, and in creek sediments.

Approach: Collect cores from three sites in the playground. Conduct a thorough inspection of other outdoor areas (both inside and outside fence) where mixing and handling occurred and obtain additional soil samples. Examine building thorougly and sample for pesticide residue or volatile chlordane. Sample creek sediments.

Samples: In playground, 18-inch-deep cores of soils from three separate locations. In other outdoor areas, one 18-inch-deep core from each. From building, air sampling for volatiles plus from most used rooms, residue samples from places likely to harbor fugitive substances, e.g., behind moldings. In creek, sediment samples at four places: immediately downstream of site, about 1,400 feet downstream near Well No. 646, about 4,000 feet downstream above confluence with Overs Creek, and in Overs Creek above location of creek widening at Northeast Creek.

Frequency: An initial sampling in locations specified above. If residuals are present, then further intensive sampling to determine extent and distribution of contamination.

Analyses: Soils, sediments, and residues: DDT and isomers, organochlorine pesticides, herbicides (including 2,4,5-T), pertinent phosphate-based pesticides; air: volatile Chlordane.

Site No. 6: Storage Lots 201 and 203

Problem: DDT contamination of soils due to burial in northeast section of Lot 203 and spills

Goal: Determine presence of DDT in soils

Approach: Sample soils in vicinity of suspected dumping and spilling of DDT. Emphasize areas radially from the four DDT-related locations. Consider limited analyses for PCB near transformer storage. Although no spills reported, incremental costs may favor gaining added measure of confidence. Take corings radially from the two transformer storage locations.

Samples: At each location, select five places to obtain cores. Unless there are on-site indications to concentrate sampling places, encircle locations. At each sampling place, within an approximately 3-foot diameter circle, take minimum of five shallow cores 12 inches deep to produce 3 kilograms (kgs) of soil at each sample point. Cores are composited and handled as a single sample for each point. At the DDT dump, deeper cores may be necessary.

Frequency: Once

Analyses: DDT and isomers or PCB, as appropriate

Site No. 9: Fire Fighting Training Pit at Piney Green Road

Problem: Contaminated fuels and other POL compounds have been used at this site with potential contamination of soils and water table.

Goal: Determine if POL compounds present and if migration has occurred.

Approach: Sample soils and groundwater for POL. Because pit is now lined, plume of material may have moved downgradient during approximately twenty-years since lining. Therefore, collect cores adjacent to plus downgradient of pit. Well HP-635 is approximately 300 feet away. Although not downgradient, it is pumping and should be sampled.

Wells: Well No. 635

Samples: Sample soils at 1 foot below surface and at 1- to 2-foot intervals down to 1 foot below water table. Locate three coring lines perpendicular to groundwater flow (gradient) and downgradient of pit sample: 1) Adjacent to pit outside of liner; 2) 200 feet away, and 3) 1,000 feet away. Take two cores, 50 feet each side of a line parallel to groundflow and intersecting pit. Static and dynamic water levels should be recorded referenced to datum.

Frequency: Once

Analyses: Oil and grease, volatile hydrocarbons

Site No. 16: Montford Point Burn Dump

Problem: Unauthorized dumping of asbestos

Goal: Confirm quantity of asbestos on land surface in order to estimate clean-up effort. Alternately, proceed directly to clean up and remove friable asbestos to a properly operated landfill.

Approach: Conduct a careful inspection of the site. Alternately, collect asbestos material on ground surface and dispose in an approved manner.

Samples: None

| | |
|---|---|
| Site No. 22: | Industrial Area Tank Farm |
| Problem: | Fuels amounting to 20,000 to 50,000 gallons leaked into soils around tank farm. There is potential migration to ground water. |
| Goal: | Determine whether fuel is present in soils of the tank farm area and assess potential movement into ground water. |
| Approach: | Sample soils around perimeter of tank farm. Sample Well No. 602, which is 1,100 feet downgradient and pumping. |
| Wells: | Use existing Well No. 602. |
| Samples: | Soil cores at 5 places around tank farm perimeter. Obtain cores at 1- to 2-foot intervals down to 1 foot into the water table. |
| Frequency: | Soils--once; well water--twice separated by 2 to 3 months |
| Analyses: | Oil and grease, lead, and volatile hydrocarbons |

Site No. 24: Industrial Area Fly Ash Dump

Problem: Disposal of fly ash, sludges from water and wastewater treatment plants, and solvents has occurred. There is potential for migration to ground water and/or surface water.

Goal: Determine whether hazardous wastes are present and assess potential for migration.

Approach: Conduct an inspection of the site to determine boundaries. Install wells and sample ground water. Sample sediments and water in adjacent creek.

Wells: Install three wells at the downgradient edge of the site and one upgradient to establish background.

Samples: From each well. Creek sediments: at site and 100 yards downstream. Creekwater: at site.

Frequency: Wells: Two times separated by 2 months in wet season. Sediments and water: once.

Analyses: Surface water: Specific conductance, pH, heavy metals, oil and grease, TOC. Groundwater: volatile organic solvents plus others. Static water levels in wells referenced to common datum. Sediments: metals only.

Site No. 28: Hadnot Point Burn Dump

Problem: Domestic and industrial wastes were disposed of at this site.

Goal: Determine whether hazardous wastes are present and assess potential for migration. Check on potential impacts on recreational pond.

Approach: Conduct a careful inspection of the site to better define boundaries. Install wells and sample surface water and sediment in Cogdels Creek. Determine if individual persons eat fish often from pond. If so, sample fish for chlorinated organic compounds.

Wells: Upgradient for background; one well downgradient of the dump on the east side of Cogdels Creek; three wells downgradient of the dump and adjacent of the New River.

Samples: Each well. Water column and sediment from three creek locations: (1) upstream of dump, (2) adjacent to dump area, and (3) downstream at the mouth of Cogdels Creek.

Frequency: Wells, water column, and sediment: Twice separated by 2 months during wet season.

Analyses: Water: specific conductance, oil and grease, pH, metals, PCB, pesticides, TOC; sediment: oil and grease, metals, PCB, pesticides; in wells: water level referenced to common datum.

Site No. 30: Sneads Ferry Road Fuel Tank Sludge Area

Problem: Sludge or bottom deposits from a large fuel tank were disposed of on the ground.

Goal: Determine whether hazardous waste is present and migrating toward ground water

Approach: Define location of dumping. Sample soil for substantial residuals. Sample ground water toward Frenchs Creek.

Wells: Three downgradient toward Frenchs Creek

Samples: Each well. Cores at 5 places near dumping sites at surface.

Frequency: Well: Twice separated by 2 to 3 months. Cores: once.

Analyses: Specific conductance, oil and grease, tetraethyl lead

Site No. 35: Geiger Area Fuel Farm

Problem: Fuel spills have contaminated soils. There is a possibility of groundwater contamination.

Goal: Determine if soils and ground water remain contaminated with Mogas.

Approach: Sample soil between leak and Brinson Creek to assess extent of contamination, if any remains, and to assess potential for movement into Brinson Creek. Surface gradient to creek is near due east; however, exact path of spill migration is not documented. Therefore, sample soil at points along the topographic gradient, but at locations either side of the gradient line passing directly through the leak.

Samples: Collect soil cores down to 1 foot below water table at 1- to 2-foot increments. Establish a line parallel to the gradient passing through the leak. Establish three perpendicular cross-lines along the line: near leak, near creek, and intermediate. At each cross-line core, take two cores, one 50 to 100 feet on each side original line.

Frequency: Once

Analyses: Oil and grease, lead

| | |
|---|---|
| Site No. 36: | Geiger Area Sewage Treatment Plant Dump |
| Problem: | Industrial wastes may have been disposed of at this site. |
| Goal: | Determine whether hazardous wastes are present and if migration has occurred |
| Approach: | Establish monitor wells to document groundwater quality |
| Wells: | Four downgradient, close to boundary, surrounding mound north through east to south. |
| Samples: | Each well |
| Frequency: | Twice separated by 2 to 3 months |
| Analyses: | Specific conductance, pH, oil and grease, metals, TOC, pesticides, herbicides |

Site No. 41: Camp Geiger Dump (Trailer Park)

Problem: Industrial wastes may have been dumped here. Potential contamination of ground water and two small tributaries in Southwest Creek.

Goal: Determine whether ground water is contaminated and if migration has occurred toward nearby water surface.

Approach: Test Well Nos. 18, 19, 20, and 21 are reported to be in place. Determine adequacy of construction (see Appendix B) and location of these wells. At least three wells should be downgradient. One upgradient can be used for background water quality if other nearby wells do not provide sufficient background information. If any existing wells are found unsuitable, then casings should be removed and holes plugged. Downgradient wells should address potential movement to each small tributary and wetland.

Wells: As noted above

Samples: Each well

Frequency: Twice in a 3-month period during wet season

Analyses: Specific conductance, pH, oil and grease, metals, TCE, pesticides, PCB; water levels referenced to common datum.

| | |
|---|---|
| Site No. 45: | Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm at Air Station |
| Problem: | Potential migration and groundwater contamination from fuels |
| Goals: | Determine if JP has contaminated soils outside of fuel farm, groundwater, or surface drainage. Determine extent of contamination of soil and surface drainage due to Avgas leak. |
| Approach: | Sample soils near both sites to define extent of impact. Sample surface drainage canal which parallels roadway south (downgradient) of fuel farm. This ditch should intercept most surface and subsurface flow southward. Sample Well No. 4140, which is about 700 to 800 feet downgradient of sites and lies near the drainage ditch/canal. |
| Wells: | Existing Well No. 4140 |
| Samples: | Well: quarterly. Drainage ditch/canal: sediments near sites on Campbell Street, near Well No. 4140, and south of Schmidt Street (i.e., about 3,000 feet from site). |
| Frequency: | Soils: once. Well No. 4140: quarterly |
| Analyses: | Oil and grease; volatile hydrocarbons; static and dynamic water levels referenced to datum. |

Site No. 48: MCAS Mercury Dumpsite

Problem: Metallic mercury may have been dumped over a 10-year period behind Building 804. No evidence has been found to indicate a central disposal place. It is summized that disposal occurred at random places with each place containing relatively small amounts of mercury.

Goal: Determine whether mercury is in ground water near river.

Approach: Install wells in line parallel to river. About 100 feet of shoreline is involved. Well spacing should be relatively close due to potential for several pockets of mercury to exist. Elaborate wells are not needed because mercury is only consitutent of interest.

Wells: Install four to six simple monitoring wells

Frequency: Initial sampling, sampling 6 months later, followed by annual sampling

Analyses: Total mercury

| | |
|---|---|
| Site No. 54: | Crash Crew Fire Training Burn Pit at the Air Station |
| Problem: | Contaminated fuels and various POL compounds used for training purposes. Spills may have contaminated the soils. |
| Goal: | Determine whether soils in immediate area of site are contaminated and if there is potential for POL to enter ground water. |
| Approach: | Sample soil in immediate area. |
| Wells: | None |
| Samples: | Cores should be deep enough to extend 1 foot into groundwater table. Take examples at 1- to 2-foot intervals at five places west and northwest of pit. |
| Frequency: | Once |
| Analyses: | Oil and grease, lead |

Site No. 68: Rifle Range Dump

Problem: Solvents disposed of at this site which may be affecting nearby potable wells.

Goal: Determine if POL compounds or solvents are present and have moved upgradient to threatened potable wells.

Approach: Establish test wells upgradient and downgradient of dump site to be sampled in conjunction with nearby water supply wells. Upgradient wells used to assess possible migration rather than to document background.

Wells: Three downgradient of dump site to determine whether pollutants have moved toward Stones Creek. Three wells upgradient between dump site and Well Nos. RR-45 and RR-97.

Sampling: Each well

Frequency: Test wells to be sampled twice separated by 2 or 3 months. Well Nos. RR-45 and RR-97 to be sampled quarterly.

Analyses: Volatile organic compounds, oil and grease, static and dynamic water levels referenced to datum.

Site No. 69: Rifle Range Chemical Dump

Problem: Hazardous wastes of various types buried here over a period of years

Goal: Determine whether wastes are migrating to ground water in sufficient quantities to cause risk to health.

Approach: Consider suitability of old monitor wells. They may need to be properly sealed from surface water runoff. Another option is to take wells out, plug holes, and put in properly installed wells. Use additional downgradient wells because of multidirectional drainage. Upgradient wells (at site) are of questionable value due to topography. Document background from off-site wells. Sample some nearby surface seeps.

Wells: Five downgradient

Samples: Each well. Two or three seeps northward.

Frequency: Wells: Quarterly. Seeps: Twice, 6 months apart.

Analyses: Specific conductance, pH, oil and grease, DDT, organochlorine pesticides, PCBs, purge and volatile hydrocarbon analysis, pentachlorophenol, HTC, mercury; water levels referenced to common datum.

# 5.0 BACKGROUND

## 5.0 BACKGROUND

### 5.1 GENERAL

Camp Lejeune is on the coastal plain in Onslow County, North Carolina. The facility covers approximately 170 square miles and is bisected by the New River, which flows in a generally southeasterly direction. This system forms a large estuary before entering the Atlantic Ocean.

Eleven miles of Atlantic shoreline form the eastern boundary of Camp Lejeune. The western and northeastern boundaries are U.S. 17 and State Road 24, respectively. Jacksonville, North Carolina, acts as the northern boundary. The complex has a roughly triangular outline.

Development at the Camp Lejeune complex is primarily in five geographical locations under the jurisdiction of the base command. They include Camp Geiger, Montford Point, Mainside, Courthouse Bay, and the Rifle Range area. New River Air Station, a helicopter base, is a separate command on the west side of New River. There are also two OLFs under control of New River Air Station. These are HOLF Oak Grove, approximately 25 miles to the north, and OLF Camp Davis, 10 miles to the southwest (NAVFACENGCOM, 1975).

Northwest of the base, 2,672 acres have been used for the air station. In the past, training was carried out for fixed-wing aircraft. Presently, only helicopter training occurs here.

Northwest of Camp Lejeune is HOLF Oak Grove. The field is no longer active and is under caretaker status. The property has some camping facilities and occasionally is used for recreation by scouting groups. Infrequent use is also made for ground troop exercises and helicopter landings. Oak Grove is on 976 acres in eastern Jones County.

Within 15 miles of Camp Lejeune are three large, publicly owned tracts of land--Croatan National Forest, Hofmann Forest, and Camp Davis Forest. Because of the low elevations in the coastal plain, wetlands form significant acreage. These areas, to some extent, have been exploited by agricultural and silvicultural interests. There is a growing concern on a state and national level that these ecosystems, unique to the coastal plain, require a protected status to survive.

For the most part, remaining land use is agricultural. Typical crops are soybeans, small grains, and tobacco.

Productive estuaries along the coast support commercial finfish and shellfish industries. Increased leisure time has boosted tourism and enlarged resort residential areas. This, in turn, has stimulated the regional economy.

According to the most recent master plan (NAVFACENGCOM, 1975), there are two major corridors of developable land in the area. These extend south from New Bern along U.S. 17 and U.S. 58, and from Swansboro northwest to Jacksonville and Richlands along Routes 24 and 258. The principal economic base is Camp Lejeune and associated military activities. More then 46,000 military personnel are stationed at the base, and more than 110,000 people are either employed or are eligible for support (NAVFACENGCOM, 1975).

## 5.2 HISTORY

Site selection for "The World's Most Complete Amphibious Training Base" was made in the 1940s. Construction of the camp began in 1941 after extensive land acquisition and was named in honor of Lieutenant General John A. Lejeune, USMC (Odell, 1970).

During construction, 9 million board feet of timber were harvested from the reservation. In 1944, a sawmill with a daily capacity of 10,000 board feet was being operated by base maintenance personnel. The sawmill closed in 1954, when lumber needs were filled by contract.

Construction of the base started on Hadnot Point, where the major functions were centered. As the facility grew and developed, Hadnot Point became crowded with maintenance and industrial activities. The problem led to the creation of a master plan that addressed these and other present and potential problems.

During World War II, Camp Lejeune was used as a training area to prepare Marines for combat. This has been a continuing function of the facility during the Korean and Vietnam conflicts. Toward the end of World War II, the camp was designated as a home base for the Second Marine Division. Since that time, FMF units also have been stationed here as tenant commands.

By 1945, construction in the Montford Point, Camp Geiger, and Courthouse Bay areas was complete. Montford Point, originally designated for training of black troops, now is used for Marine Corps Service Support Schools. In the 1940s, recent recruits from Parris Island received tactical training at Camp Geiger. This practice has been discontinued, however. Courthouse Bay hosts amphibious training, while Paradise Point is still the site of housing commissioned personnel. Noncommissioned housing is provided in Tarawa Terrace I and II, Midway Park, and other designated areas.

The U.S. Naval Hospital opened in 1943 and has served military personnel during World War II and the Korean War. In addition, the hospital provides medical services for all assigned military personnel and their dependents. It once operated as a 500-bed unit, but has become obsolete, and a new medical center is under construction along Brewster Boulevard (NAVFACENGCOM, 1975).

MCAS New River was set up as a separate command in 1951. At that time, it was called Peterfield Point, but the name was changed to New River in 1968. In 1942, three new runways were added and the station came under the jurisdiction of MCAS Cherry Point. During this time, a PBJ squadron was based here and the facility was also used for glider training (NAVFACENGCOM, 1975). During the Korean War, it was used as a helicopter training base and for touch-and-go training for jet fighters (Natural Resource Management Plan, 1975).

In 1968, MCOLF Oak Grove was placed under the jurisdiction of MCAS New River. The field was used as a helicopter base and renamed HOLF Oak Grove. During World War II, the field was under the command of MCAS Cherry Point. At the end of that war, all structures were destroyed with the exception of the runways.

## 5.3 PHYSICAL FEATURES

### 5.3.1 Climatology

The coastal plain area of Camp Lejeune is influenced by mild winters. Summers are humid with typically elevated temperatures. Rainfall usually averages more than 50 inches per year. Winter and summer are the usual wet seasons. Temperature ranges are reported to be 33°F to 53°F during January and 71°F to 88°F in July (Odell, 1970).

Winds during the warm seasons are generally south-southwesterly while north-northwest winds predominate in winter. There is a relatively long growing season of 230 days. A summary of regional climatic conditions is shown in Figure 5-1.

### 5.3.2 Topography

The generally flat topography of the Camp Lejeune complex is typical of the seaward portions of the North Carolina coastal plain. Elevations on the base vary from sea level to 72 feet above msl; however, the elevation of most of Camp Lejeune is between 20 and 40 feet above msl. The coast is guarded by a 200- to 500-foot-wide barrier island complex. Elevations of the dune field on the barrier islands range from 10 to 40 feet above msl. Drainage at Camp Lejeune is predominately toward the New River, although areas near the coast drain directly toward the Atlantic Ocean through the Intracoastal Waterway. In developed areas, natural drainage

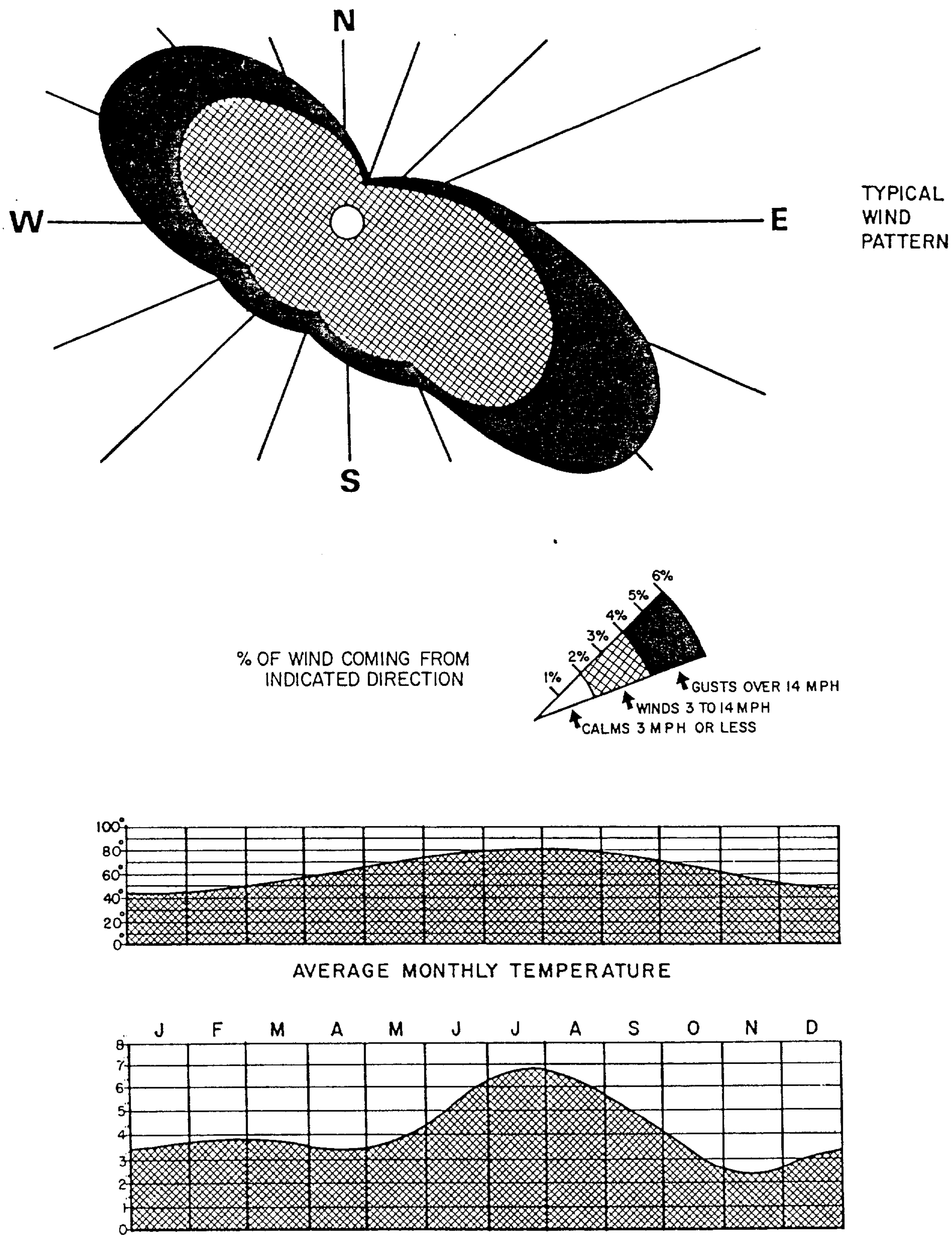



FIGURE 5-1. Regional Climatic Conditions in the Vicinity of MCB Camp Lejeune

SOURCE: MASTER PLAN CAMP LEJEUNE, NORTH CAROLINA, 1979 has been changed by drainage ditches, storm sewers, and extensive concrete and asphalt areas. Drainage sub-basins for Hadnot Point area and MCAS New River are shown in Figures 5-2 and 5-3, respectively. Most sites evaluated in this study are in these two areas.

Approximately 70 percent of Camp Lejeune is in the broad, flat interstream areas (Atlantic Division, 1965). Drainage here is poor, and the soils are often wet.

Flooding is a potential problem for base areas within the 100-year floodplain. The U.S. Army Corps of Engineers has mapped the limits of 100-year floodplain at Camp Lejeune at 7.0 feet above msl in the upper reaches of the New River (Natural Resource Management Plan, 1975). The elevation of the 100-year floodplain increases downstream and is 11.0 feet msl on the open coast.

### 5.3.3 Geology

MCB Camp Lejeune is in the Atlantic Coastal Plain physiographic province. The geology of this area is typically a seaward-thickening wedge of sediments (Figures 5-4 and 5-5) on a basement complex of igneous and metamorphic rock similar to that at the surface in the Piedmont physiographic province. Sediments of the coastal plain vary in age from Cretaceous to Recent and consist of layers of sand, silt, clay, marl, limestone, and dolostone.

A mantle of Pleistocene and Recent sands and clays commonly covers the older sediments of the area. Beneath this mantle is a belted subcrop pattern with Cretaceous sediments nearest the surface in the west and progressively younger sediments nearest land surface toward the coast (Figure 5-6).

Although the sedimentary sequence is approximately 1,400 to 1,700 feet thick beneath MCB Camp Lejeune, only the uppermost 300 feet are pertinent to the purpose of this report. Because these strata contain the important water-bearing rocks at Camp Lejeune.

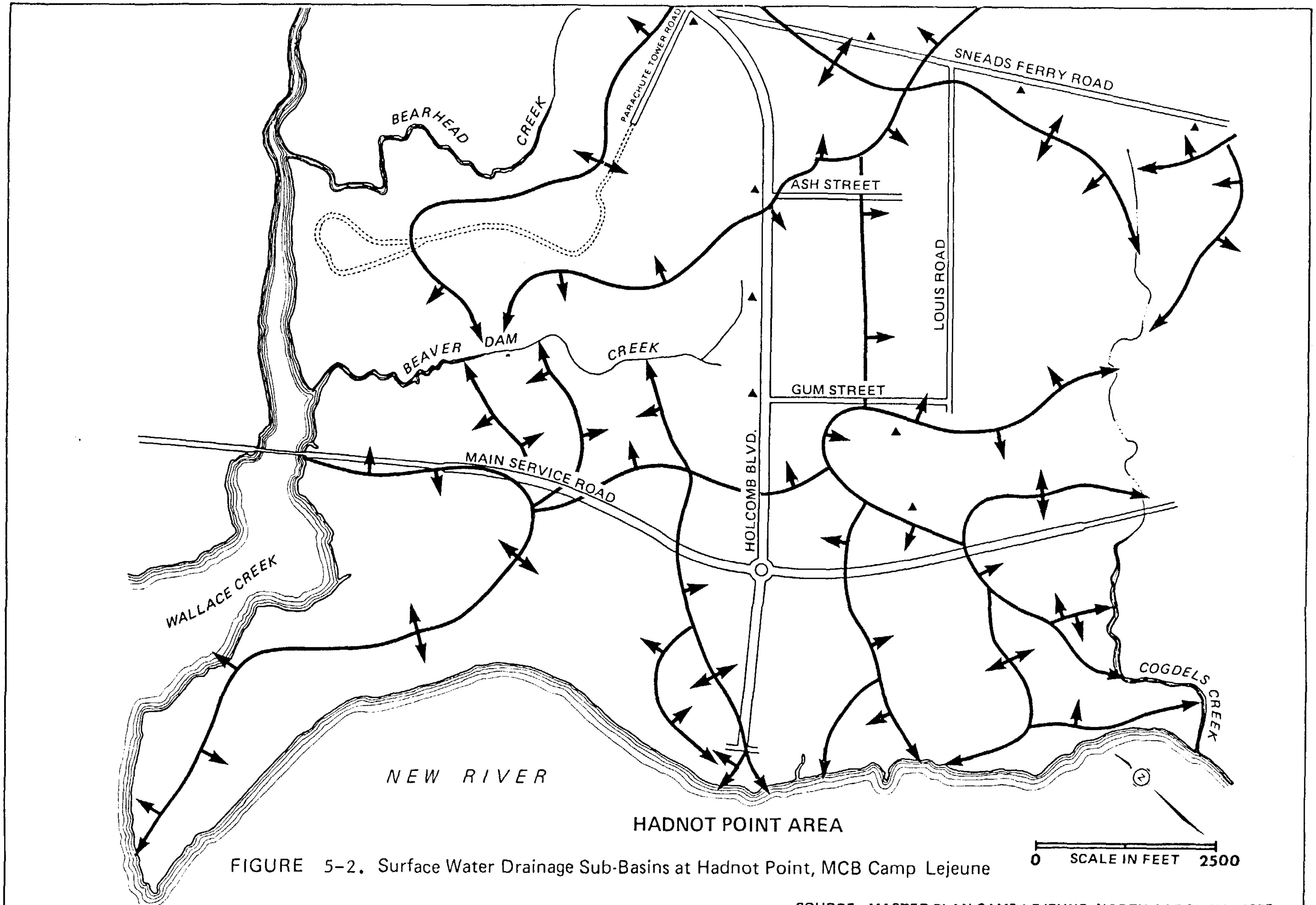



FIGURE 5-2. Surface Water Drainage Sub-Basins at Hadnot Point, MCB Camp Lejeune

SOURCE: MASTER PLAN CAMP LEJEUNE, NORTH CAROLINA, 1975

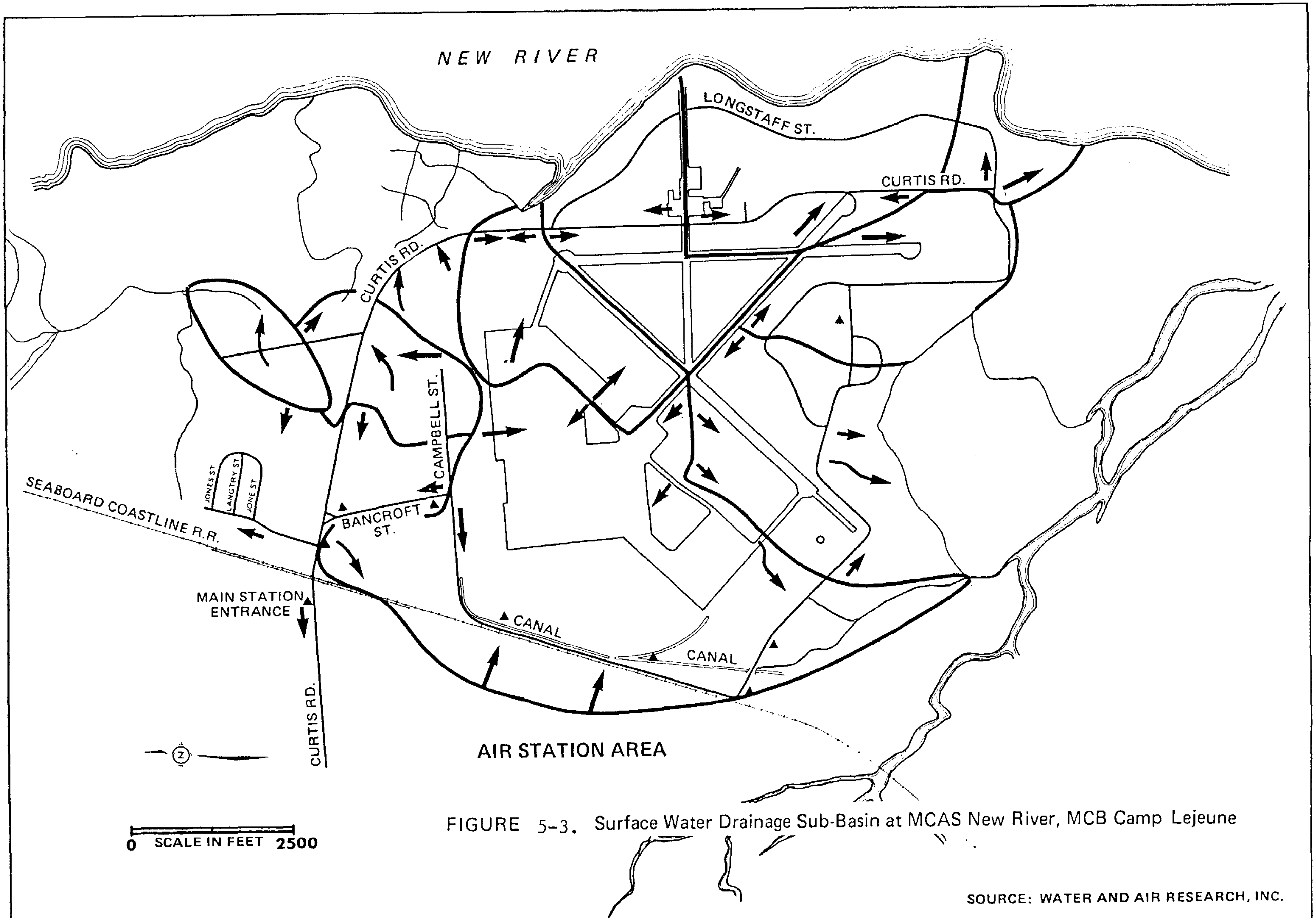
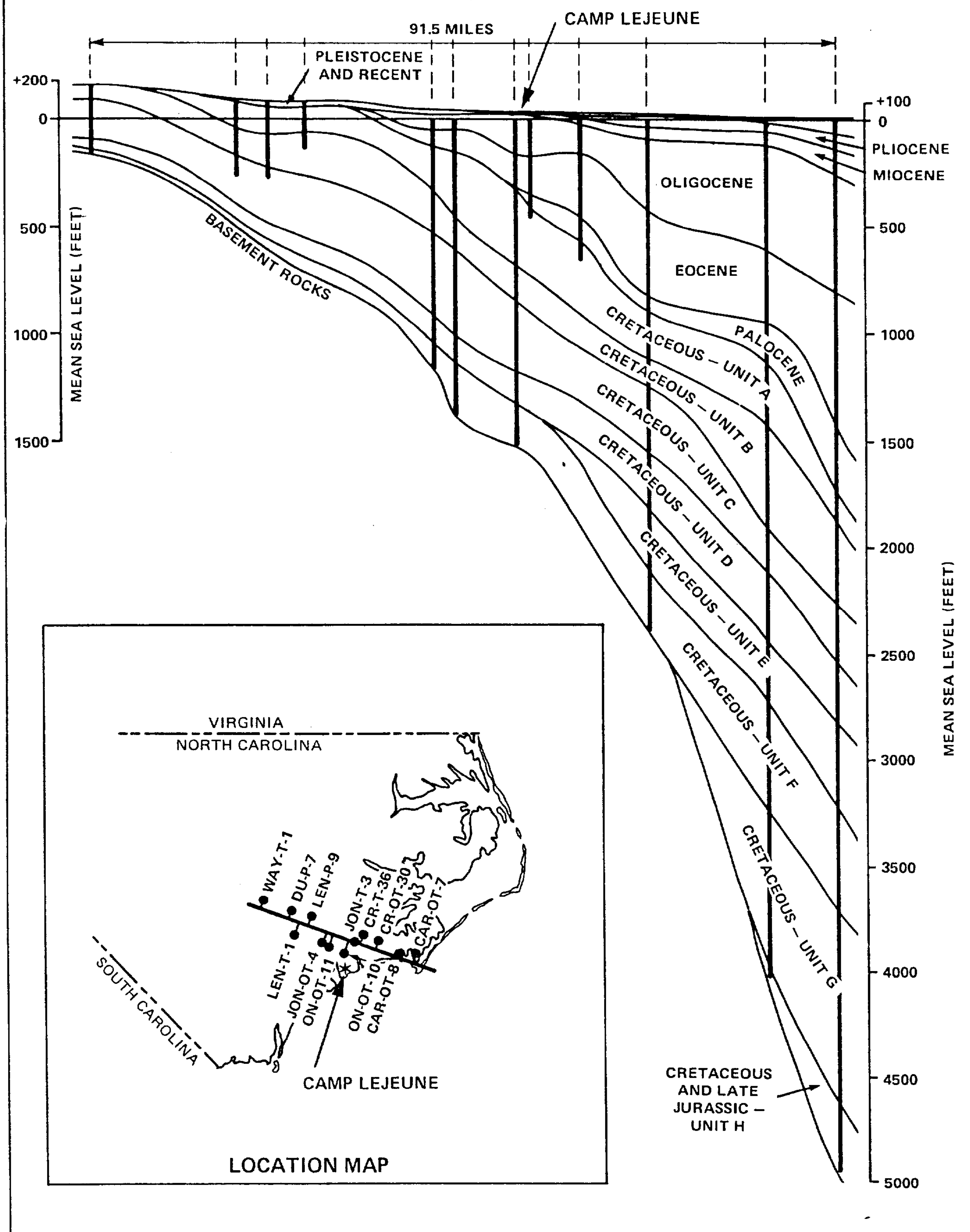



FIGURE 5-3. Surface Water Drainage Sub-Basin at MCAS New River, MCB Camp Lejeune

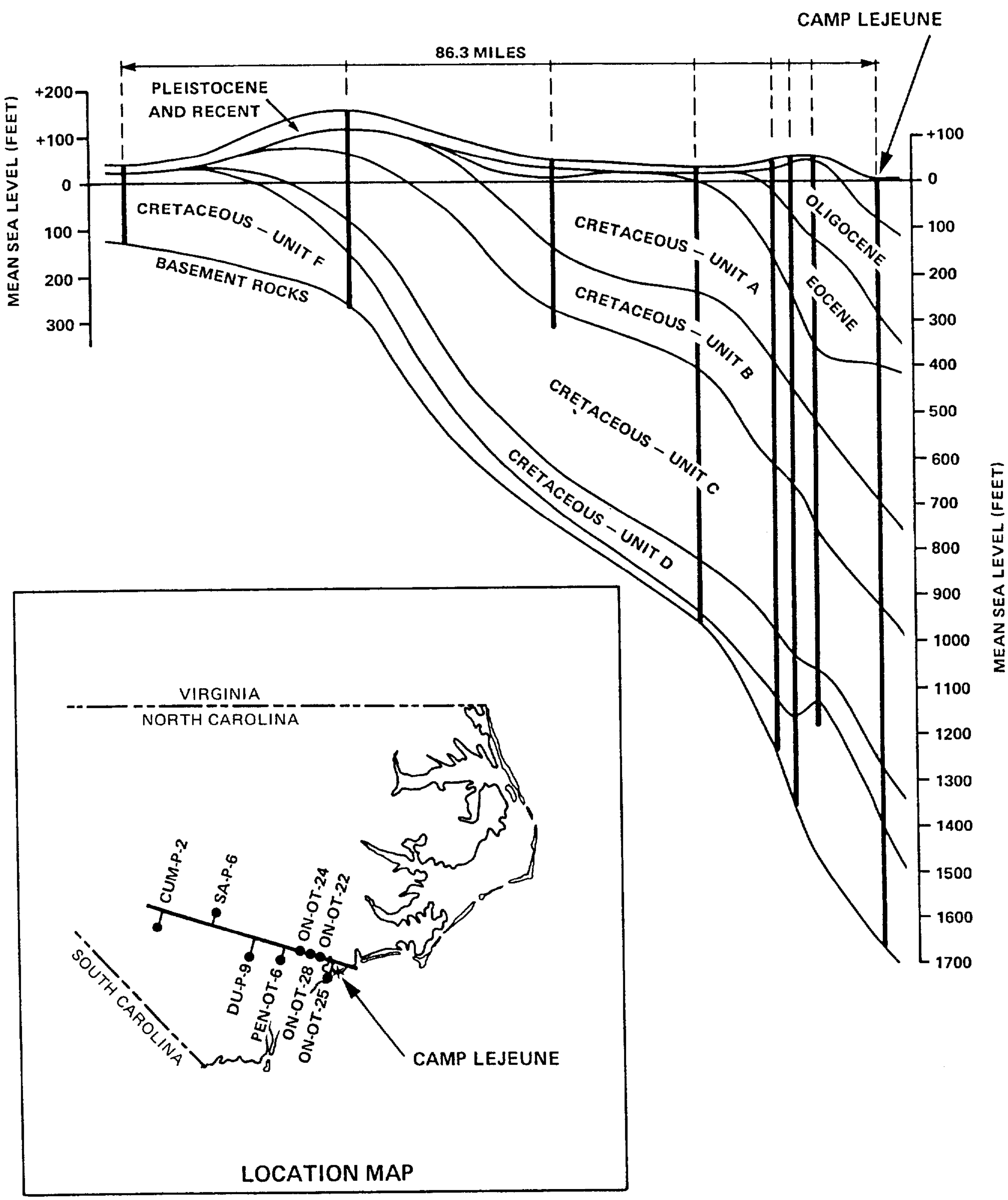
SOURCE: WATER AND AIR RESEARCH, INC.

FIGURE 5-4. Geologic Cross Section from Wayne County, N.C. to Carteret County, N.C.




SOURCE: BROWN, ET AL., 1972

FIGURE 5-5. Geologic Cross Section from Cumberland County, N.C. to Onslow County, N.C.




SOURCE: BROWN, ET AL., 1972

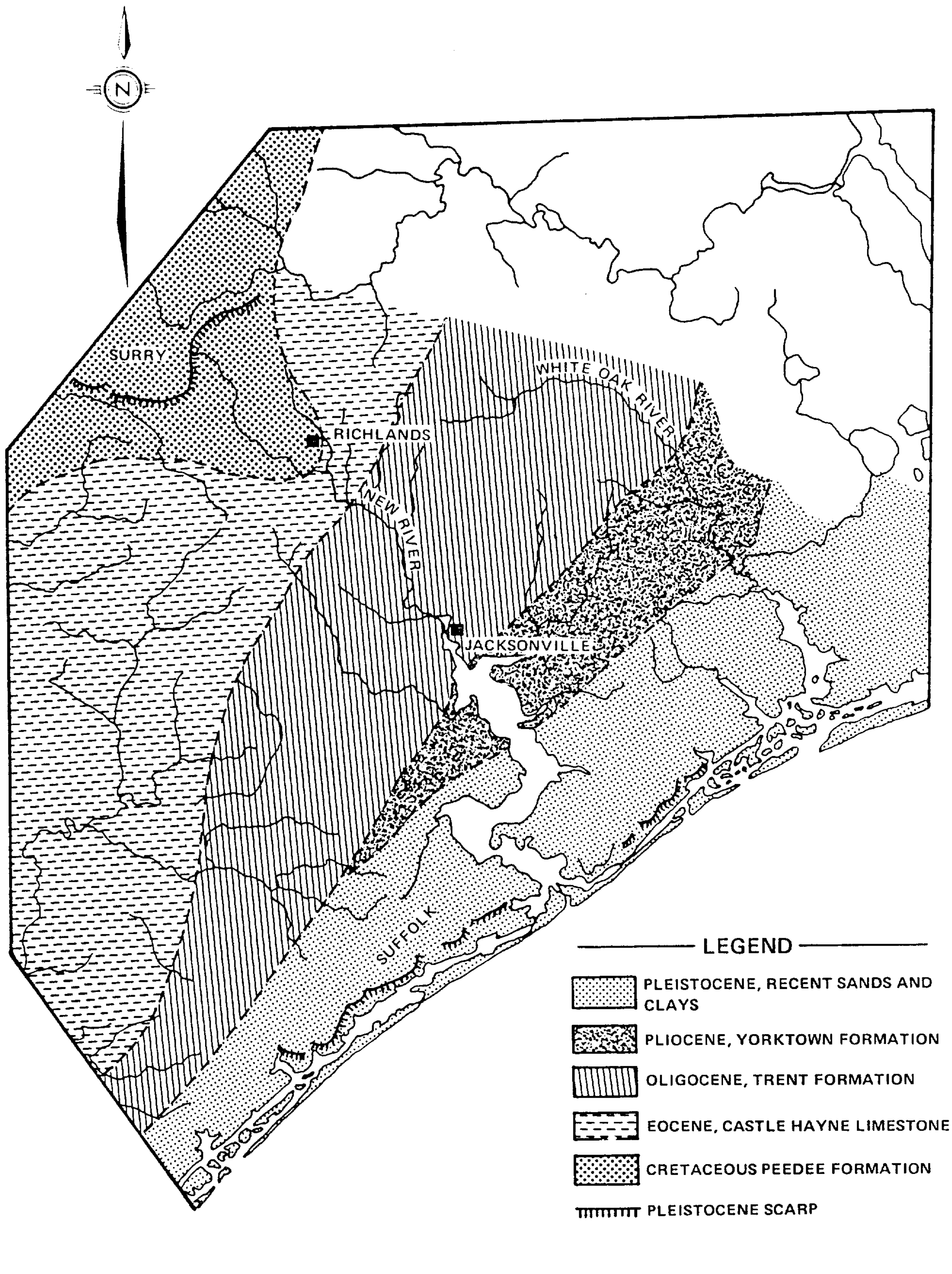



FIGURE 5-6. New River Area Geology

SOURCE: BURNETTE, 1977

The Eocene Castle Hayne Limestone consists of shell limestone, marl, calcareous sand, and clay. In Onslow County, the Castle Hayne varies in thickness from approximately 100 feet to more than 200 feet. Rocks of Oligocene age unconformably overlie the Castle Hayne. These sediments consist of fossiliferous limestone, calcareous sand, and clay and are equivalent to the Trent Formation according to recent correlation charts (Baum, et al., 1979). In the subsurface of Onslow County, rocks of Oligocene age vary from approximately 40 feet to more than 200 feet thick (Brown, et al., 1972).

The Yorktown Formation overlies the Oligocene and outcrops in a band east and south of Jacksonville. This unit consists of lenses of sand, clay, marl, and limestone. The Yorktown Formation has long been considered Late Miocene, but the latest correlation charts (Baum, et al., 1979a&b) date it in the Pliocene.

Pleistocene and Recent sands and clays mantle the older stratigraphic units in most of the study area and form the most seaward band of sediments. These sediments were deposited in Pleistocene and Recent time, when the retreat of continental glaciers raised sea levels.

### 5.3.4 Hydrology

5.3.4.1 Surface Water--The dominant surface water feature at Camp Lejeune is the New River. It receives drainage from most of the base. The New River is short, with a course of approximately 50 miles on the central coastal plain of North Carolina. Over most of its course, the New River is confined to a relatively narrow channel entrenched in the Eocene and Oligocene limestones. South of Jacksonville, the river widens dramatically as it flows across less resistant sands, clays, and marls (Burnette, 1977). At Camp Lejeune, the New River flows in a southerly direction and empties into the Atlantic Ocean through the New River Inlet. Several small coastal creeks drain the area of Camp Lejeune that is not drained by the New River and its tributaries. These creeks flow into the Intracoastal Waterway, which is connected to the Atlantic Ocean by Bear Inlet, Brown's Inlet, and the New River Inlet.

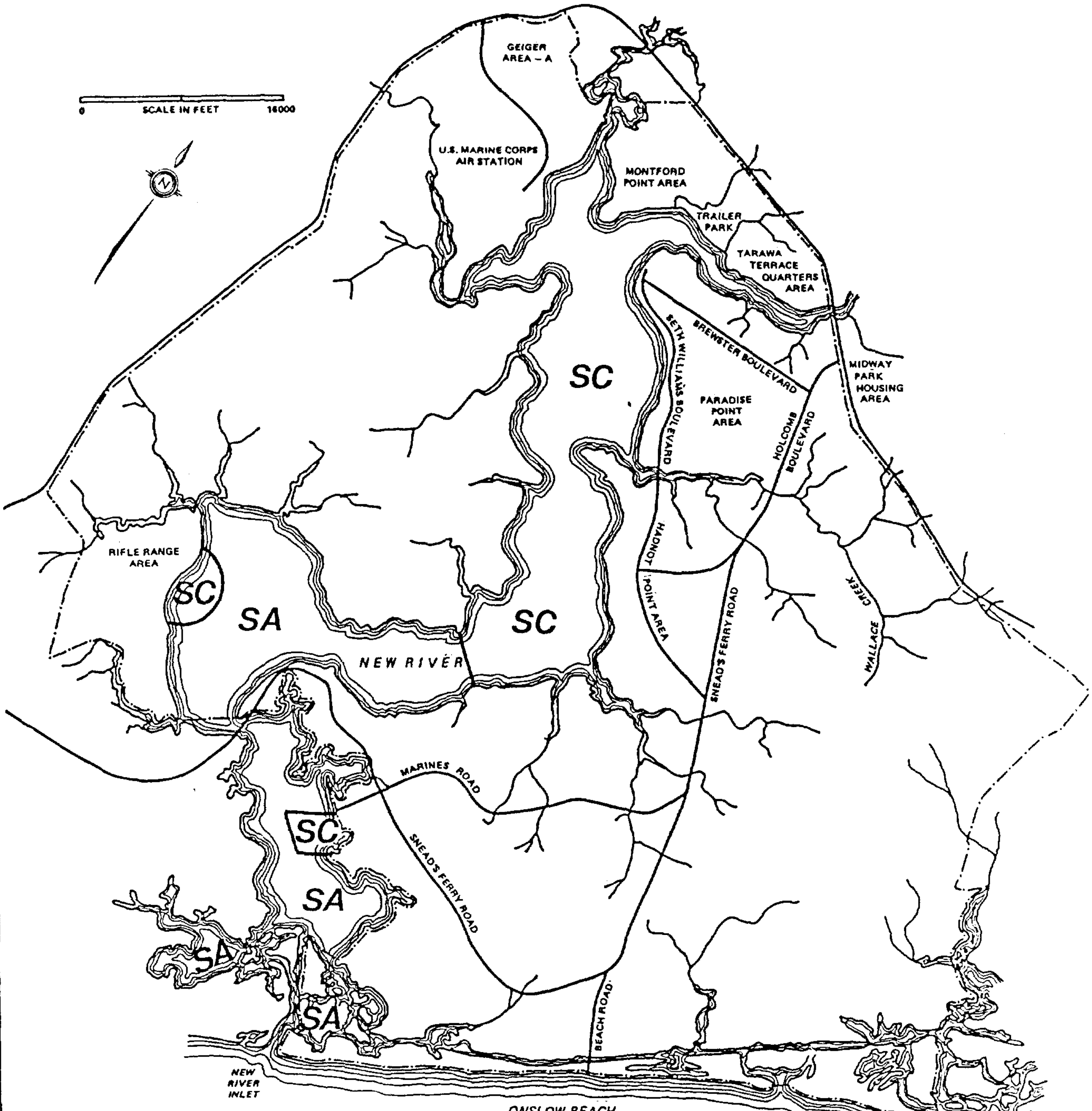
Wilder, et al. (1978) state the standard streamflow measurements employed by the U.S. Geological Survey are not applicable in low-gradient, tidal conditions. This is probably why streamflow in the New River below Jacksonville has not been determined. The tides at New River Inlet have a normal range of 3.0 feet and a spring range of 3.6 feet (U.S. Department of Commerce, 1979). The tidal range diminishes upstream to approximately 1 foot at Jacksonville (Howard, 1982). The flood tidal prism entering the New River Inlet in one tidal cycle was determined to be approximately $2.35 \times 10^5$ $ft^3$ (Burnette, 1977).

The average annual runoff of the Camp Lejeune area has not been determined; however, Craven and Carteret Counties, to the northeast, have an average annual runoff of approximately 18 inches. The groundwater contribution to runoff in the same area northeast of Camp Lejeune is estimated as 65 percent of total runoff (Wilder, et al., 1978).

The water in the New River at Camp Lejeune is brackish, shallow, and warm. Salinity is largely a function of distance from the ocean and rainfall. At Jacksonville, New River may reach salinities of 10 parts per thousand (ppt) during extended periods of low rainfall. However, near the New River Inlet, salinity in the river is usually equivalent to that of sea water (35 ppt). Salinities near the inlet become significantly lower only during heavy rains (Burnette, 1977).

Water quality criteria for surface waters in North Carolina have been published by the state under Title 15 of the North Carolina Administrative Code. The New River at Camp Lejeune falls into two classifications (Figure 5-7). Classification SC applies to three areas of the New River at Camp Lejeune. The best usage of Class SC waters is "fishing, secondary recreation, and any other usage except primary recreation or shellfishing for market purposes." The rest of the New River at Camp

FIGURE 5-7. Water Quality Classifications for the New River at MCB Camp Lejeune




LEGEND

**SC** ESTUARINE WATERS NOT SUITED FOR BODY CONTACT SPORTS OR COMMERCIAL SHELLFISHING

**SA** ESTUARINE WATERS SUITED FOR COMMERCIAL SHELLFISHING

SOURCE: NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES, 1977

Lejeune is Class SA, the highest estuarine classification. The best usage of Class SA waters is "shellfishing for market purposes and any other usage specified by the SB or SC classification."

5.3.4.2 Ground Water

The uppermost 300 feet of sediments at Camp Lejeune is the source of base fresh water. Brackish water is usually found deeper than 300 feet below msl (Shiver, 1982). In general, the aquifer system consists of a water table aquifer and one or more semi-confined aquifers. Confining beds lie between the two aquifer systems and between the layers of the semi-confined aquifers. Variations in the local hydrogeology result from the complex depositional history of the area.

The uppermost hydrogeologic unit, the water table aquifer, extends from land surface to the first confining bed. This aquifer consists of sand, silt, limestone, and small amounts of clay. These sediments are usually Pliocene and younger.

The water table aquifer is recharged when rainfall seeps into the ground and percolates into the zone of saturation. Depth to the zone of saturation is 10 feet or less at Camp Lejeune (Atlantic Division, 1965). Ground water in the water table aquifer generally flows from upland areas toward stream valleys where it discharges to surface water. In inter-stream areas, some ground water will flow from the water table aquifer to the first semi-confined aquifer as recharge given favorable hydraulic gradient and geology. Recharge of the semi-confined aquifer may be expressed using Darcy's Law as

$$Q = \frac{h_1 - h_2}{m} \; K \; A$$

where: $Q$ = Quantity of recharge per unit time,
$h_1$ = Hydraulic head in the water table aquifer,
$h_2$ = Hydraulic head in the semi-confined aquifer,
$m$ = Thickness of the confining bed,

k = Hydraulic conductivity of the confining bed, and
A = area for which recharge is calculated.

From this, it may be seen that ground water will flow from the upper aquifer to the lower aquifer only if the hydraulic head in the water table aquifer is greater than the hydraulic head in the semi-confined aquifer. The thickness and hydraulic conductivity of the confining bed retard the flow of water between the two aquifers.

The semi-confined aquifer is composed of limestone and calcarous sands of the Eocene Castle Hayne Limestone, the Oligocene Trent Formation, and in some places, sand and limestone of the Pliocene Yorktown Formation. Regional groundwater flow in the semi-confined aquifer is toward the southeast. The regional flow is altered locally by pumping wells that penetrate this aquifer.

Narkunas (1980) reported that transmissivity of the limestone aquifer in the central coastal plain of North Carolina varied from 6,100 $feet^2$/day to 12,100 $feet^2$/day. Storativity varied from $2.6 \times 10^{-3}$ to $7.4 \times 10^{-5}$. Specific capacity of wells at Camp Lejeune was reported as 5 to 10 gallons per minute per foot of drawdown (gpm/ft) in 1960 (LeGrand, 1960). Recent data indicate that the specific capacity of the wells tapping the semi-confined aquifer at Camp Lejeune varies from less than 3 gpm/ft to approximately 20 gpm/ft.

The confining units, where present, consist of clay, sandy clay, silty clay, and occasionally dense limestone. These units occur as discontinuous lenses and may be present at any depth. A comparison of the logs for Well Nos. HP-613 and HP-616 (Appendix D) shows a reduction in the thickness of the confining bed from 27 feet to 6 feet in less than 2,000 feet. Many of the well logs for the base indicate that the confining units are either thin or absent. Wells in these areas withdraw at least some water from the water table aquifer.

5.3.4.3 Migration Potential

There are three potential migration pathways at Camp Lejeune. In the first case, contaminants may be carried off-base by surface water drainage to the New River and its tributaries. The other two pathways are in ground water. Contaminants entering the water table aquifer may then migrate to surface water, or they may migrate down into the semi-confined aquifer. Some attenuation of contaminants, chiefly metallic tons, in ground water may be expected as a result of the adsorption of contaminants by clay minerals.

Surface water drainage is most rapid in the developed areas of the base where natural drainage has been modifed by ditches, storm sewers, and extensive areas of asphalt and concrete. Contaminants are most likely to be transported directly to surface drainage during periods of heavy rainfall. At other times, transport is likely to be to and through ground water, except in areas adjacent to surface streams.

The water table aquifer is highly susceptible to contamination because it is composed of predominantly permeable materials at the earth surface. If a site is near a surface water feature, contaminants in the water table aquifer, can be expected to move horizontally and toward the zone of discharge at the groundwater/surface water interface.

In the interstream areas (i.e., relatively distant from surface drainage), the horizontal component of flow will still tend to follow the topography, but under some circumstances a vertical flow may develop from the water table aquifer to the semi-confined limestone aquifer. These conditions depend on 1) a hydraulic gradient from the water table aquifer toward the semi-confined aquifer and 2) on the thickness and hydraulic conductivity of confining units. These factors are not well known at Camp Lejeune. What is known is that conditions vary with locations.

In some areas, contamination of lower aquifers is very unlikely. For example, at Georgetown, near Camp Geiger area, the hydrogeology tends to prevent migration of water from the water table aquifer to the deeper aquifer (Division of Environmental Management, 1979). This is because the confining zone is approximately 50 feet thick and the hydraulic gradient is from the limestone aquifer toward the water table aquifer. These same conditions may be present in parts, but not all, of Camp Lejeune.

Variability of the confining units decreases assurance of protection of the semi-confined limestone aquifer. Furthermore, although the hydraulic gradient between water table and semi-confined aquifers is unknown at Camp Lejeune, large-scale withdrawals of ground water necessary to supply the base with water may have produced an overall decline of pressure in the semi-confined aquifer. This decreases the ability to assume no contaminant movement to the deeper aquifer.

Another possible threat to groundwater quality at Camp Lejeune is the unknown status of abandoned wells. If a well is not properly sealed when abandoned, it may become a pathway for contaminants. Conversations with personnel at base maintenance and the water treatment plant have indicated that there is no inventory of abandoned wells nor details of how they were closed.

## 5.4 BIOLOGICAL FEATURES

The three forest areas surrounding Camp Lejeune--Croatan, Hofmann, and Camp Davis--provide extensive wildlife habitat. Animal life includes deer, black bear, turkey, squirrel, quail, rabbits, raccoons, muskrat, mink, and otter. The creeks, bays, swamps, marshes, and pocosins provide habitat for many types of birds, including egrets, fly catchers, woodpeckers, hawks, woodcocks, owls, bald eagles, peregrine falcons, and osprey. Reptiles include alligators, turtles, and snakes. Several species of the latter group are venemous. Freshwater fish in the streams and lakes of the forests include largemouth bass, redbreast sunfish, bluegill, chain pickerel, warmouth, yellow perch, and catfish. Trees found in the forests include loblolly, pond, longleaf, and shortleaf pines; sweet gum, tupelo gum, yellow-poplar, oak, red maple, sweet bay, and loblolly bay. In the pocosin wetlands, there is generally a shrub understory of evergreen and deciduous species. Several unusual plant species also can be found, including pitcher plants, sundews, and Venus flytraps (Richardson, 1981; Yong, 1982; Wilson, 1982).

The Camp Lejeune complex is predominantly tree covered, with large amounts of softwood (shortleaf, longleaf, pond, and primarily loblolly pines) and substantial stands of hardwood species. Timber-producing areas are under even-aged management with the exception of those along major streams and in swamps. These areas are managed to provide both wildlife habitat and erosion control. Smaller areas are managed for the benefit of endangered or threatened wildlife species such as the red-cockaded woodpecker.

Of Camp Lejeune's 112,000 acres, more than 60,000 are under forestry management. At the forests' borders are several species of shrubs, vines, and herbs. Acidic soils host carnivorous plants, including pitcher plants, sundews, and Venus flytraps. Forest management provides wood production, increased wildlife populations, enhancement of natural beauty, soil protection, prevention of stream pollution, and protection of endangered wildlife species (Natural Resource Management Plan, 1975).

Wildlife management at Camp Lejeune is based on guidelines in the United States Forest Service Wildlife Management Handbook. Upland game species, including deer, black bear, gray squirrel, fox squirrel, quail, turkey, and waterfowl, are abundant and are considered in the wildlife management program. There is an attempt to coordinate forest and wildlife management. Wildlife management is accomplished in part by providing a variety of habitats, including forests, perennial grass clearings, small-game strips, wildlife food plots, planted forest access roads, and plantings of shrub and fruit trees which produce edible seeds and fruits. Figure 5-~~1~~ 8 presents the locations of wildlife food plots, fish ponds, wildlife openings, and small-game plots within the 14 wildlife units of

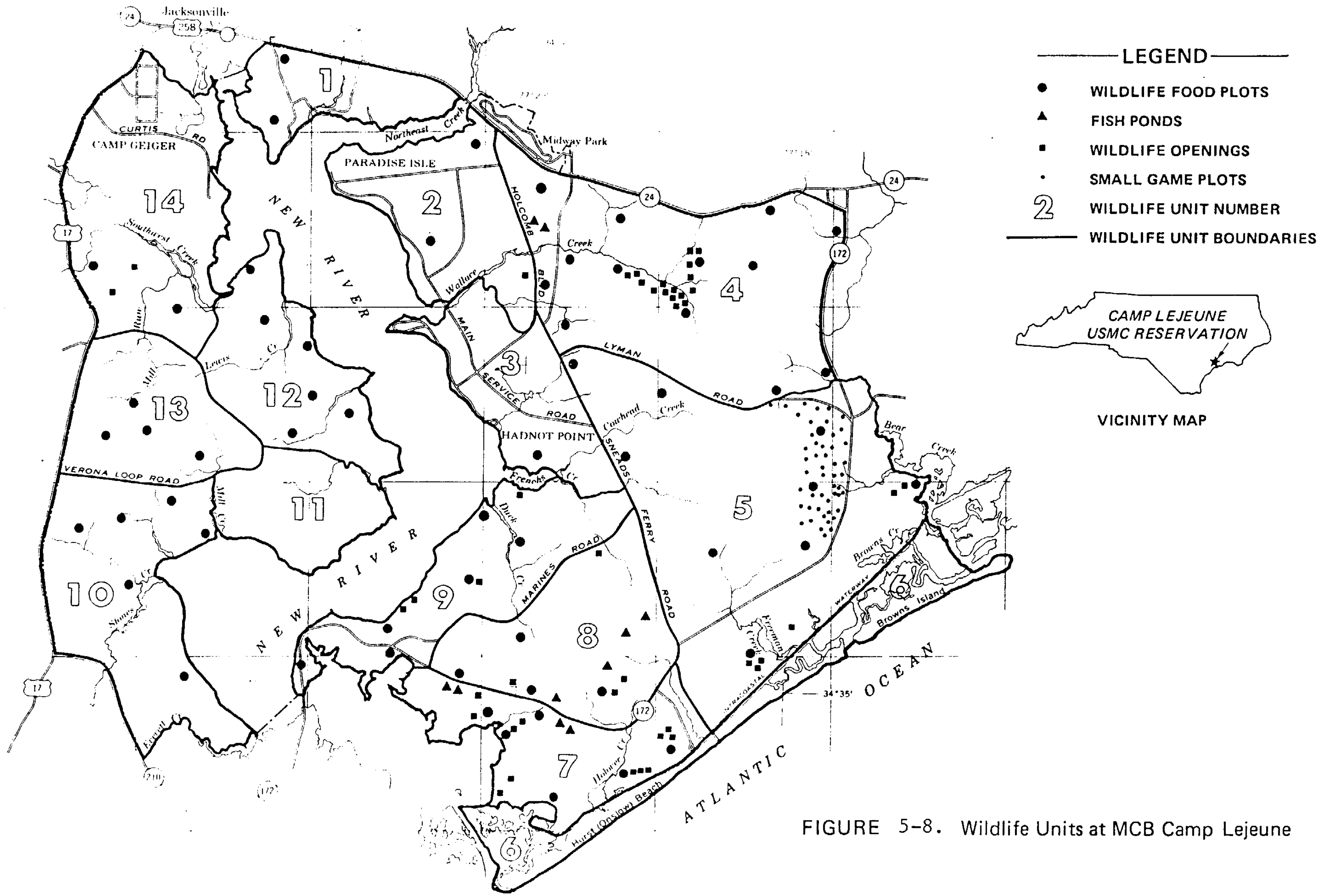



FIGURE 5-8. Wildlife Units at MCB Camp Lejeune

SOURCE: NATURAL RESOURCE MANAGEMENT PLAN CAMP LEJEUNE, NORTH CAROLINA, 1975 the complex (Natural Resource Management Plan, 1975; NAVFACENGCOM, 1975).

Ecosystems discussed in this report will be broken into terrestrial (or upland), wetland, and aquatic communities.

5.4.1 Terrestrial Ecosystems

Camp Lejeune contains four upland habitat types (Natural Resource Management Plan, 1975). These are:

1. Longleaf pine,
2. Loblolly pine,
3. Loblolly pine/hardwood, and
4. Oak/hickory.

5.4.1.1 Longleaf Pine--Longleaf is the principal pine species and occurs on higher upland sites. Turkey, blackjack, post, and willow oaks, along with red bay, holly, and black gum, are the associated species. Gallberry, yaupon, low-bush huckleberry, titi, and chinquapin are also common in the understory. Herbaceous species include teaberry, ferns, and sawgrass. Quail and fox squirrel are common in this habitat and wild turkey find this forest type quite conducive for nesting and brooding range.

5.4.1.2 Loblolly Pine--Loblolly pine is the main timber stand of the area and many now grow on old farm homesteads. Persimmon, black cherry, red cedar, holly, dogwood, and scrub oak are common, while huckleberry, chinquapin, gallberry, beauty-berry, and wax myrtle make up the understory. Weeds and herbaceous plants include pokeweed, ragweed, smartweed, beggarweed, and partridge pea. Deer, turkey, gray squirrel, and quail are common in this forest type, especially if clearings are provided or prescribed burning is done to improve food and cover for the above species.

5.4.1.3 Loblolly Pine/Hardwood--This mixed forest occurs above the hardwoods and just below the pure stands of loblolly pine. Sweet gum, black cherry, red cedar, holly, sweet bay, and dogwood trees are common, while high bush huckleberry, gallberry, and wax myrtle comprise the understory. Weeds and herbaceous plants include panic grass, broomsedge, pokeweed, partridge pea, and beggarweed. Gray squirrel, deer, and other small mammals are common here. The habitat is also conducive to wild turkey.

5.4.1.4 Oak/Hickory--This association is frequently found along streams and creeks below the loblolly/hardwood stands and above the bottomland hardwoods. White oak and southern red oak are the principal species. Black, post, chestnut, scrub oak; yellow poplar, sweet gum, black gum, persimmon, black cherry, maple, and dogwood also are common. Blueberry, chinquapin, and beauty-berry make up the understory. Herbaceous plants include ferns, teaberry, paspalums, and sedges. Wildlife frequently observed in this habitat include gray squirrel, wild turkey, deer, and wood duck. Black bears are also found here.

### 5.4.2 Wetland Ecosystems

Wetlands found in the coastal plain vary from those bordering freshwater streams and ponds to salt marshes along coastal estuaries. The most unusual wetland system is the pocosin, which has been referred to as a shrub bog by Christensen (1979). The term pocosin originates from an Algonquin Indian name meaning "swamp on a hill." Pocosins initially develop as wetlands formed in basins or depressions. The wetlands expand beyond the physical boundries of the depression as the peat retains water. Eventually, the wetland expands above the ground water, with peat acting as a reservoir, holding water by capillarity above the level of the main groundwater mass (Moore and Bellamy, 1974).

According to Richardson (1981), these evergreen shrub bogs comprise more than 50 percent of North Carolina's freshwater wetlands. Typically, these systems cover thousands of acres, are isolated from other water bodies, and periodically are subject to fire. Much of the pocosin habitat in North Carolina is gradually being lost to timber cutting or drainage with subsequent agricultural development. In 1962, for example, pocosins covered more than 2.2 million acres, but by 1979, only 695,000 acres remained undisturbed. Destruction of pocosins has resulted in changes of hydrologic regime, and nutrient export to other aquatic systems (Richardson, 1981).

A shrub understory with scattered emergent trees dominates pocosin vegetation. The most common species is pond pine. Other species include Atlantic white cedar, loblolly and longleaf pine, red maple, sweet bay, and loblolly bay (Christensen, et al., 1981.)

The characteristics of pocosin fauna are less well understood than those of the plant community. Wilbur (1981) notes that pocosins serve wildlife species two ways: They are habitat for endemic species, but also are refuge for those species which once ranged widely, but now are confined because of habitat destruction. Endemics include two vertebrates, the pine barrens treefrog and the spotted turtle. Small mammals and reptiles also are endemic to the pocosins. Such species as white-tailed deer and black bear also find refuge in the pocosins.

Wetland ecosystems on the Camp Lejeune complex can be separated into five habitat types (Natural Resource Management Plan, 1975).

1. Pond pine or pocosin,
2. Sweet gum/water oak/cypress and tupelo,
3. Sweet bay/swamp black gum and red maple,
4. Tidal marshes, and
5. Coastal beaches.

5.4.2.1 Pond Pine--This habitat (commonly known as pocosin or upland swamp) is dominated by pond pine with Atlantic white cedar, loblolly and longleaf pine, red maple, sweet bay, and loblolly bay also present as stated above. Understory plant species include greenbriar, cyrilla, fetter bush, and sheep laurel. Associated marsh and aquatic plants include mosses, ferns, pitcher plants, sundews, and Venus flytraps. Animals which can be frequently observed here include deer and black bear. Pocosins provide excellent escape cover for bear because pocosins are seldom disturbed by humans. The presence of pocosin-type habitat at Camp Lejeune is primarily responsible for the continued existence of black bear in the area. Many of the pocosins on the base are overgrown with brush and pine species that would be unprofitable to harvest.

5.4.2.2 Sweet Gum/Water Oak/Cypress and Tupelo--This habitat is found in the rich, moist bottomlands along streams and rivers and extends to the marine shoreline. Cypress dominate if water is present most of the year, while gums dominate if water availability is seasonal. Maple, black gum, hawthorn, sweet bay, red bay, and elm along with hornbeam, holly, and mulberry are also frequently present. Huckleberry, grape, and palmetto make up the understory. Deer, bear, turkey, and waterfowl (including woodcocks) are commonly found in this type of habitat.

5.4.2.3 Sweet Bay/Swamp Black Gum and Red Maple--As the name implies, sweet bay or swamp black gum and red maple are the dominant tree species in this floodplain habitat. Swamp tupelo, ash, and elm are also present. Greenbrier, rattan-vine, grape, and rose make up the understory. Fauna frequently found in this area include waterfowl, mink, otter, raccoon, deer, bear, and gray squirrel.

5.4.2.4 Tidal Marshes--The tidal marsh at the mouth of the New River on the Camp Lejeune complex is one of the few remaining North Carolina coastal areas relatively free from filling or other man-made changes. Vegetation consists of marsh and aquatic plants such as algae, cattails, saltgrass, cordgrass, bulrush, and spikerush. This habitat generously provides wildlife with food and cover. Migratory waterfowl, shorebirds, alligators, raccoons, and river otter are frequently seen within this habitat type.

5.4.2.5 Coastal Beaches--Coastal beaches along the Intracoastal Waterway and along the Outer Banks of Camp Lejeune are used for recreation and to house a small military command unit on the beach. The Marines also conduct beach assault training maneuvers from company-size units to combined 2nd Division, Force Troops, and Marine Air Wing units. These exercises involve the use of heavy equipment including AMTRACs. Training regulations presently restrict where heavy tracked vehicles are permitted to cross the dunes. These restrictions are intended to protect the ecologically sensitive coastal barrier dunes. The vegetation along the beaches includes trees (live oak and red cedar), woody plants (greenbrier, yaupon, holly, wax myrtle, and palmetto), and weeds and herbs (sea oats, beachgrass, butterfly pen, Virginia creeper, swamp mallow, and passion flower). Although in comparison to other types the coastal beaches are generally low in value to most game species, they serve as buffers to the mainland and provide habitat for many shorebirds.

### 5.4.3 Aquatic Ecosystems

Aquatic ecosystems on Camp Lejeune consist of small lakes, the New River estuary, numerous tributary creeks, and part of the Intracoastal Waterway. A wide variety of freshwater and saltwater fish species live here. A number of freshwater ponds are under management to produce optimum yields and ensure continued harvest of desirable fish species (Natural Resource Management Plan, 1975).

Principal freshwater game fish species in the ponds, creeks, and the New River include largemouth bass, bluegill, redear sunfish, warmouth, pumpkinseed, yellow perch, redfin pickerel, jack pickerel, and channel catfish. The New River estuary is used extensively for shellfishing, especially in the bays and protected areas of the river such as Stones Bay, Traps Bay, and Ellis Cove.

The Intracoastal Waterway cuts the southeast edge of Camp Lejeune. As it passes between the mainland and the barrier islands, the waterway carries a heavy flow of private pleasure boats during the summer and a steady flow of commercial barges year-round. A variety of saltwater fish is found in the Intracoastal Waterway and in the Atlantic Ocean adjacent to the base. These include flounder, weakfish, bluefish, spot, croaker, whiting, drum, mackeral, tarpon, marlin, and sailfish. Shellfish, represented by oysters, scallops, and clams, are also abundant (Natural Resource Management Plan, 1975; NAVFACENGCOM, 1975).

This part of the North Carolina coast is within the Atlantic flyway and many species of migrating birds pass through the region. Area habitats are used by migrating birds, and local species of shorebirds also employ the marsh areas as a nursery.

The long-range management plan for Camp Lejeune calls for recreational improvements and increased access along the New River and Intracoastal Waterway for the wildlife observer and photographer as well as the game hunter and fisherman (NAVFACENGCOM, 1975).

Regionally, the area is important because of the marine fisheries resource. At nearby Beaufort, Duke University has a marine laboratory. The National Marine Fisheries Service Center for Menhaden Research is also near Beaufort. The University of North Carolina Institute of Marine Sciences and the State of North Carolina Department of Natural Resources Division of Marine Fisheries are in Morehead City.

### 5.4.4 Rare, Threatened, or Endangered Species

The flora of North Carolina consists of approximately 3,400 taxa of vascular plants. The vertebrate fauna of over 865 species and subspecies includes 200 freshwater fish, 78 amphibians, 79 reptiles, 225 breeding and 175 winter and transient birds, 80 nonmarine mammals, and 28 pelagic or offshore mammals (Cooper, 1977). Of these organisms, 26 have been designated as endangered or threatened by the State of North Carolina and 25 are listed by the federal government as endangered or threatened for North Carolina (Table 5-1). The North Carolina Department of

Table 5-1. State and Federal Status of Sensitive Species for North Carolina

| Scientific Name | Common Name | North Carolina* | Federal† |
|---|---|---|---|
| MAMMALS | | | |
| Felis concolor cougar | Eastern cougar | E | E |
| Trichechus manatus | Florida manatee | E | E |
| Myotis grisescens | Gray bat | E | E |
| Myotis sodalis | Indiana bat | E | E |
| Eubalaena glacialis | Atlantic right whale | E | E |
| Balaenoptera physalus | Finback whale | E | E |
| Megaptera novaeangliae | Humpback whale | E | E |
| Balaenoptera borealis | Sei whale | E | E |
| BIRDS | | | |
| Falco peregrinus anatum | American peregrine falcon | E | E |
| Falco peregrinus tundrius | Artic peregrine falcon | E | E |
| Haliaeetus leucocephalus | Bald eagle | E | E |
| Vermivora bachmanii | Bachman's warbler | E | E |
| Dendroica kirtlandii | Kirtland's warbler | E | E |
| Pelecanus occidentalis carolinensis | Eastern brown pelican | E | E |
| Picoides borealis | Red-cockaded woodpecker | E | E |
| FISH | | | |
| Acipenser brevirostrum | Shortnose sturgeon | E | E |
| Hybopsis monacha | Spotfin chub | T | T |
| REPTILES | | | |
| Alligator mississippiensis | American alligator | E | E |
| Chelonia mydos | Green turtle | T | T |
| Eretmochelys imbricata | Hawksbill turtle | E | E |
| Lepidochelys kempii | Kemp's ridley turtle | E | E |
| Dermochelys coriacea | Leatherback turtle | E | E |
| Caretta caretta | Loggerhead turtle | T | T |
| MOLLUSKS | | | |
| Mesodon clarki nantahala | Noonday land snail | T | T |
| PLANTS | | | |
| Sagittaria fasciculata | Bunched arrowhead | E | E |
| Hudsonia montana | Mountain golden heather | T | |

* Parker, W. and L. Dixon, 1980.
† U.S. Fish and Wildlife Service, 1980.

E = Endangered and T = Threatened.

Agriculture is currently reviewing additional plants for inclusion on the state endangered and threatened plant list. Table 5-2 presents 14 additional proposed taxa and taxa under review which are known to occur in Carteret, Craven, Jones, or Onslow Counties. The presence of North Carolina's sensitive species on the Camp Lejeune complex is described in Table 5-3.

The NREA Division of MCB Camp Lejeune, the U.S. Fish and Wildlife Service, and the North Carolina Wildlife Resource Commission have entered into an agreement for the protection of endangered and threatened species that might inhabit Camp Lejeune. Habitats are maintained at Camp Lejeune for the preservation and protection of rare and endangered species through the base's forest and wildlife management programs. Full protection is provided to such species and critical habitat is designated in management plans to prevent or mitigate adverse effects of station activities.

As part of the rare and endangered species management program, special emphasis is placed on habitat and sightings of alligators, osprey, bald eagles, cougars, dusky seaside sparrows, and red-cockaded woodpeckers. The red-cockaded woodpecker is present in pine forests on Camp Lejeune as noted in Table 5-3. This small woodpecker subsists on insects and is important in controlling insect pests which attack pine trees. Nesting cavities used by these birds are usually in overmature pine trees with red-heart disease. In some colonies, all the cavity trees are within 300 feet of each other, but in other colonies, they may be 0.5 mile apart (Hooper, et al., 1980). Numerous red-cockaded woodpecker colonies on Camp Lejeune have been mapped and marked (Natural Resource Management Plan, 1975). These areas are shown in Figure 5-~~2~~9.

Table 5-2. Proposed Protected Plant List for North Carolina* Listing Only Those Taxa Known to Occur in Carteret, Craven, Jones, or Onslow Counties

| Scientific Name | Common Name | Known Counties† | Habitat** | Proposed Status |
|---|---|---|---|---|
| Proposed Taxa | | | | |
| Arenaria godfreyi | Godfrey's sandwort | Craven, Jones | Woodland seepage slopes of marl substrates | E |
| Asplenium heteroresiliens | Carolina spleenwort fern | Jones | Shaded marl outcrops | E |
| Calamovilfa brevipilis | Riverbank sandreed | Carteret, Craven Onslow | Long-leaf pine forests, bogs, and savannahs | T |
| Carex chapmanii | Chapman's sedge | Craven | Dry, sandy woods and roadsides | T |
| Cystopteris tennesseensis | Tennessee bladder fern | Craven, Jones | Marl outcrops | E |
| Lysimachia asperulaefolia | Rough-leaf loosestrife | Carteret, Craven, Jones, Onslow | Savannahs, pocosins, lowbay, upland bogs, and mesic environments. Acidic soils. | E |
| Myriophyllum laxum | Loose watermilfoil | Carteret, Craven | Lime sinks, pools, and ponds | T |
| Sarracenia rubra | Mountain sweet pitcher-plant | Carteret, Craven, Onslow | Shrub bogs and savannahs in the coastal plain | SC-E |
| Solidago verna | Spring-flowering goldenrod | Craven, Onslow | Savannahs, pocosins, pine barrens, pine flatwoods, and shrub bogs | E |
| Utricularia olivacea | Dwarf bladderwort | Carteret | Shallow, acid ponds with pH of 3 to 5 | T |
| Taxa Under Review | | | | |
| Aeschynomene virginica | Sensitive joint-vetch | Craven | Riverbanks, swamps, and tidal marshes in the coastal plain | I |
| Dionaea muscipula | Venus flytrap | Carteret, Craven Jones, Onslow | Wet, sandy ditches, pocosins, savannahs, and open bog margins | PP |
| Gentiana autumnalis | Pine barren gentian | Craven, Onslow | Pocosins, savannahs, and pine barrens | PP |
| Parnassia caroliniana | Carolina parnassia | Onslow | Savannahs | PP |

* North Carolina Department of Agriculture, 1981a, 1981b.
† Radford, A.E., H.E. Ahles, and C.R. Bell, 1968; Justice, W.S. and C.R. Bell, 1968; Beal, E.O., 1977; and Wilson, E.J., 1982.
** Radford, A.E., H.E. Ahles, and C.R. Bell, 1968 and Cooper, J.E., ed., 1977.

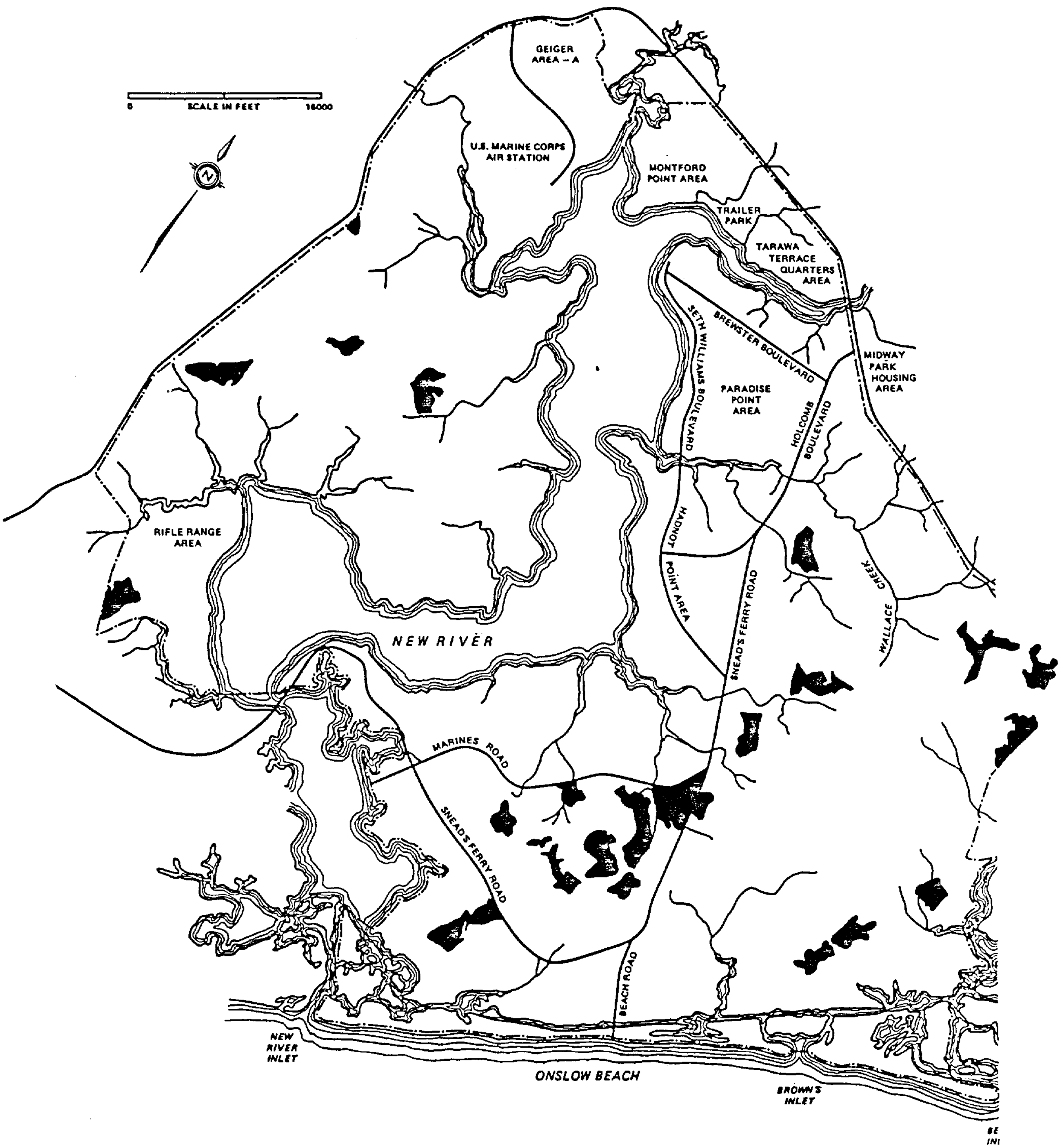
E = Endangered, T = Threatened, SC-E = Special Concern—Endangered, I = Indeterminate, and PP = Primary Proposed Species.

Table 5-3. Comments on Sensitive Species Regarding Occurrence Within Study Area (Camp Lejeune Complex*)

| Species | Comment |
|---|---|
| MAMMALS | |
| Eastern cougar | Possible transient but not seen since 1974 |
| Florida manatee | Study area is northern extreme of summer range |
| Gray bat | Not in area |
| Indiana bat | Not in area |
| Atlantic right whale | Possible migrant offshore |
| Finback whale | Possible migrant offshore |
| Humpback whale | Possible migrant offshore |
| Sei whale | Possible migrant offshore |
| BIRDS | |
| American peregrine falcon | Possible but not common |
| Arctic peregrine falcon | Possible |
| Bald eagle | Not reported or seen |
| Bachman's warbler | Possible migrant but not observed |
| Kirtland's warbler | Possible migrant but not reported |
| Eastern brown pelican | Reported in area |
| Red-cockaded woodpecker | Frequent in area with known nesting areas |
| FISH | |
| Shortnose sturgeon | Not observed recently |
| Spotfin chub | Not in area |
| REPTILES | |
| American alligator | Not probable |
| Green turtle | Known nesting sites along coast |
| Hawksbill turtle | Possible migrant offshore |
| Kemp's ridley turtle | Possible migrant offshore |
| Leatherback turtle | Possible migrant offshore |
| Loggerhead turtle | Known nesting sites along coast |
| MOLLUSKS | |
| Noonday land snail | Not in area |
| PLANTS | |
| Bunched arrowhead | Not in area |
| Mountain golden heather | Not in area |

* Peterson, C., 1982.
Cooper, J.E., ed., 1977.
Parker, W. and L. Dixon, 1980.

FIGURE 5-9. Red-Cockaded Woodpecker Colony Areas at MCB Camp LeJeune




SOURCE: PETERSON, C., 1982

# 6.0 ACTIVITY FINDINGS

## 6.0 ACTIVITY FINDINGS

This chapter contains summaries of base activities and operations which may involve potential environmental contamination. Emphasis is placed on past practices. At the end of the chapter is an inventory of all waste disposal sites which includes site descriptions. For sites requiring confirmation, this information is more comprehensive and is presented using information forms.

Throughout the activities and operations summaries, the reader is referred to specific sites for more information. In these instances, the information forms at the end of this chapter should be consulted.

### 6.1 OPERATIONS ORDNANCE

Because ordnance operations at Camp Lejeune are carefully controlled, there is little public health or environmental concern about past disposal practices. For that reason, this discussion is abbreviated and presents only an overview of this function. It is recognized, however, that ordnance operations are a significant base activity. Camp Lejeune was established as a training before World War II and has retained this characteristic feature. Numerous activities, from infantry and tank training to amphibious operations, require substantial amounts of ordnance each year. No manufacturing or load and pack operations occur on the base. All ordnance is shipped in and stored on the facility. Types of ordnance range from small arms ammunition to rockets, artillery, and mortar rounds. Principal magazine storage is in the Frenchs Creek area, while smaller storage areas exist in other designated places on the base.

Because of the training mission, a substantial amount of land has been designated as firing ranges and impact areas. There are three impact zones, called G-10, N-2, and K-2, for high explosives.[1] The New River

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[1] G-10 Impact Area. Bounded by GC 943361 to 941336 to 920341 to 907336 to 896361 to 943361. Coordinates based on Camp Lejeune Special Map 5th ed. 1976.

N-1 Impact Area. Extends east from the junction of Gridline 94 and Onslow Beach along the beach line to Bear Creek Inlet, and then along Bear Creek to a point 400 yards north of the Intracoastal Waterway, and thence on a line 400 yards north of a parallel to the Intracoastal Waterway to Gridline 94. Ordnance from aircraft will impact on Brown's Island only.

K-2 Impact Area. Bounded by GC 782332 to 794346, east to New River, south and west along the shoreline of New River and Stone Bay to 782332.

bisects Camp Lejeune and splits impact zones G-10 and K-2 into east and west sections. N-2 is southeast of G-10 and borders the Atlantic.

A bombing range known as BT-3 has been established at Brown's Island. This property is 7 miles southwest of Swansboro, North Carolina. The island referred to as the Brown's Island Target Complex is used by aircraft for target runs with ordnance not to exceed a net explosive weight of 250 pounds TNT equivalent. The target complex also is used by artillery to releive high trajectory rounds.

There are two EOD areas on the base near the impact zones. They are G-4 for the east and K-326 for the west side of the camp. They are used to dispose of inert, unserviceable, or dud ordnance. Burning and electrically exploding ordnance materials are the main disposal methods. There is no chemical waste of consequence generated by this activity. At times, there can be residual propellant or incompletely burned munition compounds, but amounts of less than 1 pound are typical. They are routinely collected by skilled personnel and disposed of in an appropriate way.

## 6.2 OPERATIONS, NONORDNANCE

Support and maintenance functions for the training mission of the base generate most waste materials. The 170-square-mile land area necessitates decentralization of utilities and other essential services.

### 6.2.1 Vehicle and Aircraft Operations

Vehicle use for both training purposes and support of base activities is extensive. Vehicles range from tanks to amphibious assault craft to conventional wheeled types. The magnitude of this activity at Camp Lejeune indicates that significant quantities of wastes have been generated. Ground contamination potential (at least to a limited extent) is high because of the risk of fuel spills, leaks from POL storage, and vehicle maintenance activities.

In addition to base motor transportation are vehicular components of the 2nd Marine Division, the 2d FSSG and AMTRAC units at Courthouse Bay. Maintenance, fueling, and repair of vehicles in these areas generate waste POL compounds which have sometimes been disposed of indiscriminately. Furthermore, remoteness of many activities (e.g., Courthouse Bay Complex) has tended to splinter waste disposal. This applies to past practices rather than recent ones. Remoteness fostered on-site dumping for two reasons: 1) availability of much wooded, isolated areas, and 2) relative difficulty of attaining general base transport vehicles. Past practices in POL disposal resulted in significant soil contamination. POL spills were localized and eventually controlled using oil-water separators, which is Best Available Technology (BAT).

Before modern pollution control practices, vehicle wash racks added to pollutant loading of soils and/or surface water. Vehicle grease and wash racks according to 1979 records numbered 35 and 23, respectively. While the base continues to grow, the most rapid growth occurred more than 30 years ago. Therefore, these 1979 data can be used to approximate historical levels of similar activities. Maintenance facilities are most concentrated at Hadnot Point in the Division Shop area.

Operations of vehicles and aircraft also involve waste materials other than POL. For example, old tires and batteries were often disposed of in both designated and unauthorized disposal locations. The Camp Geiger dump received batteries. Before a salvage program, now carried out by DPDO, old tires were burned or buried at various sites throughout the base. An occasional vehicle body would be buried, but this was an exception. Old vehicles were excessed. There is a large and continuing demand, for example, for tanks and other armored vehicls for display purposes.

### 6.2.2 Fuel-Related Operations

Fuel storage, dispensing, and disposal are significant activities related to environmental contamination issues. One principal tank farm is located in the Hadnot Point area. These are storage facilities for gasoline and diesel fuel. Here, fuel is transferred into tank trucks and transported to smaller dispensing facilities on base. This operation, in the past, has resulted in the release of POL compounds to the environment via leaks (e.g., refer to Site No. 22) or spills from tank trucks (e.g., refer to Site No. 64). Prompt action in the past has, by and large, prevented serious contamination from major spills.

Another principal tank farm is at the air station. JP-4 and JP-5 fuels are stored here, as well as gasoline. In the past, fuel spills or leaks have been recorded these areas. Refer to description of Site No. 45 for details. The Camp Geiger Fuel Farm (see Site No. 35) has also experienced leaks in the underground lines. These events have prompted an awareness by base personnel of contamination problems. Construction of aboveground lines has been one control measure at the JP Fuel Farm (Site No. 45).

### 6.2.3 POL-Related Activities

Before a pollution control program was implemented in the early 1970s, it was common to spread waste oils and other POL materials on road surfaces for dust control. As many as 1,400 gallons per week were disposed of in this way. There are five sites (Nos. 5, 31, 33, 34, and 56) which are noted for this type of disposal. Wastes were collected from various maintenance shops on the station at intervals throughout the year. There was no regulated collection practice, and substantial quantities were flushed to drains that emptied into New River. Personnel have estimated about 5 percent of total was disposed of at dumps with the remainder going on roadways and into storm drains.

Some characteristics of waste oil are presented in Table 6-1. The data show significant levels of metals such as lead (376 mg/l) and zinc (475 mg/l). Cadmium, copper, chromium, and barium were also at elevated levels. Amounts of volatile organic compounds were found in the parts-per-billion (ppb) range with the exception of phenols (20 mg/l). These data emphasize the potential contamination which could result from improper disposal of waste oils. It is recognized that past practice in many vehicle maintenance shops allowed oil to seep into soil on site and cause contamination. However, for the most part, now (1982) this has been stopped and current controls regulate collection and proper disposal of these materials. Furthermore, in most instances, relatively small amounts of oil were placed on relatively large amounts of land, and significant degradation is not an issue.

### 6.2.4 Utility Operation

Utility functions have influenced environmental issues at the base. Power, steam, and water are discussed below. Waste disposal is discussed in Section 6.5

Power for the base is supplied by Carolina Power and Light Company. The lines are all above ground. Maintenance of the system is performed by the company, although transformer leakage within the systems is a concern of base environmental affairs personnel because of potential PCB contamination. Transformer storage is temporary and is now carried out with proper environmental controls. Presently, transformers are stored in Lot 140, between Ash Street and Sneads Ferry Road on Center Road Extension. It is currently designated as a hazardous waste storage area. Historically, transformers were stored at Storage Lots 201 and 203. Refer to description of Site No. 6 for additional information.

The steam plant at Hadnot Point can produce 480,000 pounds of steam per hour and supplies the Frenchs Creek area as well as mainside. Steam is used for heating and cleaning of equipment. Substantial amounts of coal are stored near this facility. Berms to prevent coal pile runoff were not noted and some alterations to runoff control may be warranted. The current master plan indicates that increased demand will be placed on the system in the future. As many as 45,000 tons of coal are used per year. Fly ash has been disposed of on base for many years. Refer to Site No. 24 for additional waste disposal information.

Ground water is the potable supply. This is significant, not as a potential source of contamination, but rather as a potential receptor. Strategically located wells provide water to eight treatment plants within the military complex. Generally, wells are deep enough to penetrate at least one impervious layer. The Hadnot Point plant also serves Frenchs Creek, Tarawa Terrace, and Berkeley Manor. Storage is in elevated tanks with a capacity of 1.4 million gallons. Table 6-2 presents characteristics of the water treatment plants.

The drinking water system at the Rifle Range area has been a concern because of elevated trihalomethane (THM) levels and proximity of wells to the chemical landfill (Site No. 69). Test wells have been placed around the landfill to monitor groundwater characteristics. Table 6-3 shows THM levels in treated water at the Rifle Range. Strategies to reduce THM levels such as changes in chlorination procedures are being evaluated now (1982). Source of THM precursors is not known, but groundwater monitoring related to the chemical landfill is continuing. THM levels at 41 locations at Camp Lejeune are shown in Table 6-4. Three samples (see Samples 14, 15, and 16) contained total THM at or greater than the 100 ppb drinking water limit. THM precursors obviously exist at various locations. However, sources of precursors may or may not be related to past hazardous material disposal. In fact, origins of precursors may not be related to any human activity (e.g., detrital matter, algae).

### 6.2.5 Pest Control

Federal regulations have restricted the use of chemical substances used for pest control. Chlorinated hydrocarbons are the chief compounds that are either banned or have rigid controls on use. Pesticides and herbicides that are not EPA-approved are stored in a controlled area before disposal by DPDO. Presently, Building PT37, called Pest Control Shop, houses pesticides and is designated as a hazardous waste storage site. An environmental engineering survey in 1980 showed that 132 gallons of Silvex were stored here. In addition, DPDO had, at that time, 5,094 cans (4-ounce size) of DDT awaiting disposal (NAVFACENGCOM, 1980).

6.2.6 Solvent Usage

At the air station and Camp Lejeune, large amounts of solvents were used. Paint thinners, degreasers, and stripping compounds are three principal materials used commonly during the history of the base. These were used at operations scattered throughout the base and control of waste was difficult. Routinely, some portion of waste solvents were deposited in storm drains. Solvents were collected in waste containers for eventual spraying on roads (noted earlier). Others were used in firefighting training. Some spent boiler cleaning solvents were poured onto fly ash and cinders piles. Finally, some solvents were disposed of at designated disposal dumps where they may have been burned or allowed to seep through other wastes.

6.2.7 Radar Equipment Operations

At the air station, metallic mercury was drained from delay lines at the radar site and buried without containment. The radar units were located near the Photo Lab, Building 804.

6.3 OPERATIONS--RADIOLOGICAL

The Naval Research Laboratory site is near the present Pest Control Shop. Activities at the laboratory included using radionuclides for metabolic studies on small animals. Approximately 100 dogs were disposed of in a small area near the building. In November 1980, strontium 90 beta buttons were found while grading a parking lot near the building. The area was surveyed, and contaminated items were recovered. Soil samples were obtained and the site was cleaned of radioactive substances. Five 55-gallon drums of soil and animal residues were collected along with 499 beta buttons (400 microcuries per button). Iodine 131 was used. Because Iodine 131 has a half-life of only 8 days, potential for residual radiological contamination is nil.

6.4 MATERIAL STORAGE

Responsibility for support of the facility activities rests with the supply organizations of the various commands. Materials of interest include POL, pesticides, chemicals, and radiological substances.

Storage of oils, fuels, and other lubricants has been addressed in Section 6.2. Under the present plan, these substances are stored with adequate environmental safeguards; large fuel tanks or tank farms have earthen berms to contain spills. Other POL products in cans or drums are stored on concrete pads and are fenced. Historically, there was no reason to be aware of the hazards associated with these compounds and containment measures were minor or did not exist at all. In the past, there have been leaks in fuel tanks or underground lines. When the break or leak is minor, there may be a considerable time before detection, sometimes resulting in a large amount entering surrounding soils. For example, tank farms at Hadnot Point, the air station, and Camp Geiger have experienced losses through tank or line leakage. At the air station, aboveground distribution lines have been built to lessen this problem. Refer to Site No. 22, 35, and 45 for detailed descriptions of various fuel storage problems.

Hazardous chemicals are segregated and stored in accordance with federal regulations. Containment must minimize risk to environment and to human health.

Chemicals such as solvents are now stored on concrete pads and fenced. There is adequate protection against runoff in case of a spill.

Pesticides currently are stored at the former Naval Research Laboratory (see Section 6.2). From 1943 to approximately 1958, pesticides were stored in Building 712, which is used now as the day-care center. Subsequently, pesticides were moved to Building 1105, where they remained until 1977. Stored in Building 1105 were chlorinated hydrocarbons such as DDT and Chlordane as well as Diazinon, Malathion, Lindane, Mirex, 2,4-D, Dalapon, and Dursban.

## 6.5 WASTE DISPOSAL OPERATIONS

Liquid sanitary wastes are conventionally treated throughout the complex. Because of the large surface area, sewage treatment plants (STPs) must be located in various areas. At Hadnot Point, gravity and force mains convey waste to a secondary trickling filter plant capable of treatment 0.8 mgd. This plant originally serving Hadnot Point has been extended to Paradise Point, Frenchs Creek, and the Berkeley Manor housing area.

Courthouse Bay houses the Engineer's School and the Second Amphibious Tractor Battalion. Sewage treatment is at the secondary level using lime as a pH control. The design capacity of the plan is 0.5 mgd.

The air station and nearby Camp Geiger at one time had separate treatment plants, each capable of providing secondary treatment. The Geiger plant has been upgraded and now serves the air station.

Solid waste disposal in the base complex in the past has been on land. Past practice has not been well regulated, and unauthorized dump sites were used for many substances, some of which were hazardous. The original base dump (prior to 1950) was off Holcomb Boulevard across from Storage Lot 203. The site was a borrow pit used for disposal of construction debris. Following construction, which began in 1941, dumps were located near individual activities. As a result, a number of sites were active simultaneously. In the early 1970s, a central landfill was established to receive wastes from the entire complex while other landfills were gradually phased out. One possible exception is the chemical waste dump in the Rifle Range area. This site was set aside to receive toxic waste materials. A complete inventory was kept of types of wastes, amounts, and position of burial. These records have been lost, but according to Mr. Donald Tallman, former base safety officer, an estimated 50 barrels of DDT, trichloroethylene sludge, wood preservative compounds, and PCBs (some in sealed cement septic tanks) were buried here. The surface area is about 6 acres and the volume of disposed materials may be as high as 93,000 cubic yards (see Site No. 69 for description). This dump was closed in 1978.

Overall, during the history of the base, approximately 28 sites were used to dispose of solid or liquid wastes. These do not include garbage and trash buried during field training exercises.

A 1977 report by SCS Engineers shows that Camp Lejeune generates 664 tons of solid waste per week, or approximately 95 tons per day. The composition is similar to municipal waste in other communities. The industrial waste contains nonhazardous materials and is typical of commercial industrial wastes from similar activities.

## 6.6 SITES

A total of 72 waste disposal sites have been identified at Camp Lejeune, MCAS New River, and HOLF Oak Grove. The sites are located on maps in Figures 2-1 through 2-12. For many sites, photographs have been included, as Figures 6-1 through 6-14. These show limited information regarding foliage, land use, and topography near sites.

The confirmation study ranking system model has been applied to these sites. At Camp Lejeune, 54 sites were considered; 37 of these were judged not to require further consideration as a result of applying Phase I of the NACIP model. These judgments were based on factors such as type of waste material and potential for migration. Fifteen sites were identified at MCAS New River and three sites at Oak Grove. Twelve at the air station and all three at HOLF Oak Grove were judged not to require further consideration.

Summaries of pertinent information concerning all sites are given in the following pages. The 54 sites excluded from further consideration are are identified in Table 6-5. The table also explains specific reasoning for exclusion by indicating decision points in the NACIP model at which sites were eliminated. A key to model decision points is given in Appendix B.

Site No.: 1

Name: Midway Park Dump

Location: Special Map coordinates 859458; near Lee Avenue, about 700 feet northeast of Deep Branch.

Size: Area estimated at 11 to 12 acres.

Previously Reported: No

Activity: This site was a surface dump for the disposal of construction debris which included asbestos materials.

Materials Involved: Asphalt paving, wood, asbestos shingles

Quantity: Records were not kept detailing what was received at the dump. Based on topography and water table elevations, a reasonable depth of fill is 5 to 10 feet. This yields a total dump volume of 100,000 to 200,000 cubic yards. Only a fraction of this is expected to be asbestos. An upper limit is estimated to be 0.1 percent, or 100 to 200 cubic yards. Caution: This value is not based on reliable data and represents an estimate for purposes of providing order of magnitude guidance only.

When: Early 1960s to 1972

Photo: Yes

Comments: This site is part of property deeded to Onslow Community College several years ago. It now supports a low ground cover and a growth of mature pines.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-2 and 6-1.

FIGURE 6–1
Site No. 1 – Midway Park Dump

FIGURE 6–2
Site No. 2 – Nursery/Day - Care Center at Building 712
Water Treatment Plant in Foreground

Site No.: 2

Name: Nursery/Day-Care Center

Location: Special Map coordinates 855441; Building 712 on Holcomb Boulevard at Brewster Boulevard.

Size: See comments section.

Previously Reported: No

Activity: Building 712 formerly was used for pesticide storage and mixing. Current use as a day-care center may pose health risks to young children and supervisory staff.

Materials Involved: Chlordane, DDT, Diazinon, Dieldrin, Lindane, Malathion, Mirex, 2,4-D, 2,4,5-T, Silvex, Dalapon, Dursban

Quantity: Contamination would have occurred as result of small spills, washout, and excess disposal. During 15-year use, it is reasonable to assume several gallons per year were involved. Therefore, estimated quantity involved is on the order of 100 to 500 gallons of various strength liquids. Solid residues in cracks and crevasses may total 1 to 5 pounds. Caution: Quantity estimates are not based on reliable data and are provided for order of magnitude guidance only. Disposal to creek is undocumented.

When: 1943 to 1958

Photo: Yes

Comments: In late 1957 or 1958, pesticide storage and mixing were moved to Building 1105. Chemical use is reported to have been: Baygon--unknown, but considered to be minor; Chlordane--100 gallons of 40-percent powder per year; DDT--750 to 1,000 gallons per day of 5- to 15-percent material; Diazinon--25 gallons per month; Dieldrin--less than 100 pounds per year; Dursban--stored but not used; Lindane--less than 10 gallons of 1-percent material per year; Malathion--100 gallons per year; Mirex--stored but not used; Silvex (2,4,5-TP)--stored but not used; 2,4-D--1,000 gallons per year of 1 to 100 dilution of concentrate; 2,4,5-T--50 gallons per year--used for 1 year only. The contaminated areas are the fenced playground, approximately 6,300 square feet; the mixing pad covering approximately 100 square feet; the wash pad, approximately 225 square feet; and possibly, the railroad tracks drainage ditch that is a tributary of Overs Creek. See Figures 2-2 and 6-2.

Site No.: 6

Name: Storage Lots 201 and 203

Location: Special Map coordinates 866406, on Holcomb Boulevard between Wallace and Bearhead Creeks.

Size: Lots 201 and 203 are estimated at 25 and 46 acres, respectively.

Previously Reported: Yes EPA Form 8900-1 MC Bul 6280

Activity: The site was and still is used to store hazardous materials. DDT is reported to have been dumped at Lot 203 when it served as a dump in the 1940s. There has been long-term storage of DDT and transformers containing PCB. No spills or leaks of PCB have been reported, but reports of white powder (DDT) were noted.

Materials Involved: Pesticides, building debris, metals. Area was used for transformer storage with attendant risk for PCB contamination.

Quantity: Inspection of area of DDT dump reveals no clues to areal extent of disposal. Trees are not disturbed and no ground depressions or mounds can been seen. Reports of dumping are vague; no indication of types of containers disposed of, e.g., aerosol cans versus 55-gallon drums. For site to be remembered, it is reasonable to assume more than 1 or 2 pounds were involved. However, there is no basis for assuming massive quantities were involved. Therefore, for purposes of indicating the perceived magnitude of importance of site, several hundreds of pounds of DDT are assumed to have been dumped. No physical or other reliable evidence is available to indicate size of contaminated area. However, because some assessment of size is needed to guide any further actions (if any), assume that an area within, say, an 80- to 100-foot radius is involved.

Regarding PCB and DDT spills near storage areas: Minimal information has been discovered during site investigations. No amount of judgment by environmental and public health professionals can yield reliable estimates of spill quantities because conditions are so variable. Guidance for assessing magnitude may be obtained as follows: No direct evidence of PCB spills was found. Therefore, assume no PCBs are involved. Inferences of DDT spills come from reports of white powder

Site No.: 6 (Continued)

on ground. No recollection of size of powdered area is available. Assume that around storage pallets, DDT was spilled in a 1- or 2-food band. This suggests pounds, not hundreds of pounds, were involved. Over time, quantities may be added. Therefore, assume 100 to 200 pounds of DDT involved.

Caution: Estimates of quantities are not based on reliable data and are provided as order of magnitude guidance only.

When: Lots in a variety of uses from 1940s to present

Photo: Yes

Comments: These areas have long history of various uses, including dumping and storage. Area is flat, unpaved, and surface soils have been moved about substantially due to regrading and equipment movement. There is no direct physical evidence of hazardous material contamination.

There are six areas at the two sites which have highest liklihood of contamination, if any contamination exists. These are identified on Figure 2-3. Representitive photo is given in Figure 6-3.

Disturbance of trees is not evident; however, age of trees is estimated at 10 to 20 years. Therefore, trees are more recent than dumping and cannot be used as clues to dumping area.

FIGURE 6–3
Site No. 6 — Storage Lots 201 - 203

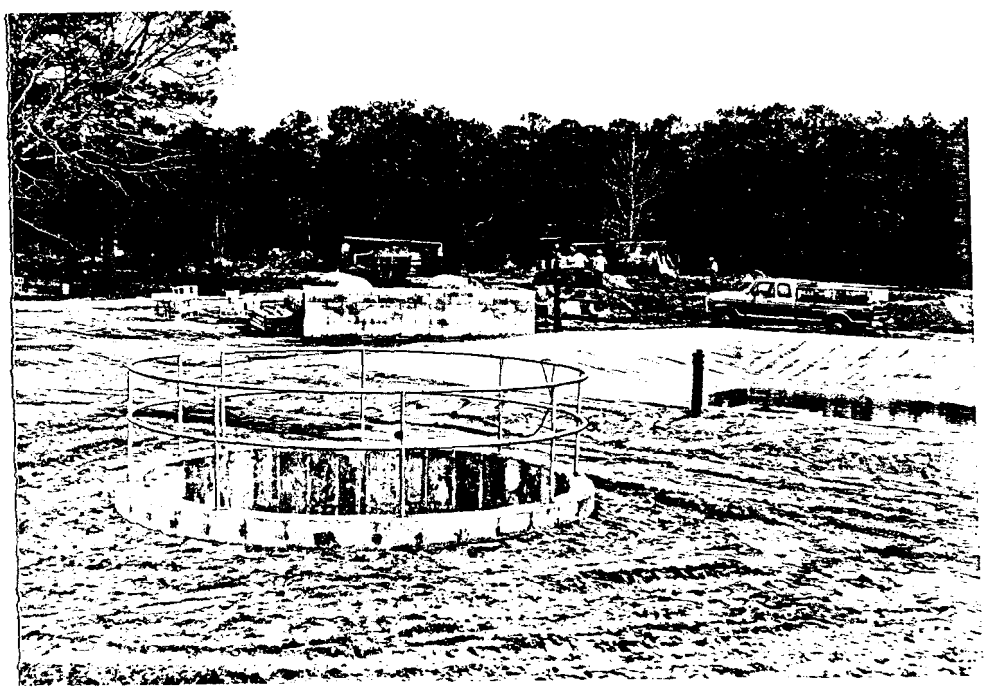

FIGURE 6–4
Site No. 9 — Fire Fighting Training Pit near Piney Green Road.
Oil Water Separation in Foreground.

Site No.: 9

Name: Fire Fighting Training Pit at Piney Green Road

Location: Special Map coordinates 868398; near Building S-TP-454, between Piney Geen Road and Holcomb Boulevard, south of Bearhead Creek.

Size: Estimated area is approximately 2 acres.

Previously Reported: Yes EPA Form 8900-1 MC Bul 6280

Activity: Fire fighting training carried out in an unlined pit. Flammable liquids burned in pit. No pollution control equipment such as oil-water separators.

Materials Involved: Used oil, solvents, contaminated fuels

Quantity: Approximately 30,000 gallons per year

When: 1960s to present

Photo: Yes

Comments: Training began after 1961. The pit was unlined until approximately mid- to late 1960s. No leaded fuels were burned. Used only JP-4 and JP-5. Pit presently used and an oil-water separator has been installed. See Figures 2-3 and 6-4.

Site No.: 16

Name: Montford Point Burn Dump, Site A

Location: Special Map coordinates 795450; between Wilson Drive and Northeast Creek, about 900 feet east of intersection of Coolidge and Harding Roads.

Size: Area affected is about 3.5 to 4 acres.

Previously Reported: No

Activity: Burn dump for debris, garbage, and minor quantities of oil

Materials Involved: Building debris, including asbestos, garbage, tires, waste oils

Quantity: Amount of asbestos visible on the surface is estimated to be less than 1 cubic yard.

When: Approximately 1958 to 1972. Site now closed.

Photo: Yes

Comments: Site is being used occasionally for unauthorized disposal of debris. See Figures 2-4 and 6-5.

FIGURE 6–5
Site No. 16 – Montford Point Burn Dump
Showing Asbestos Pipe Insulation

Site No.: 22

Name: Industrial Area Tank Farm

Location: Special Map coordinates 864389, east of intersection of Cribb Road and Ash Street.

Size: Area estimated at 3.5 to 4 acres.

Previously Reported: No

Activity: Site is a fuel storage and dispensing area for vehicles. Leakage has occurred from fuel lines.

Materials Involved: Diesel and unleaded gasoline

Quantity: 20,000 to 50,000 gallons from an underground line near the tank truck loading facility

When: 1979

Photo: Yes

Comments: Fuel farm installed in 1940s. There have been problems with leaks. The latest was a 100-gallon leak of diesel fuel in 1981. In 1979, a fuel leak of an estimated 20,000 to 30,000 gallons occurred. The leak was in an underground line slightly to the rear of the tank truck loading facility and between the building and the large aboveground fuel tank. Fuel has been lost through pinhole leaks in the underground lines. There is no evidence of extensive corrosion in the system. Control is maintained by an established fuel audit system. See Figures 2-5 and 6-6.

FIGURE 6–86
Site No. 22 – Industrial Area Tank Farm

FIGURE 6–87
Site No. 24 – Industrial Area Fly Ash Dump

Site No.: 24

Name: Industrial Area Fly Ash Dump

Location: Special Map coordinates 866380; south of intersection of Birch and Duncan Streets.

Size: Area is about 20 to 25 acres.

Previously Reported: No

Activity: Fly ash and cinders dumped on ground surface. Solvents used to clean out boilers were poured on fly ash and cinder piles. During 1960s, construction rubble dumped here. Sludges from WTP and STP also placed here. Furniture stripping wastes also dumped.

Materials Involved: Fly ash, cinders, and solvent from central heating plant, WTP spiractor sludge and sludge from the sewage treatment plant. Limited quantities of furniture lacquers and varnish.

Quantity: The amount of fly ash is estimated at 31,500 tons based on a 10-percent ash content and a usage of 45,000 tons per year of coal over 7 years. The estimate of furniture stripping compounds dumped here is about 45,000 gallons over 7 years. This estimate is based on assuming that one vat of fluids per month was disposed. A vat contains approximately 500 to 550 gallons. The quantity of cleaning solvents which reached this site is not known but is considered to be small.

When: 1972 to approximately 1980

Photo: Yes

Comments: Sandy soil conducive to migration. The eastern boundary of this site is a tributary of Cogdels Creek. Drainage is probably to the east, south and west toward Cogdels Creek and its tributaries.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-5 and 6-7.

Site No.: 28

Name: Hadnot Point Burn Dump

Location: Special Map coordinates 855364, east of Mainside Sewage Treatment Plant on both sides of Cogdels Creek.

Size: Area is approximately 23 acres.

Previously Reported: Yes EPA Form 8900-1 MC Bul 6280

Activity: This large disposal area received a variety of solid waste. The site is now closed. The surface has been graded, grass has been planted and is now a recreational area with fishing pond. When site was active, wastes were burned and covered with dirt.

Materials Involved: Mixed industrial type waste, refuse, trash, oil-based paint, garbage

Quantity: Volume of fill is estimated at 185,000 to 370,000 cubic yards. The volume of waste is based on a surface area of 23 acres and a depth ranging from 5 to 10 feet. Because waste was burned, no approximation of remaining amount of specific substances can be reasonably made. However, approximate size of the site provides order of magnitude guidance.

When: Approximately 1946 to 1971

Photo: Yes

Comments: Reports of leachate and oily seepage to Cogdels Creek. Site is on a former wetland.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-5 and 6-8.

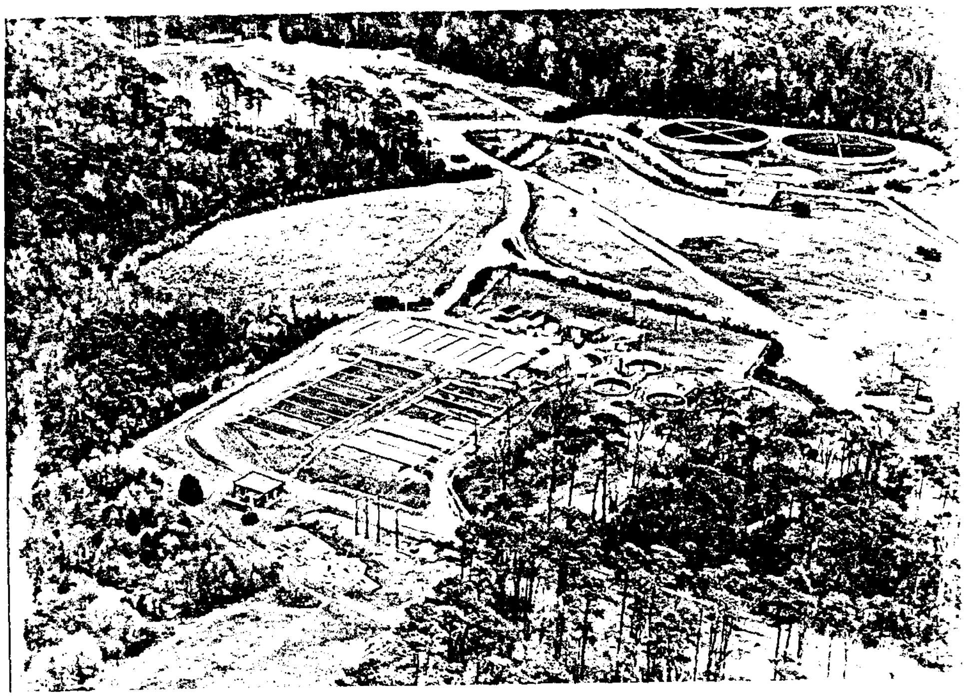

FIGURE 6–8
Site No. 28 – Hadnot Point Burn Dump

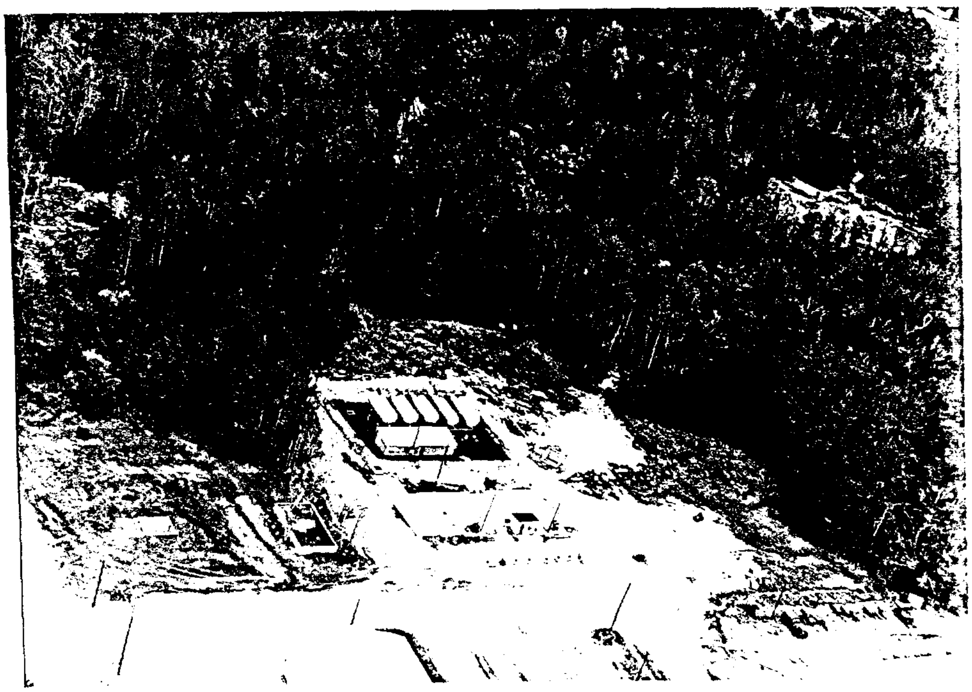

FIGURE 6–9
Site No. 35 – Geiger Area Fuel Farm

Site No.: 30

Name: Sneads Ferry Road--Fuel Tank Sludge Area

Location: Special Map coordinates 898324; along a tank trail which intersects Sneads Ferry Road from west, about 6,000 feet south of intersection with Marines Road.

Size: Exact location along trail unknown. See comments below.

Previously Reported: No

Activity: One-time disposal of sludge pumped from fuel tank storing leaded gasoline

Materials Involved: Sludge from fuel storage tank, especially tetraethyl lead and related compounds; tank washout waters

Quantity: About 600 gallons of tank bottom deposits. See comments below

When: 1970

Photo: No

Comments: Soils conducive to migration. The hydraulic gradient in the water table aquifer is toward Frenchs Creek. A private contractor disposed of the sludge along the tank trail as an expedient measure. Trail alignment is parallel to groundwater gradient.

As yet no records (including contract documents) have been found to indicate amount of sludge disposed of at this site. Two 12,000-gallon tanks were involved. Tanks were pumped out while changing the type of fuel stored. Based on knowledge of tank capacity below tank outlfow ports, about 600 gallons of sludge or tank bottoms were dumped. Additional washout water may have been present. There is additional information to suggest that the site has been used for similar wastes from other tanks. Therefore the 600 gallon amount must be considered a minimum. Composition fo sludge and/or washout is unknown and may vary from containing substantial amounts of tetraethyl lead to containing mostly cleaning compounds. See Figure 2-6.

Site No.: 35

Name: Geiger Area Fuel Farm

Location: Special Map coordinates 756466, north of intersection of G and Fourth Streets.

Size: Area estimated at about 2,500 square feet.

Previously Reported: No

Activity: Area used for storing and pumping fuel. Mogas released to soil through a leak or leaks in underground line near aboveground storage tank and tank pad.

Materials Involved: Mogas

Quantity: The amount of fuel is estimated by Chief Padgett, Camp Lejeune Fire Department, to be in the thousands of gallons. Exact estimates cannot be made as these records were destroyed.

When: 1957 to 1958

Photo: Yes

Comments: Spill reported to have migrated east and northeast toward and into creek. Spilled fuel at the surface of the shallow aquifer was disposed of by digging holes near the leak and igniting the gas. Fuel that contaminated Brinson Creek was also burned off near the leak.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-7 and 6-9.

Site No.: 36

Name: Geiger Area Sewage Treatment Plant Dump

Location: Special Map coordinates 763462, east of Geiger Area Sewage Treatment Plant on south side of Brinson Creek

Size: Area is about 25,000 square feet.

Previously Reported: No

Activity: Site was used for disposal of municipal wastes and mixed industrial waste from the air station. Most material was burned and buried, but some unburned material was buried.

Materials Involved: Garbage, trash, waste oils, solvents, hydraulic fluids

Quantity: According to interviews, less than 5 percent of all hydrocarbons used at the air station were disposed of in dumps. The rest was used for dust control on roads or went directly into storm drains. Based on interviews, a conservative estimate is that 700 to 1,000 gallons per week were used on roads. A smaller but undetermined amount was washed into the storm drains. Using a 5-percent estimate for dumping over 9 years, about 25,000 gallons of material could have been dumped into storm drains. Assuming this amount was split between this site and the trailer park dump (Site No. 41), an estimated 10,000 to 15,000 gallons of solvent and oil were placed here. Most probably were burned.

When: Late 1940s to late 1950s

Photo: Yes

Comments: Movement of contaminants via water table aquifer and surface runoff will be toward Brinson Creek or roadside drainage ditch south of dump. See Figure 2-7. The site covers about 25,000 square feet and rises 10 to 12 feet above grade. Estimated volume is 14,000 cubic yards, based on an average depth of fill of 15 feet.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

Site No.: 41

Name: Camp Geiger Dump

Location: Special Map coordinates 732442; south of end of Robert L. Wilson Boulevard, Camp Geiger Trailer Park (abandoned).

Size: Area is approximately 15 acres.

Previously Reported: Yes EPA Form 8900-1 MC Bul 6280

Activity: Site was used as an open dump. It received industrial and municipal wastes, as well as construction debris.

Materials Involved: Waste oils, solvents from air station, garbage, asphalt, concrete, old batteries

Quantity: 10,000 to 15,000 gallons of waste POL and solvents are estimated to have been disposed of (refer to Site No. 36). Most probably were burned.

When: Approximately 1946 to 1970

Photo: Yes

Comments: Site was operated as a burn dump. Based on an estimated fill depth of 5 feet, total volume of the site is about 110,000 cubic yards.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-8 and 6-10.

FIGURE 6–10
Site No. 41 – Camp Geiger Dump Near the Trailer Park

FIGURE 6–~~12~~ 11
Site No. 45 – Campbell Street Underground Fuel Storage Area

Site No.: 45

Name: Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm at Air Station

Location: Special Map coordinates 754444, Campbell Street at White Street (JP Fuel Farm) and approximately 250 feet east of White Street (Avgas).

Size: The underground storage area is approximately 40,000 square feet. The JP Fuel Farm covers approximately 6 acres.

Previously Reported: No

Activity: Underground tank (or tanks) leaked at the fuel storage area during 1978. At the JP Fuel Farm, extensive leakage from underground connecting lines was discovered in about 1981. Southeastern one-third of area (i.e., approximately 2 acres) is generally affected.

Materials Involved: Avgas and other JP fuel

Quantity: 200 to 300 gallons of Avgas. Assuming soils overlying ground water are generally saturated with oil over about 2 acres, about 600,000 gallons of oil may be involved (i.e., using 20-percent porosity and 5 feet to groundwater). Therefore, estimates are that more than 100,000 gallons of JP fuel have leaked.

When: 1978

Photo: Yes

Comments: These two storage areas are close together and are considered as one site. Most recent leaks were JP-4 and JP-5 from underground pipes. These pipes have been replaced by an aboveground system in which leaks can be readily detected. An oil-water separator has been installed on the south boundary of the fuel farm, which now shows a substantial amount of oil. Drainage ditch and canal parallel Campbell Street, then flow southward. See Figures 2-9 and 6-11.

Site No.: 48

Name: MCAS Mercury Dump Site

Location: Special Map coordinates 772438, Building 804 on Longstaff Road

Size: See comment section.

Previously Reported: No

Activity: Mercury was drained from radar units periodically and disposed in woods near photo lab (Building 804). Best information indicates that material was carried by hand, probably to area between building and river and dumped or buried in small quantities at randomly selected spots.

Materials Involved: Metallic mercury

Quantity: Approximately 1 gallon per year over 10 years, i.e., more than 100 pounds total

When: 1956 to 1966

Photo: No

Comments: The disposal area is in a 100 by 200 foot corridor extending from the rear of Building 804 to the river. See Figure 2-9.

Site No.: 54

Name: Crash Crew Fire Training Burn Pit at Air Station

Location: Special Map coordinates 755428, adjacent to southwest end of Runway 5-23 near of Building 3614.

Size: Affected area is approximately 1.5 acres.

Previously Reported: Yes EPA Form 8900-1 MC Bul 6280

Activity: Pit used in crash crew training at air station. Waste oils and solvents were burned.

Materials Involved: Contaminated fuels, waste solvents

Quantity: Based on present usage of 15,000 gallons of POL annually, nearly one-half million gallons of these compounds have been used at this site. If only 1 percent of solvents and POL soaked into ground before lining, then 3,000 to 4,000 gallons would have entered the soils. Caution: Reliable data have not been found from which to quantify soil contamination. The above estimating procedure is used to provide order of magnitude guidance only.

When: First use is believed to have been in mid-1950s.

Photo: Yes

Comments: Burn pit was lined around 1975. According to some reports, site was used unlined a number of years before this. However, 1964 aerial photographs reveal a very "clean" looking area, as no large fuel stains are apparent.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-9 and 6-12.

FIGURE 6–~~18~~ 12
Site No. 54 – Crash Crew Fire Training Burn Pit

Site No.: 68

Name: Rifle Range Dump

Location: Special Map coordinates 748302; west of Range Road, 2,000 or more feet west of Rifle Range water treatment, 800 or more feet east of Stone Creek.

Size: Estimated area is 6 to 8 acres.

Previously Reported: No

Activity: Operated as a dump for materials from Rifle Range activities

Materials Involved: Construction debris, WTP sludge, solvents

Quantity: Using 6 to 8 acres as area and assuming 10 feet of fill, volume is estimated at 100,000 cubic yards. Solvent amounts are estimated to be 1,000 to 2,000 gallons, based on period of use and quantities noted in comments (below).

When: 1942 to 1972

Photo: Yes

Comments: Sandy soils in area make site favorable for migration of contaminants. Although site is downgradient from Potable Well Nos. RR-47 and RR-97, heavy pumping may allow contaminants to move upgradient.

The report of solvent waste being disposed at the Rifle Range Dump has not been substantiated by follow-up interviews. Although the number of personnel qualifying with weapons at the rifle range apparently has decreased to 20,000 to 30,000 per year (range use has been higher during war years), weapon cleaning practices are probably unchanged for at least the last 20 years. Typically, weapon cleaning occurs at the "parent organization" and does not occur in the rifle range area except for the relatively small number of people working

Site No.: 68 (Continued)

there. Dry cleaning solvent waste used for weapon cleaning does not exceed 20 to 30 gallons per year. Some discrepancy exists as to whether or not "bare cleaner" is presently used but, if it is, quantities used are expected to be similar to the amounts of dry cleaning solvents. No other unusual or specialized activity that uses solvents has been identified in this area.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-11 and 6-13.

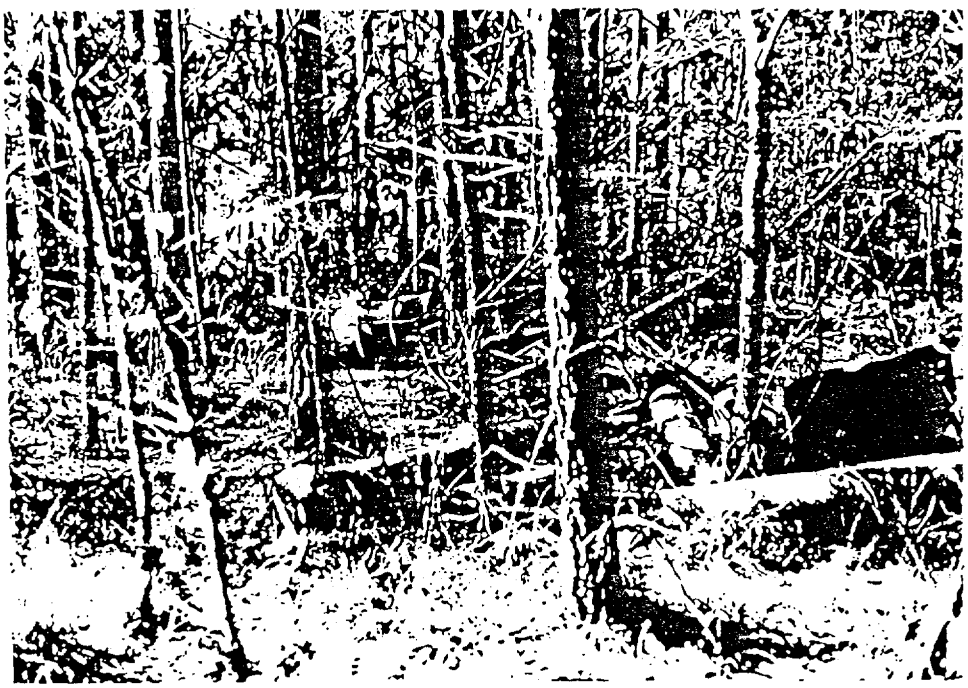

FIGURE- 6-13 Site No. 68 – Rifle Range Dump

Site No.: 69

Name: Rifle Range Chemical Dump

Location: Special Map coordinates 770290; about 8,000 to 9,000 feet due east of intersection of Range and Sneads Ferry Roads, north of Everett Creek.

Size: Estimated area is about 6 acres.

Previously Reported: Yes EPA Form 8900-1 MC Bul 6280

Activity: Former site for chemical wastes, including various pesticides, PCBs, fire retardents

Materials Involved: Pentachlorophenol, DDT, TCE, Malathion, Diazinon, Lindane, gas cylinders, HTH, PCB, all other hazardous materials generated or used on base

Quantity: Overall volume may be 93,000 cubic yards. This is based on an area of approximately 6 acres and an assumed depth of 10 feet.

When: Early to mid-1950s to approximately 1976

Photo: Yes

Comments: Mr. Don Tallman, former base safety officer, prepared a list of what and where chemicals were buried in the landfill. This list has been lost, but some information is known from an interview with Mr. Tallman.

This site is at a higher elevation than surrounding terrain. Subsurface contaminant migration could be in many directions. Groundwater seeps were observed in the surrounding area.

Two reports of atmospheric emissions were noted. One incident occurred possibly as a result of meteorological conditions;

Site No.: 69 (Continued)

the second incident was caused by accidental mechanical perturbation of the ground at the site.

Some PCBs, sealed in cement septic tanks, are reported to be buried here.

Note: Size estimates are based on map and photograph information. Field estimates may have been made, but no field measurements have been performed. Estimates are provided for general guidance only.

See Figures 2-11 and 6-14.

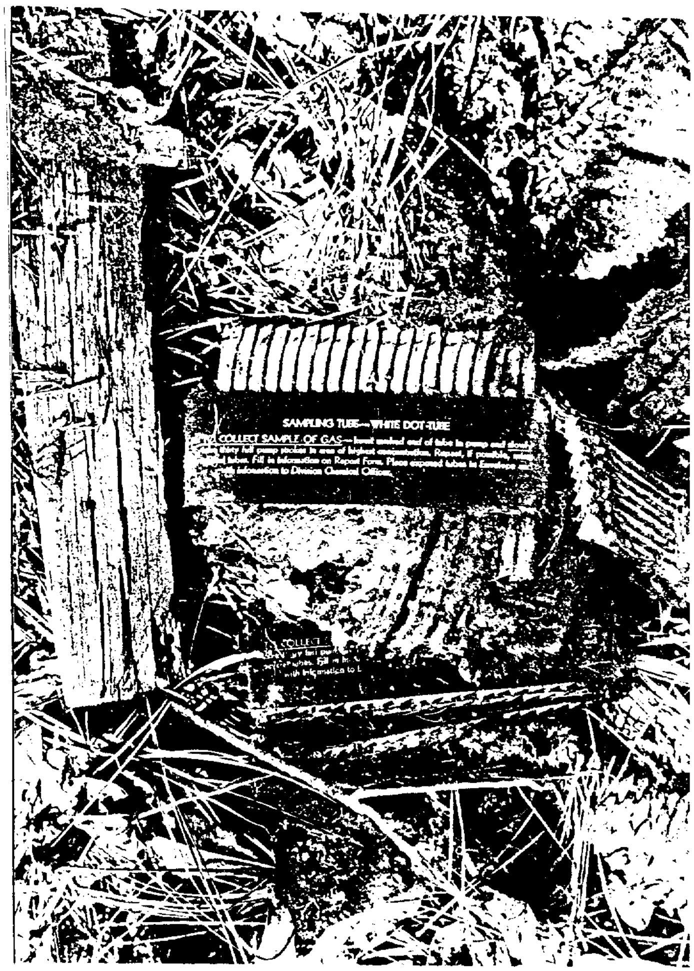


FIGURE 6-14
Site No. 69 – Rifle Range Chemical Dump
Showing Discarded Gas Detection Kits

# 7.0 REFERENCES

# REFERENCES

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# APPENDIX A

# MONITORING-WELL CONSTRUCTION

## RECOMMENDATIONS FOR GROUNDWATER MONITORING

### MONITORING-WELL INVENTORY

Wells that have been improperly abandoned or that have been out of service for a long period are potential conduits for contamination from the water table aquifer to those deeper. Many of the wells at Camp Lejeune have been abandoned or are no longer in service, but there is not a complete inventory of the location or abandonment procedure.

It is recommended that the status of wells at the installation be clarified by determining the location of all the wells that have ever been drilled at the base. A comparison of the complete list of wells with the wells now in use will show those that have been abandoned or that are out of service. If these wells are close to and downgradient of a confirmed hazardous waste site, a further assessment of the wells' status should be made. This assessment should include the reason for abandonment or nonuse, the date when the well was last used, how it was abandoned (if applicable), and future plans for the well (if not yet abandoned).

A satisfactory abandonment procedure involves filling the well and gravel pack with grout so that contaminants cannot migrate between aquifers.

### MONITORING-WELL PLACEMENT

At each site selected for groundwater monitoring, four monitoring wells are recommended. Three of these should be placed immediately downgradient of the site to detect the contaminant plume, if present, and the fourth well should be installed upgradient of the site to monitor the quality of water moving toward the site.

### MONITORING-WELL INSTALLATION

Each monitoring-well should be constructed so that it has both an efficient hydraulic connection to the surrounding water table aquifer and an effective seal against the migration of surface waters into the borehole.

The following techniques and materials are recommended to accomplish these two aims (Figure A-1):

1. Drill an 8-inch borehole to 10 feet below the water table, as noted during drilling. Collect representative lithologic samples every 5 feet during drilling for preparation of the lithologic log.
2. Install a string of threaded, flush-joint, 2-inch, schedule 40 PVC well casing and well screen. Set the top of a 10-foot length of PVC well screen at the water table. The recommended well-screen slot size is 0.010 inches. The top of the casing should extend approximately 12 to 18 inches above ground level.
3. After the well casing and screen have been installed in the borehole, place a filter pack of fine- to medium-quartz sand in the annular space from the bottom of the hole to approximately 2 feet above the top of the screen.
4. Place a 1-foot seal of bentonite pellets in the annular space on top of the filter pack.
5. Fill the remainder of annular space with a sand-cement grout composed of two parts dry weight of sand to one part of cement with not more than 6 gallons of clean water per bag of cement (94 pounds or 1 cubic foot).
6. Install a 5-foot-long, 6-inch, steel protective casing 3 feet into the grout. The protective casing should have a lockable steel cap and a padlock. The aboveground portions of both the protective casing and the PVC well casing should be vented with a 1/8-inch hole to permit the water in the well to fluctuate freely.

It may be necessary to vary the placement of the top of the screen and the thickness of the bentonite seal and the sand-cement grout if the water table is less than 5 feet below land surface.

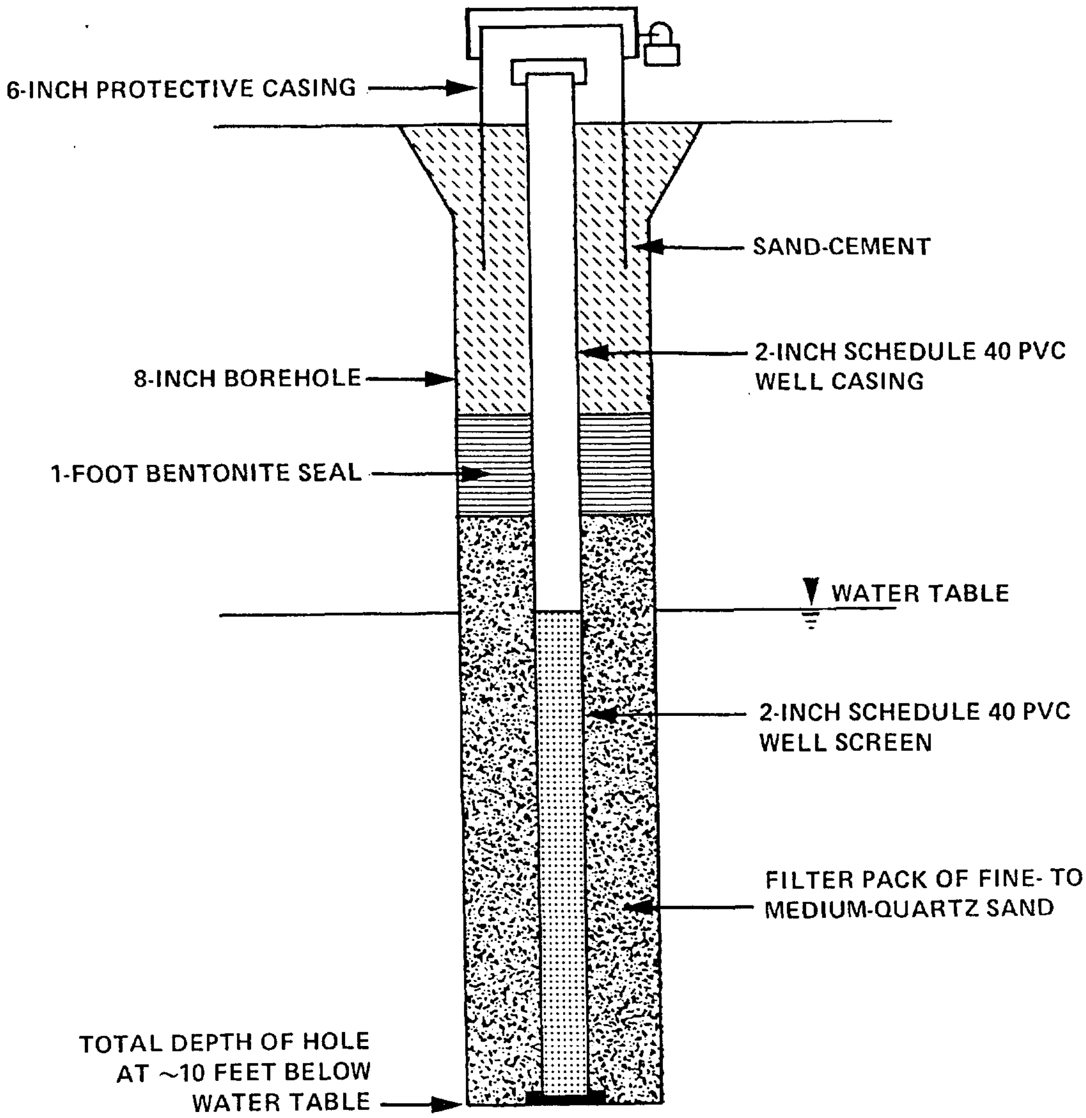



FIGURE A–1. Recommended Monitoring-Well Construction

# APPENDIX B

# CONFIRMATION STUDY RANKING SYSTEM

# CONFIRMATION STUDY RANKING SYSTEM

## Background

With the passage of "Superfund," or CERCLA, in December 1980, a need for a systematic approach towards the clean-up of old hazardous waste disposal sites became apparent. The Department of Defense (DOD), anticipating "Superfund," established the Installation Restoration (IR) program. The Navy's section of this program is the Navy Assessment and Control of Instllation Pollutants (NACIP) program.

This program consists of four phases: (1) Initial Assessment Study (IAS); (2) Confirmation; (3) Control Technology Development (if needed); and (4) Corrective Measures. One of the most important steps in the program is the decision to go from the IAS, based on record searches, interviews, and minimal sampling, to the Confirmation Study, which involves extensive sampling. Another aspect of proceeding to Confirmation from the IAS is the IR program requirement to "develop and maintain a priority listing of contaminated installations and facilities for remedial action" (DEQPPM 81-5, 11 December 1981). As a result, a two-step decision process has been designed specifically for the NACIP program.

## Description

The first step is a "yes-no" flowchart (figure 1) based on easily determined facts found during the IAS. These facts include type of waste, type of containment (spills, ponds, dumps, barrels, etc.), and hydrogeology. The flowchart tells whether to go to the Confirmation phase; to consider immediate mitigating action, such as restricting access to the site; or to do nothing if the site is basically innocuous. If the flowchart indicates that the Confirmation phase should be implemented, the user proceeds to step two.

In step two, the site is given a numerical ranking by going through the Confirmation Study Rating (CSR) Model (figure 2 and table 1). This ranking is also based on information obtained during the IAS and is the "priority listing" of sites. The model is based on the system used by the Air Force which in turn is based on a model developed for EPA by JRB Associates.

As with these previous models, the CSR Model assesses the different characteristics of each hazardous waste site including: areas of potential impact or possible receptors of contamination, pathways that the contamination may take to reach the receptors, and waste characteristics and containment. Each of these categories contains several weighted rating factors. These are then used to calculate the overall hazard rating.

The receptors rating is based on the JRB Model and is calculated by scoring each factor, multiplying by a weighting constant, and adding the weighted scores to obtain a total score for the receptors category.

The pathways rating is taken from the Air Force Hazard Assessment Rating Methodology (HARM) model. This rating is based on direct evidence of contamination migration or on the one of three pathways with the highest contamination migration potential. If direct evidence of contamination exists, the pathways category is given a subscore of 1. If no evidence is found, the highest score from three possible pathways is used. These pathways are surface water migration, flooding, and ground water migration.

The waste characteristics category is similar in format to the receptors category. The waste characteristics rating is obtained by scoring each factor, multiplying by a weighting constant, then adding or multiplying these weighted factors as indicated to obtain a total score for the category.

The CSR Model differs from the other two models mentioned due to differences in the Waste Characteristics section, and minor changes in the other sections. The major difference, however, lies in the final scoring of the sites. These previous models have based their rankings on the idea that factors, such as pathways of possible migration, location of receptors, and waste characteristics are additive as indicated by the formula:

$$U_{site} = \sum_{i=1}^{n} [k_i U_i(x_i)]$$

$$= Up + Ur + Uw$$

Ui = the Rating factor (1.0 is the worst, 0.0 is the best condition)

Up = the total Pathways factor

Ur = the total Receptors factor

Uw = the total Waste Characteristics factor

k = weighing constant = 1 in this instance

$U_{site}$ = the final score or rating of the site

This additive model is only theoretically correct if the factors considered (Pathways, Receptors, and Waste Characteristics) are completely independent of one another. However, these factors are not independent of each other. For example, an innocuous waste such as paper (low Uw) may be found in an area that has a hydrogeology conducive to migration (high Up) and be close to a large population (high Ur). If this site somehow slips into the above rating model, it will have a high priority due to the Up and Ur.

The CSR Model uses instead a multiplicative approach as indicated by the formula:

$$U_{site} = \frac{1}{K}\left[\prod_{i=1}^{n}(Kk_i(1-U_i)+1)-1\right]$$

$$= (Ur)(Up)(Uw)$$

This formula reflects the dependent nature of the factors involved. These formulas have been included to show the mathematical approach to the rating problem. The multiiplicative approach is rescaled from 0 to 100 and used in the CSR Model as:

$$U_{site} = 100\,(Ur)(Up)(Uw)$$

By using the multiplicative model, sites with a low Ur, Up, or Uw, such as the site previously mentioned, will have a lower rating than would be expected using an additive model, such as the JRB Model.

Use of the System

All sites found will be put through the Confirmation Study Ranking Flowchart (figure 1). This flowchart will tell the user to go to the CSR Model if further study is required.

The CSR Model is found in figure 2 and table 1. Figure 2 contains the worksheets for the model and is divided into subsections on the rating categories: I is Receptors, II is Pathways, III is Waste Characteristics, and IV is Waste Management and Final Score. Table 1 contains the data needed or information required to fill out the worksheets in figure 2 and is divided into the same subsections.

Appendix A illustrates the use of the CSR Model by showing the results of two sites.

The Confirmation Study Ranking System was designed to be used after no or limited sampling. The existing EPA models, including the Mitre and the JRB Models, were designed to rank sites after a NACIP confirmation type investigation. Because the purpose of the System is to rank sites before a full field investigation of sampling is done, this model differs from the models EPA has used. Ranking sites before the expensive Phase II is done will enable the Navy to investigate as soon as possible those sites that pose the greatest potential hazard.

## References

References used in the development of the Confirmation Study Rating Model include:


Lindenberg, B., *et al.*, *Air Force Hazardous Risk Assessment Methodology (HARM) Model*.

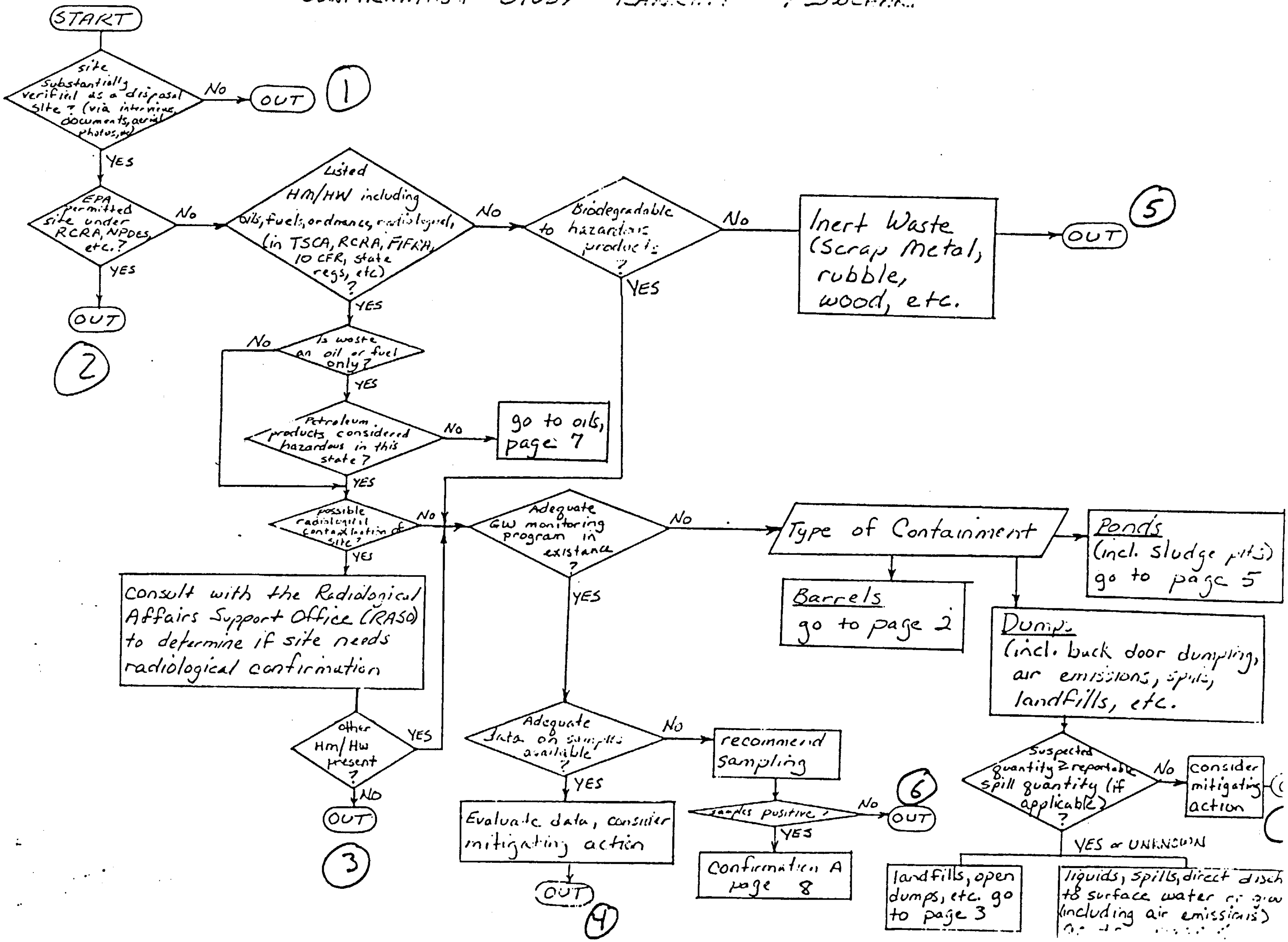
JRB Associates, *Rating Methodology Model*.

Chang, S., Barrett, K., Hans, S., Platt, A., *The Mitre Corporation Site Ranking Model for Determining Remedial Action Priorities Among Uncontrolled Hazardous Substances Facilities*.

Collins, J. P., and Glysson,, E. A., "Multiattribute Utility Theory and Environmental Decisions," *Journal of the Environmental Engineering Division*, A.S.C.E., vol. 106, No. EE 4, Proc. Paper 15648, Aug. 1980, pp. 815-830.

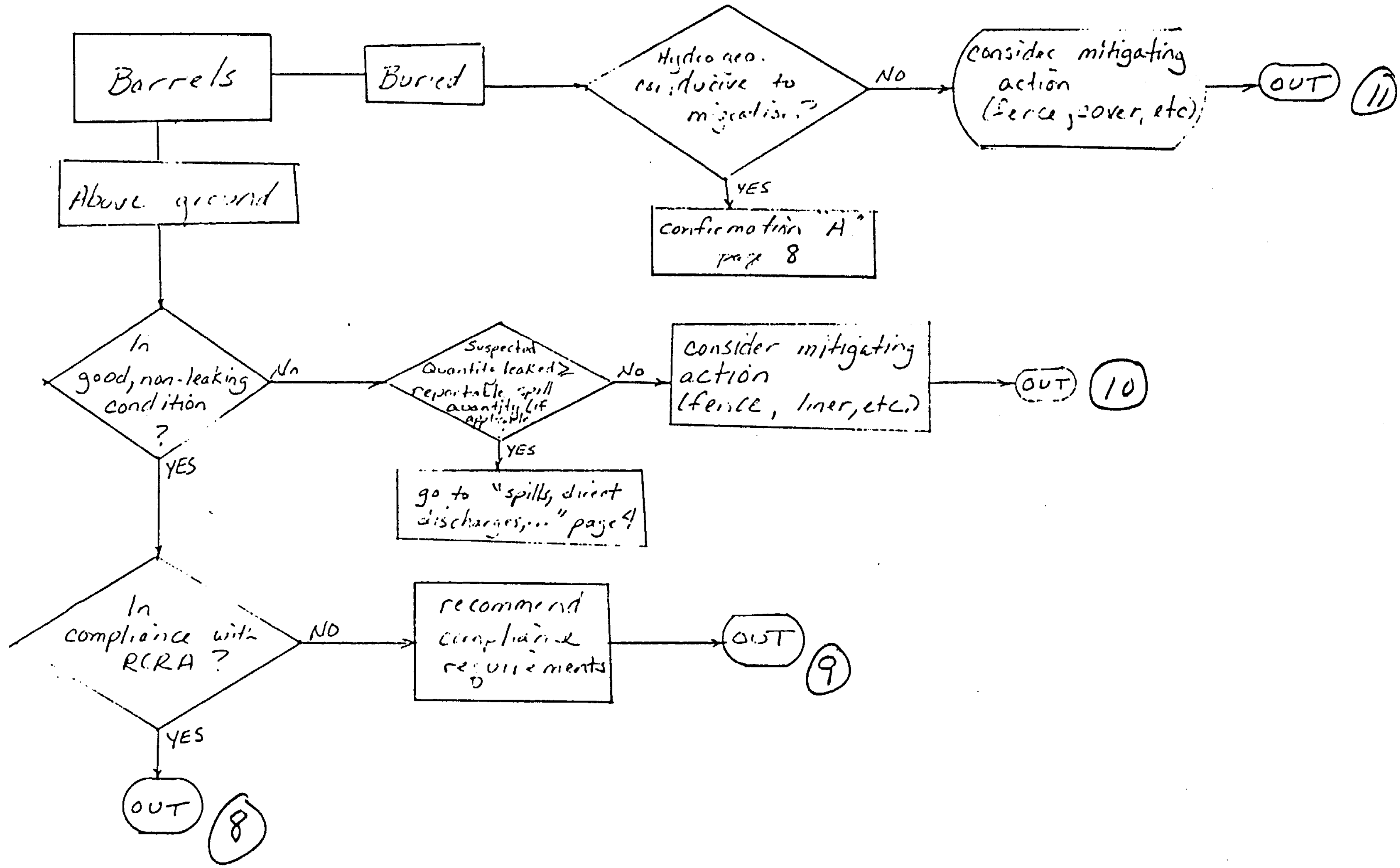
FIGURE 1

CONFIRMATION STUDY RANKING FLOWCHART



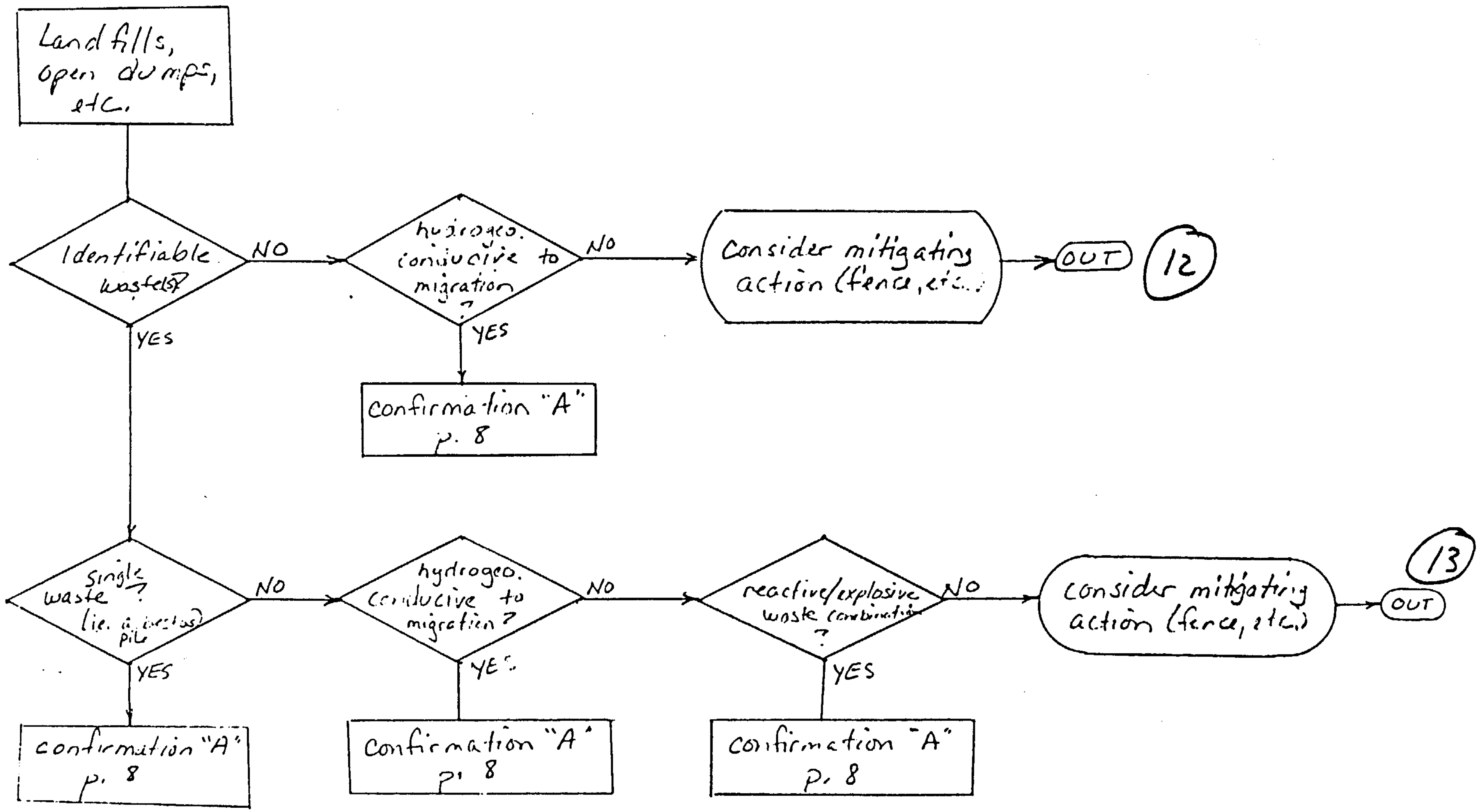
[illegible] (continued):

ESR [illegible]



[illegible]

[illegible] FLOWCHART



Landfills, open dumps, etc.
Identifiable waste(s)?
NO
YES
hydrogeo. conducive to migration?
NO
YES
confirmation "A" p. 8
Consider mitigating action (fence, etc.)
OUT
12
single waste? (ie. a asbestos pile)
NO
YES
confirmation "A" p. 8
hydrogeo. conducive to migration?
NO
YES
Confirmation "A" p. 8
reactive/explosive waste combination?
NO
YES
confirmation "A" p. 8
consider mitigating action (fence, etc.)
OUT
13

Figure 1 (Continued)

CSR FLOWCHART

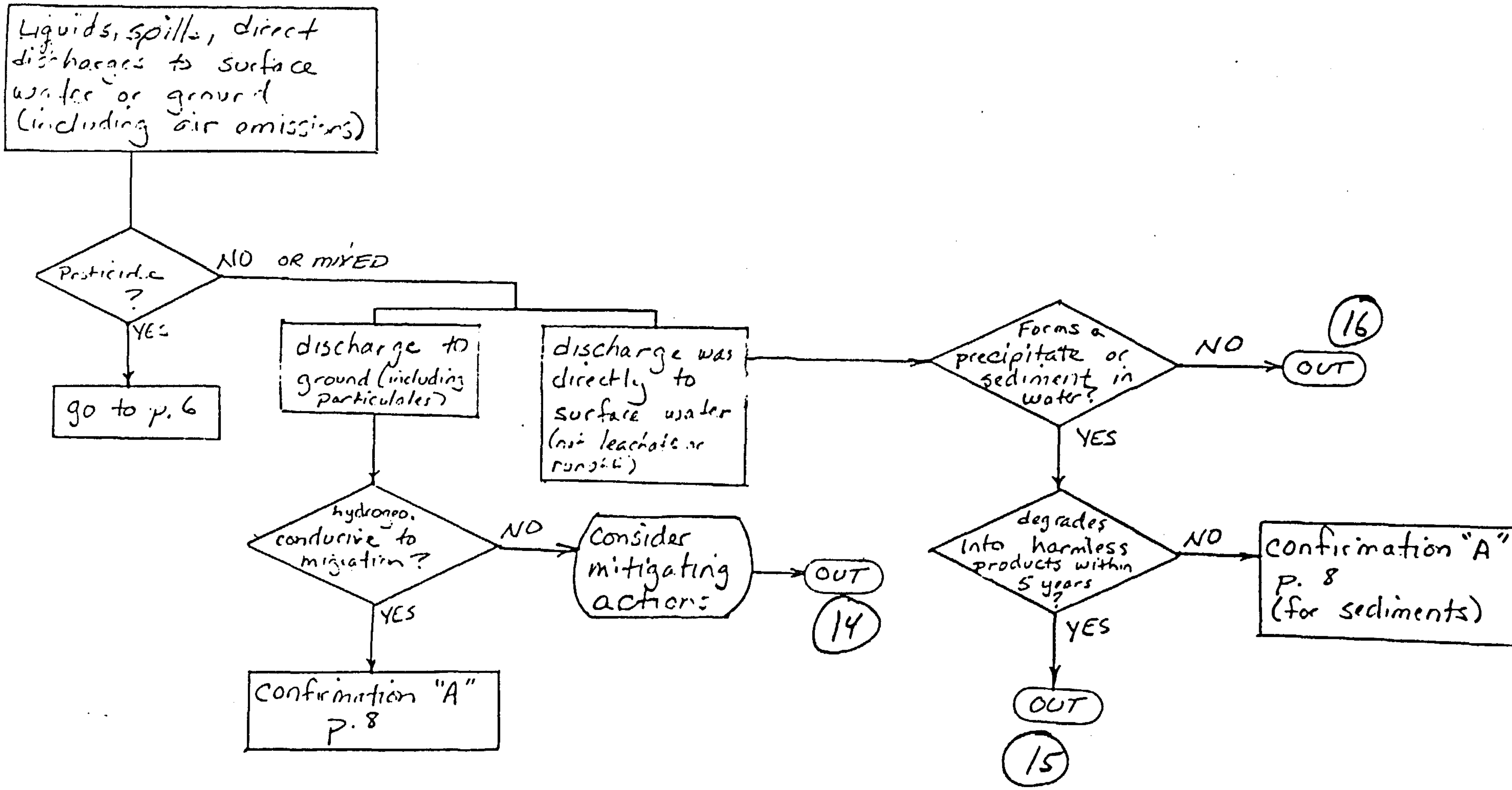


FIGURE 1 (continued
CSR FLOWCHART

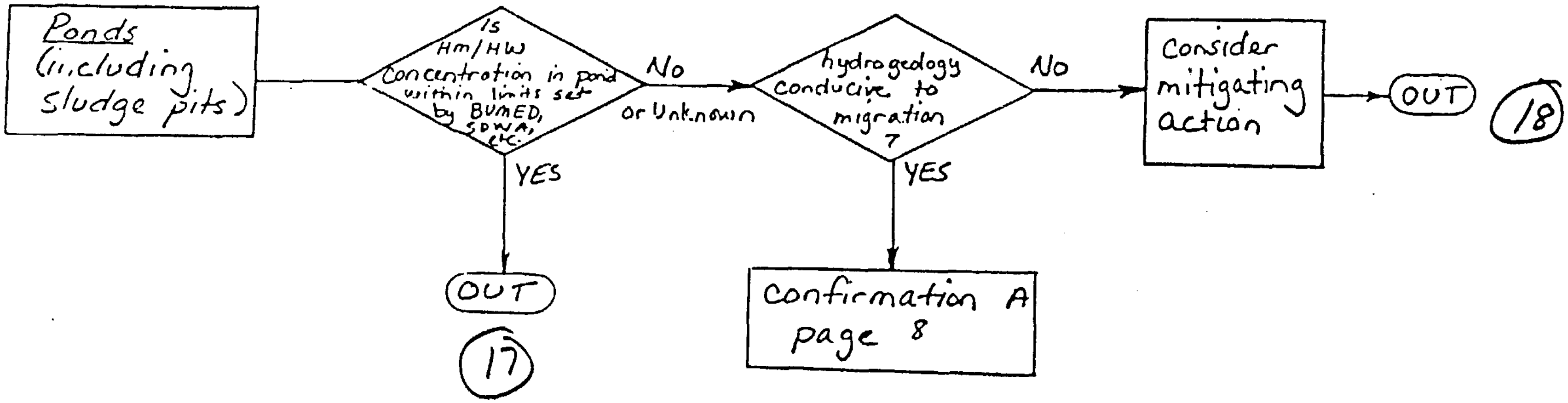


FIGURE 1 (continued)

CSR FLOWCHART

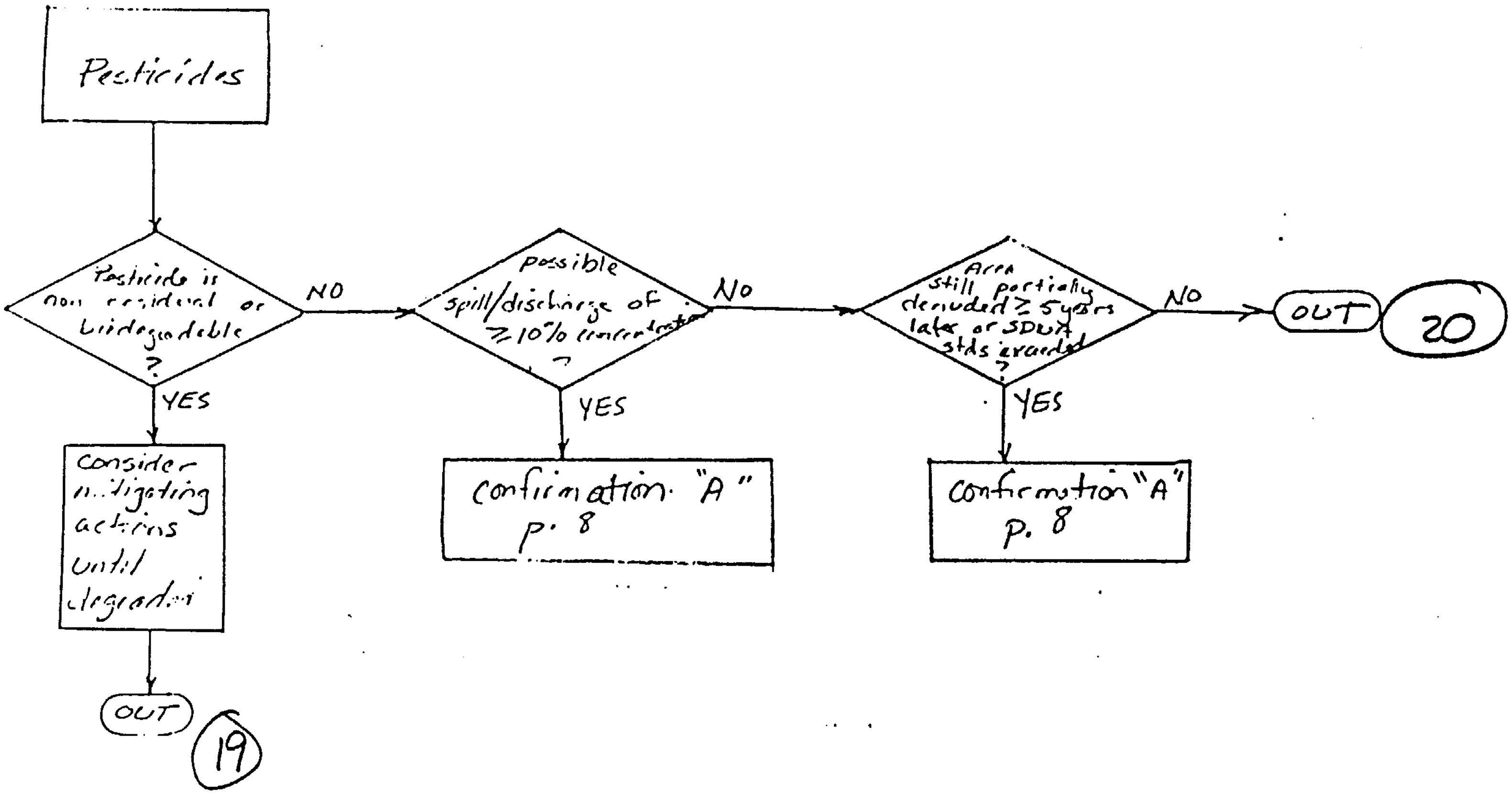


FIGURE 1 (con't'd)
CSR FLOWCHART

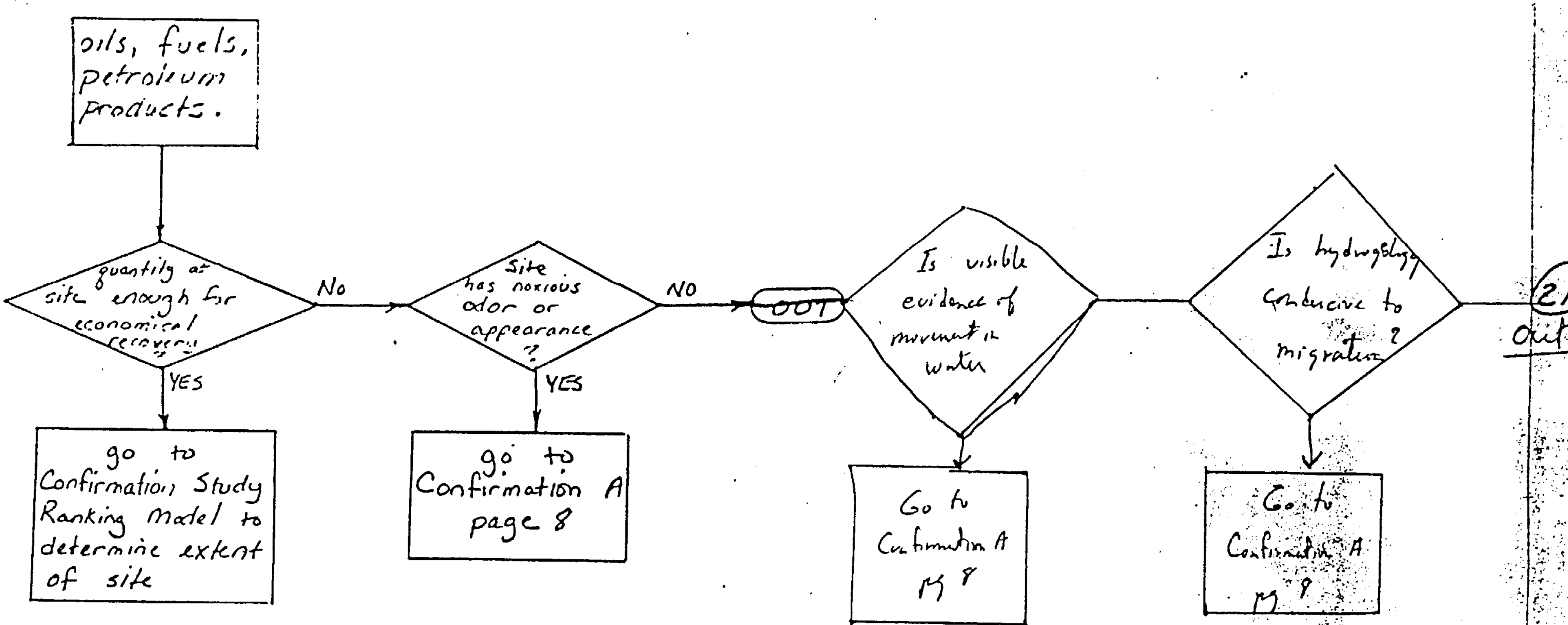
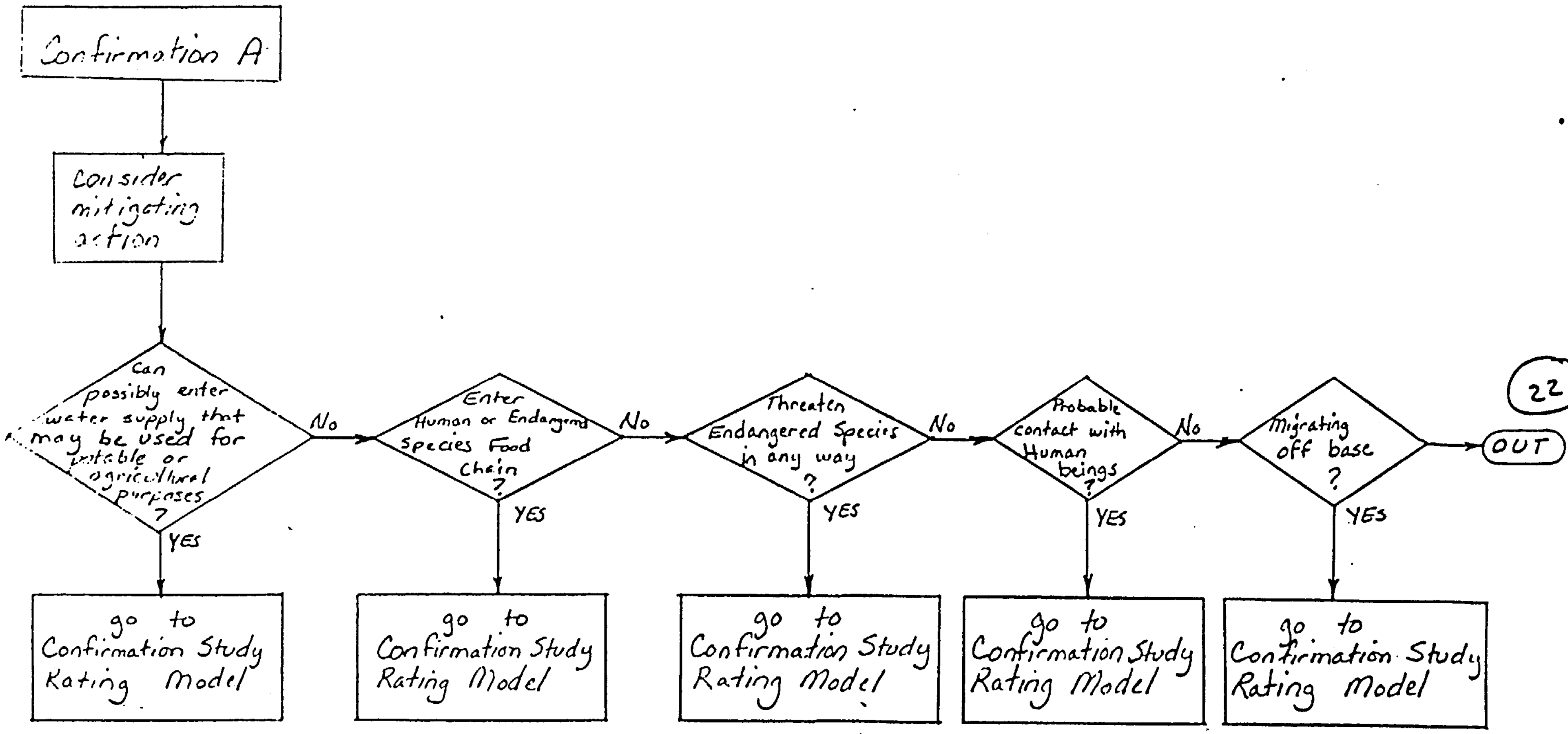


FIGURE 1 (continued)
CSR FLOWCHART





Definitions

HM/HW = hazardous material/hazardous waste

GW = ground water

EPA = Environmental Protection Agency

RCRA = Resource Conservation and Recovery Act

NPDES = National Pollutant Discharge Elimination System

TSCA = Toxic Substances Control Act

FIFRA = Federal Insecticide, Fungicide and Rodenticide Act

10 CFR = Federal Regulations covering Radiological materials

BUMED = Bureau of Medicine

SDWA = Safe Drinking Water Act

Mitigating Action = may include temporary/permanent actions such as fences, barriers, clay caps, changing method of storage (for barrels), etc.

FIGURE 2

NAME OF SITE ______________________________

LOCATION ______________________________

DATE OF OPERATION OR OCCURRENCE ______________________________

OWNER/OPERATOR ______________________________

COMMENTS/DESCRIPTION ______________________________

SITE RATED BY ______________________________

I. RECEPTORS (see also table 1-1)

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| A. Working population within 1,000 feet of site | | 4 | | 12 |
| B. Distance to nearest well | | 10 | | 30 |
| C. Land use/zoning within 1 mile radius | | 3 | | 9 |
| D. Distance to reservation boundary | | 6 | | 18 |
| E. Critical environments within 1 mile radius of site | | 10 | | 30 |
| F. Water quality of nearest surface water body | | 6 | | 18 |
| G. Ground water use of the aquifer of concern | | 9 | | 27 |
| H. Population served by surface water supply within 3 miles dowstream of site | | 6 | | 18 |
| I. Population served by ground-water supply within 3 miles of site | | 6 | | 18 |
| | | Subtotals | ______ | 180 |

Receptors subscore = (factor score subtotal/maximum score subtotal) ______

FIGURE 2 (Continued)

II. PATHWAYS (see also table 1-II)

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|

A. If there is documented laboratory evidence of migration of hazardous contaminants away from the site in question, assign maximum factor subscore of 1 point for direct evidence. If direct evidence exists then proceed to C. If no evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground water migration. Select the highest rating, and proceed to C.

1. Surface water migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Distance to nearest surface water | | 8 | | 24 |
| Net precipitation | | 6 | | 18 |
| Surface erosion | | 8 | | 24 |
| Soil permeability | | 6 | | 18 |
| Rainfall intensity | | 8 | | 24 |

Subtotals ______ 108

Subscore = (factor score subtotal/maximum score subtotal) ______

2. Flooding

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Flooding | | 1 | | |

Subscore = (factor score/3) ______

3. Ground water migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Depth to ground water | | 8 | | 24 |
| Net precipitation | | 6 | | 18 |
| Soil permeability | | 8 | | 24 |
| Subsurface flows | | 8 | | 24 |
| Direct access to ground water | | 8 | | 24 |

Subtotals ______ 114

Subscore = (factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

FIGURE 2 (Continued)

III. WASTE CHARACTERISTICS (see also table 1-III)

A.

| Rating Factor | Factor Rating (0-3) | Multiplier | Weighted Factor |
|---|---|---|---|
| Waste Quantity | | 1 | = Q |
| Acute Toxicity | | 8 | = AT |
| Chronic Toxicity | | 8 | = CT |
| Persistancy | | 6 | = P |
| Flammability | | 4 | = F |
| Reactivity | | 4 | = R |
| Incompatability | | 5 | = I |
| Corrosiveness | | 3 | = C |
| Solubility | | 5 | = S |
| Bioaccumulation | | 6 | = B |
| Physical State | | 3 | = PS |
| Years site was in use | | 1 | = t |
| Years since site closed | | 1 | = Δt |

Weighted Factor = Factor Rating x Multiplier

FIGURE 2 (Continued)

III. WASTE CHARACTERISTICS (continued)

B. Take the weighted factors and multiply together as indicated below, then add the results together.

| | Score | Maximum Score |
|---|---|---|
| AT x Q = | | 72 |
| CT x Q = | | 72 |
| C x Q = | | 27 |
| F x Q = | | 36 |
| R x Q = | | 36 |
| S x Q = | | 45 |
| P x Q x $\Delta$t = | | 162 |
| B x ($\Delta$t+t) = | | 108 |
| I x Q = | | 45 |
| Subtotal= = | | 603 |

Add Physical State Weighted Factor (figure 2-IIIA) and subtotal

Subtotal + P. S. = Subscore A

________ + ________ = __________

603 + 9 = 612 = maximum subscore A

Waste Characteristics Subscore = subscore A/maximum subscore A

= ____________________

General Note:

If data are not available or are known to be incomplete under items I-A through I, II-B-1 or II-B-3, or III-A, then leave blank for calculation of factor score and maximum subscore (i.e. for calculation of the subscore divide the factor score by the maximum subscore minus the unknown item's maximum score).

FIGURE 2 (Continued)

## IV. WASTE MANAGEMENT AND FINAL SCORE (see also table 1-IV)

A. Receptors Subscore = = $U_R$

Pathways Subscore = = $U_P$

Waste Characteristics Subscore = = $U_W$

Enter the above subscores in the equation:

Site Subscore = $U_{site}$ = 100 $(U_R)(U_P)(U_W)$

= ____________

B. Apply factor for waste containment from waste management (table 1-IV)

Site Subscore x Waste Management = Final Score

____________ x ______ ________ = ___________

Note: If Final Scores are tied for sites on one base, rate the sites according to the confidence level of the information.

Confirmed Criteria

- At least 2 verbal reports from interviews or written information from records.
- Knowledge of types and quantities of wastes generated by shops and other areas on base.
- Based on the above, a determination of the types and quantities of waste disposed of at the site.

Suspected Criteria

- One or no verbal reports or conflicting verbal reports, and no written information from records.
- Logic based on a knowledge of types and quantities of wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at the site.

Confirmed sites would be above suspected sites in the ranking.

TABLE 1

## I. RECEPTORS CATEGORY

| Rating Factors | Rating Scale Levels 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|
| (Residential x3) + A. Working Population with 1,000 feet (includes on-base facilities) | 0 | 1 - 25 | 26 - 100 | Greater than 100 | 4 |
| B. Distance to nearest water well in aquifer of concern | Greater than 3 miles | 1 to 3 miles | 3,001 feet to 1 mile | 0 to 3,000 feet | 10 |
| C. Land Use/Zoning (within 1 mile radius) | Completely remote (zoning not applicable) | Government owned, and idle | Commercial, agricultural, industrial, National Register Historic/Landmark sites | Residential | 3 |
| D. Distance to installation boundary | Greater than 2 miles | 1 to 2 miles | 1,001 feet to 1 mile | 0 to 1,000 feet | 6 |
| E. Critical environments (within 1 mile radius) | Not a critical environment | Natural areas | Pristine natural areas; minor wetlands (<5 acres); preserved areas; presence of economically important natural resources susceptible to contamination; estuarine shores. | Major habitat of an endangered or threatened species; presence of recharge area; major wetlands (≥5 acres). | 10 |
| F. Water quality/use designation of nearest surface water body | Not used or boating only | Agricultural or industrial use | Recreation, swimming, propagation and management of fish and wildlife | Potable water supplies, shellfish propagation and harvesting | 6 |
| G. Ground-water use of the aquifer of concern | Not used, other sources readily available. | Commercial, industrial, or irrigation, very limited other water sources. | Drinking water, municipal water available. | Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available. | 9 |
| H. Population served by surface water supplies within 3 miles downstream of site | 0 | 1 - 50 | 51 - 1,000 | Greater than 1,000 | 6 |
| I. Population served by the aquifer of concern supplies within 3 miles of site | 0 | 1 - 50 | 51 - 1,000 | Greater than 1,000 | 6 |

## II. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated. The samples should have been off site but near the site.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

| Rating Factor | Rating Scale Levels 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|
| Distance to nearest surface water (includes drainage ditches and storm sewers) | Greater than 1 mile | 2,001 feet to 1 mile | 501 feet to 2,000 feet | 0 to 500 feet | 8 |
| Net precipitation (total precipitation minus evapotranspiration) | Less than -10 in. | -10 to + 5 in. | +5 to +20 in. | Greater than +20 inches | 6 |
| Surface erosion | None | Slight | Moderate | Severe | 8 |
| Soil permeability | 0% to 15% clay ($>10^{-2}$ cm/sec) | 15% to 30% clay $10^{-2}$ to $10^{-4}$ cm/sec) | 30% to 50T% clay ($10^{-4}$ to $10^{-6}$ cm/sec) | Greater than 50% clay ($<10^{-6}$ cm/sec) | 6 |
| Rainfall intensity based on 1 year 24-hr rainfall (or mean annual number of thunderstorms) | Less than 1.0 inch (0-5) | 1.0-2.0 inches (6-35) | 2.1-3.0 inches (36-48) | Greater than 3.0 inches (>50) | 8 |

B-2 POTENTIAL FOR FLOODING

| Rating Factor | 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|
| Floodplain | Beyond 100-year floodplain | In 100-year floodplain | In 10-year floodplain | Floods annually | 1 |

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION OF THE AQUIFER OF CONCERN

| Rating Factor | 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|
| Depth to ground water | Greater than 500 ft | 50 to 500 feet | 11 to 50 feet | 0 to 10 feet | 8 |
| Net precipitation | Less than -10 in. | -10 to +5 in. | +5 to +20 in. | Greater than +20 inc. | 6 |
| Soil permeability | Greater than 50% clay ($>10^{-6}$ cm/sec) | 30% to 50% clay ($10^{-4}$ to $10^{-6}$ cm/sec) | 15% to 30% clay ($10^{-2}$ to $10^{-4}$ cm/sec) | 0% to 15% clay ($<10^{-2}$ cm/sec) | 8 |
| Subsurface flows | Bottom of site greater than 5 feet above high ground-water level | Bottom of site < 5 feet above high ground-water level Bottom of site occasionally submerged (1-3 times/year) | Bottom of site frequently submerged (>3 times/year) | Bottom of site submerged. | 8 |
| Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.) | No evidence of risk | Low risk | Moderate risk | High risk | 8 |

TABLE 1 (Continued)

## III. WASTE CHARACTERISTICS

| Rating Factors | Rating Scale Level 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|
| Waste Quantity (40 CFR 117) | If applicable: < reportable spill quantity or <1 lb. | 1-5 times reportable spill quantity 1-100 lbs. | 5-20 times reportable spill quantity 100-1000 lbs. | >20 times reportable spill quantity >1000 lbs. | 1 |
| Toxicity Acute & Chronic | Sax's Level 0 | Sax's Level 1 | Sax's Level 2 | Sax's Level 3 | 8 |
| Persistancy | Easily degraded compounds or harmless materials | Straight chain hydrocarbons | Substitute and other ring compounds | Heavy metal compounds, polycyclic compounds, halogenated hydrocarbons, or degradation products are hazardous | 6 |
| Flammability | NFPA Level 0 or Flash point >200°F | NFPA Level 1 Flash point 140°F-200°F | NFPA Level 2 Flash point 80°F-140°F | NFPA Level 3 & 4 Flash point <80°F | 4 |
| Reactivity | NFPA Level 0 | NFPA Level 1 | NFPA Level 2 | NFPA Level 3 & 4 | 4 |
| Incompatable wastes present (40 CFR 265 Appendix V) | No | Unknown | Yes, but adequately separated | Yes, poses a hazard | 5 |
| Corrosiveness | pH 6-8 | pH 5-6 or 8-10 | pH 3-5 or 10-12 | pH 1-3 to 12-14 | 3 |
| Solubility at 20°C | Insoluable or 0-10g/100ml water | Insoluable in water, soluable in acids or bases --- | Sparingly or slightly soluable in water 10-24g/100ml water | Soluable in water >24g/100ml water | 5 |
| Bioaccumulation | No | --- | --- | Yes | 6 |
| Physical State | Solid - consolidated or stabilized | Solid - nonconsolidated or non-stabilized | Sludge, slurry, powder, or fine material | Liquid or air emissions | 3 |
| Years site was in use | --- | <5 | 5-10 | >10 | 1 |
| Years since site was closed or use was discontinued | >50 | 15-50 | 5-15 | 0-5 | 1 |

Note: For sites with more than one hazardous waste the worst case should be used in scoring this section.

## IV. WASTE MANAGEMENT AND FINAL SCORE

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

| Waste Management Practice | Multiplier |
|---|---|
| No containment | 1.0 |
| Limited containment | 0.80 |
| Fully contained and in full compliance | 0.10 |

Guidelines for fully contained:

Landfills:

- Clay cap or other impermeable cover
- Leachate collection system
- Liners in good condition
- Adequate monitoring wells

Surface Impoundments:

- Liners in good condition
- Sound dikes and adequate freeboard
- Adequate monitoring wells

Spills:

- Quick spill cleanup action taken
- Contaminated soil removed
- Soil and/or water samples confirm total cleanup of the spill

Fire Protection Training Areas:

- Concrete surface and berms
- Oil/water separator for pretreatment of runoff
- Effluent from oil/water separator to treatment plant

Limited containment of a site would include only some of the above guidelines for fully contained.

# APPENDIX C

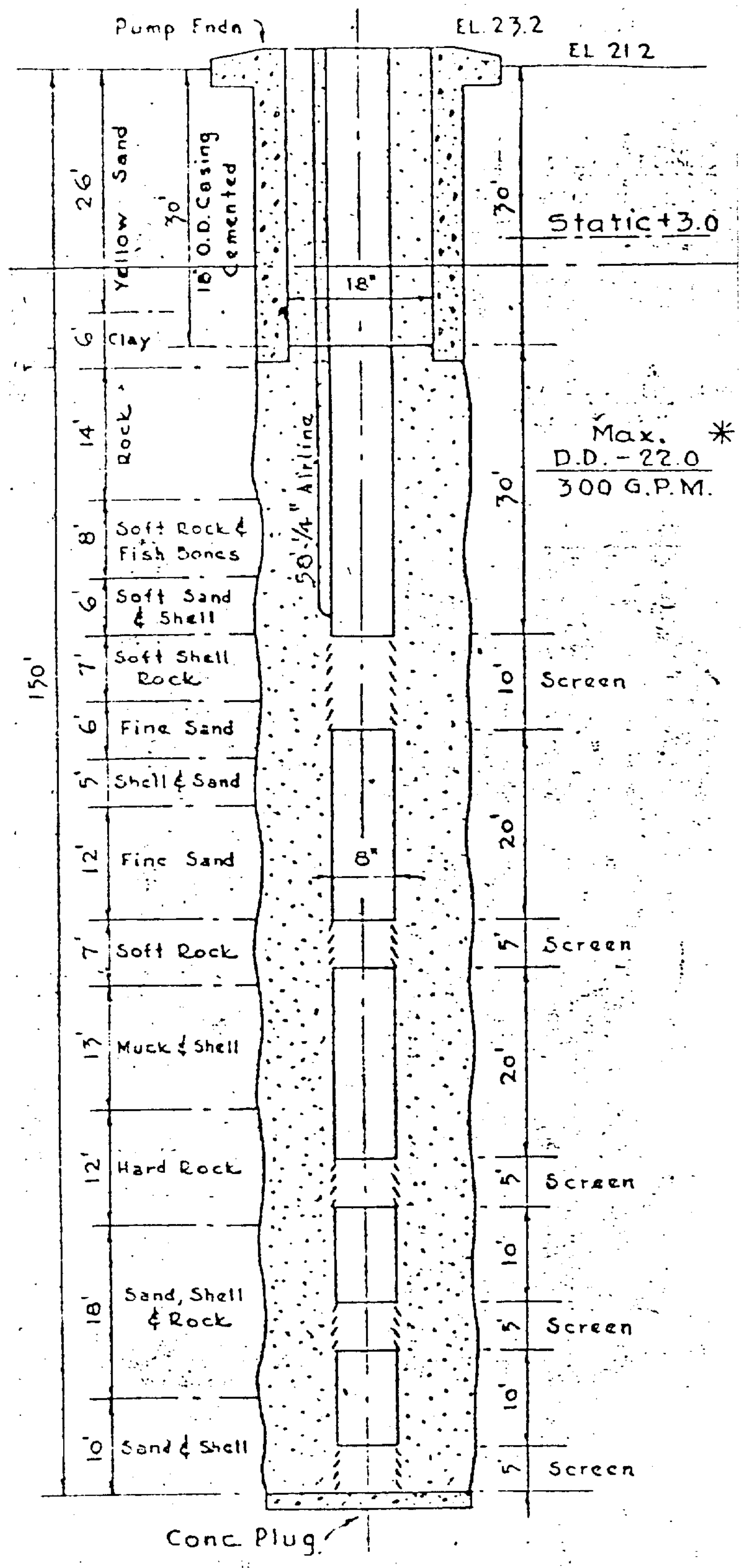
# ABBREVIATIONS LIST

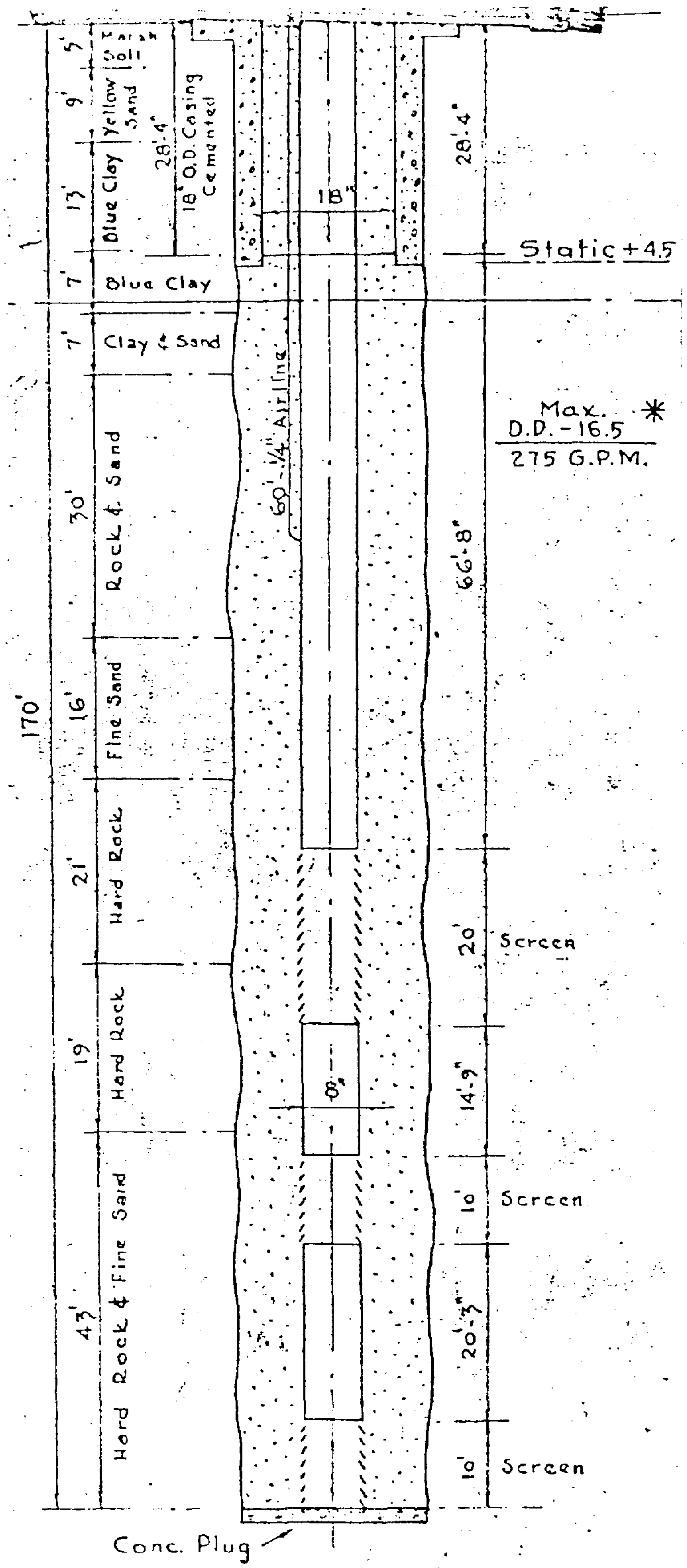
# ABBREVIATIONS LIST

| Abbreviation | Term |
|---|---|
| AID | Accident Incident Data Bank |
| AMTRAC(s) | Amphibious Tractor(s) |
| BAT | Best Available Technology |
| BT | Bombing Target |
| CIA | Controlled Industrial Area |
| COD | Chemical Oxygen Demand |
| CNO | Chief of Naval Operations |
| DPDO | Defense Property Disposal Office |
| EOD | Explosive Ordnance Disposal |
| EPA | Environmental Protection Agency |
| FMF | Fleet Marine Force |
| HOLF(s) | Helicopter Outlying Landing Field(s) |
| IAS | Initial Assessment Study |
| IWTP | Industrial Waste Treatment Plant |
| LANTDIV | Atlantic Division |
| MACS | Marine Air Control Squadron |
| MAG | Marine Aircraft Group |
| MCALF | Marine Corps Auxiliary Landing Field |
| MCAS | Marine Corps Air Station |
| MCB | Marine Corps Base |
| MC Bul | Marine Corps Bulletin |
| MCOLF | Marine Corps Outlying Landing Field |
| NACIP | Navy Assessment and Control of Installation Pollutants |
| NARF | Naval Air Rework Facility |
| NAVFACENGCOM | Naval Facilities Engineering Command |
| NBC | Nuclear, Biological, Chemical |
| NCBC | Naval Construction Battalion Center |
| NEESA | Naval Energy and Environmental Support Activity |
| NREA | Natural Resources and Environmental Affairs |
| NSWC | Naval Surface Weapons Center |
| OESO | Ordnance Environmental Support Office |
| OLF(s) | Outlying Landing Fields |
| POL | Petroleum, Oil, Lubricant(s) |
| SAFEORD | Safety Ordnance File |
| STP | Sewage Treatment Plant |
| TCE | Trichloroethylene |
| THM | Trihalomethane(s) |
| WAR | Water and Air Research, Inc. |
| WTP | Waste Treatment Plant |
| 2d FSSG | Second Force Service Support Group |

# APPENDIX D

## LOGS OF WELL NOS. HP-613 AND HP-616


Pump Fndn
EL. 23.2
EL 21.2
Yellow Sand
26'
30'
18" O.D. Casing Cemented
30'
Static +3.0
18"
Clay
6'
Rock
14'
50' 1/4" Airline
Max. D.D. - 22.0
300 G.P.M.
30'
Soft Rock & Fish Bones
8'
Soft Sand & Shell
6'
Soft Shell Rock
7'
150'
10'
Screen
Fine Sand
6'
Shell & Sand
5'
20'
Fine Sand
12'
8"
Soft Rock
7'
5'
Screen
Muck & Shell
13'
20'
Hard Rock
12'
5'
Screen
10'
Sand, Shell & Rock
18'
5'
Screen
10'
Sand & Shell
10'
5'
Screen
Conc. Plug




Armco Iron Screen Used In This Well